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and

IBM Consulting Group

**Clinical & Administrative General Practice Computer
Systems Consultancy**

Technical Framework and Architecture

Report

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Executive Summary

The Department of Health and Family Services (DH&FS) General Practice Branch engaged the IBM Consulting Group to conduct a project to deliver appropriate functional requirements specification and supporting technical framework for Clinical and Administrative General Practice Computer Systems (GPCS) that will ultimately lead to the widespread adoption and use by practitioners.

The purpose of this Report is to present recommendations on a product-independent technology view of the architecture needed to support the GPCS scope and functional requirements. This architecture is referred to as the GPCS Technical Framework.

A key objective of the GPCS Technical Framework is to provide a technical architecture in sufficient detail to enable the development of modular and interoperable applications to form the GPCS. The underlying strategic principles on which the framework is to be developed are:

- The framework must be standards driven and based, “open”, highly flexible and multi-platform.
- Applications for the GPCS are to be designed as network enabled to ensure that the GPCS has the appropriate communications capabilities built in for network connection and information exchange.

In developing the GPCS Technical Framework a number of non-technical implications have been identified. Non-technical barriers to implementation are being considered by other phases of the consultancy. In order to proceed to implementation of the GPCS, however, the following must be addressed:

- The requirement for an ongoing process of management of the Technical Framework, including the involvement of the GPCS software developers.
- The need to progress the Technical Framework to a logical design level in order to specify compliance criteria and tests for GPCS software.
- The need to build, integrate and test a *GPCS Platform* on which GPCS software developers can deliver their applications (Business Function Managers).
- The need for a secure network infrastructure to support the GPCS.

In developing the GPCS Technical Framework the following major categories of function have been identified. The body of the Technical Framework and Architecture report contains detailed definition of the categories and the functions within each. The categories are as follows:

- Business Functions
- Business Support Functions
- Application Enabling Services
- System Services
- System Platforms

Following the analysis of the functional requirements and subsequent review with the Technical Review Team the following conclusions were drawn:

- For the initial release, the GPCS Technical Framework should support a relatively small number of “coarse-grained” applications (referred to as business function

building blocks, and consisting of large groups of related business functions) a middle layer and supporting platform. The number of business function building blocks can be increased over time through extension of the scope of the common data model.

- Access to the GPCS functions is required by a General Practitioner irrespective of location (either practice or mobile), and whether in a single site or multi site practice. The locations to be supported comprise both Metropolitan and Rural areas. The GPCS Technical Framework needs to allow for a variety of configurations and communications capabilities.
- The level of security and data integrity provided by the application functions and GPCS Technical Framework components must allow for the protection of the privacy of data and the control of access to the system and its functions. Exposures introduced by Internet access by GPCS users also need to be addressed.
- The GPCS Technical framework must enable a reliable environment with a high level of systems management functions to ensure the operation of the GPCS without undue impact on the normal activities of a practice.
- The GPCS Technical Framework must support a client/server environment with a user interface that is fast, consistent, reliable and easy to learn and use. It should not be tied to a specific client/server model, nor to a single hardware and software platform.
- The GPCS Technical Framework should allow for GPCS user access to the Internet and support the evolving Internet standards and Web Browser user interface.
- Work by CEN/TC251 and Groupe RICHE provides guidance for the GPCS Technical Framework, but their architectures can not simply be adopted as the Technical Framework for GPCS as they focused on the hospital rather than the GP environment.

In order to develop the inter-operable components that will comprise the GPCS, and conform to the GPCS Technical Framework, detailed specification is required. The following actions have been identified as being necessary:

- Some aspects of the framework must be progressed to a product-specific design level, particularly where product-independent standard interfaces do not exist.
- The scope and format of the Common Data, and of the event notification and external information exchange messages must be defined in a data model
- Standards need to be selected for the Application Programming Interfaces (APIs) for the Common Data Manager and Event Manager.
- Standards need to be selected to enable interoperation with external services
- Product specific standards and guidelines for the user interface need to be specified.
- Client/server model design guidelines are needed, particularly in relation to an agreed subset of function to be provided in the mobile environment.

Preface to this Report

This Report is the deliverable from Phase Four of the Clinical & Administrative General Practice Computer Systems (GPCS) Consultancy. The GPCS Technical Framework described in this report is a product-independent technology view of the architecture needed to support the GPCS scope and functional requirements gathered in Phases Two and Three of this consultancy.

The GPCS Technical Framework provides technical guidance to the **software industry**, the prospective developers of the GPCS software that addresses the requirements documented in the GPCS Functional Requirements Specification Report. This report does not repeat the functional requirements, and GPCS software developers should read both reports.

Sections 1.0 and 2.0 provide the objectives and context for this Report.

Section 3.0 outlines the approach adopted for the development of the GPCS Technical Framework and the conduct of Phase Four of the consultancy.

Section 4.0 provides an analysis of the findings. It includes:

- A summary of the key technical requirements that have a major impact on the Technical Framework and on the GPCS software developers.
- An evaluation of modularity options for the delivery of the GPCS functionality by multiple software developers.
- A description of the General Practice environment in which the GPCS must operate.
- A summary of technology directions and health industry architectures potentially impact the development of software for the GPCS.

Section 5.0 describes the GPCS Technical Framework recommended to support the GPCS Functional Requirements Specification. It includes:

- A list of guiding principles and reference to more specific architecture principles described in *Appendix B: Architecture Principles*. These principles have shaped the Technical Framework and also will provide guidance to GPCS software developers.
- An overview description of the building blocks which form the Technical Framework. GPCS software developers will provide some of these building blocks. Others building blocks will be provided by industry standard products. Additional information on the building blocks is provided in *Appendix C: Detailed Architecture Building Block Specifications*.
- Logical views of the Technical Framework to illustrate the client/server models and practice locations which GPCS software developers need to

consider.

- A summary of the technical standards included in the Technical Framework.
- A summary of the requirements for conformance with the GPCS Technical Framework.

Section 6.0 documents the technical implications associated with establishing the GPCS Technical Framework:

- The need to establish a process for the ongoing management of the Technical Framework, including the involvement of the GPCS software developers.
- The need to progress the Technical Framework to a logical design level in order to specify compliance criteria and tests for GPCS software.
- The need to build, integrate and test a *GPCS Platform* on which GPCS software developers can deliver their applications.
- The need for a secure network infrastructure to support the GPCS.

The authors of this report wish to acknowledge the valuable contribution received from the Technical Review Team members during the course of the engagement. Valuable input and constructive comments during the course of Phase Four were also provided by Paul Clarke and Dr David More.

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Section 1.0 Scope and Objectives of the Report

The purpose of this Report is to present recommendations on a product-independent technology view of the architecture needed to support the GPCS scope and functional requirements gathered in Phases Two and Three of this consultancy. This architecture is referred to as the GPCS Technical Framework.

The GPCS scope and functional requirements are specified in the GPCS Scope Definition and Stakeholder Consultation Report and the GPCS Functional Requirements Specification Report.

The specific objectives of this Report are to:

- Present the key technology architecture findings from analysis of the GPCS scope and functional requirements, research into related health industry architectures, and consultation with the Technical Review Team.
- Present an overview of the recommended GPCS Technical Framework, including the relevant technical standards.
- Provide an overview of the technical implications of establishing the GPCS Technical Framework.
- Provide a set of architecture principles used to guide development of the GPCS Technical Framework and which should guide a future implementation of the GPCS.
- Provide a functional specification of the building blocks which make up the GPCS Technical Framework.
- Detail a set of evaluation criteria and an evaluation process for the selection of components to provide the functions of the Technical Framework building blocks.

Section 2.0 Background and Context

Since 1992 the Government and the medical profession have been cooperatively studying the introduction of Information Technology into the General Practice. The Information Management Steering Group was established in 1993 and recommended that a common business specification statement for GP systems be produced.

In September 1995, the IBM Consulting Group was commissioned by the Department of Health and Family Services Pharmaceutical Benefits Branch to investigate the optimal use of Information Technology in the support of electronic prescribing and the provision of electronic medicines information.

While undertaking this engagement, it was recognised that rather than treat Electronic Prescribing in isolation, it should be considered in the context of a clinical Workbench. Subsequently, IBM Consulting Group recommended in the Final Report that a Clinical workbench be introduced to 50% of Australian office based practices within approximately two years.

The scope of the system to be specified by this consultancy has been broadened to encompass the provision of administrative support in addition to providing clinical support for General Practitioners as recommended in the previous report.

The IBM Consulting Group understands the Clinical & Administrative General Practice Computer System (GPCS) to be a set of application functions or closely linked / integrated software applications (including clinical and administrative) that combine a high level of functionality and utility with user-friendly and consistent user-interface to support high quality and efficient clinical practice. It is further recognised that seamless access to a range of information based services are highly desirable features and that the scope and feasibility of a broad range of diverse functions as part of the GPCS need to be properly assessed.

To permit the benefits identified in the IBM Consulting Group's Final Report to be obtained as soon as possible, it was recommended that the functional scope of an quickly implementable GPCS be developed promptly.

The objective of the GPCS Technical Framework described in this report is to enable modular and interoperable applications to be developed to address the requirements described in the GPCS Functional Requirements Specification Report.

Section 3.0 Consulting Approach and Methodology

This section describes the approach adopted for Phase Four of the Consultancy and the methodology employed for the development of the GPCS Technical Framework.

3.1 Overview of the Consultancy Process

The overall consulting project involved a phased approach. In the development of the GPCS Technical Framework in Phase Four, there was a strong reliance on the requirements developed during Phases Two and Three of the Consultancy, as these phases provided the requirements to be supported by the Technical Framework.

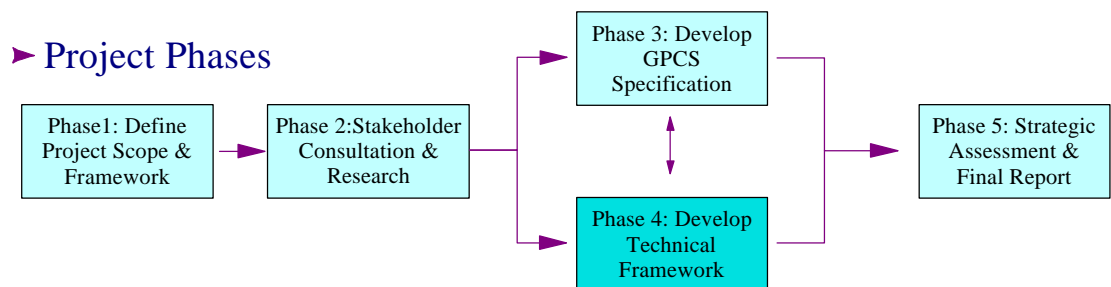


Figure 1 GPCS Project Phases

A Technical Review Team composed of representatives from the Medical Software and Health industry was formed to provide input and review as the Technical Framework was developed.

The approach developed for the production of the GPCS Technical Framework and this report, the major deliverable of Phase Four, involved the following steps:

- a. *Collect information from reference sources and previous consultancy reports.*

External information sources were searched for activities in the Health Information area relating to the Technical Framework and associated standards. Previous consulting reports were reviewed for background and relevant information.

- b. *Analysis of requirements and development of initial Architecture Principles.*

The initial set of functional requirements from Phase 2 and Phase 3 of the project were analysed and those requirements with implications for the Technical Framework were identified and consolidated. Architecture principles were developed to guide the development of the Technical Framework.

c. Review requirements and Architecture Principles with Technical Review Team.

A full day review session was held with the Technical Review Team where the Phase 4 approach, initial functional requirements and architecture principles were reviewed, and input from the Technical Review team was collected.

d. Develop initial Technical Framework.

The GPCS Technical Framework building blocks and the overall structure of the Technical Framework were defined. An initial specification of the functions of the GPCS building blocks was developed.

e. Review Technical Framework with Technical Review Team.

The initial GPCS Technical Framework was presented to the Technical Review Team and the definitions of the major building blocks were reviewed. Input from the Technical Review team was obtained to allow refinement of the definitions.

f. Develop recommendation and draft report.

The GPCS Technical Framework was updated and recommendations and technical implications identified. A draft version of the GPCS Technical Framework report was produced and circulated to Technical Review Team members for comment. The draft version was also distributed to the GP Expert panel for comment. The recommendations from the Technical Framework were presented to the Medical Software Industry Foundation and comment sought.

g. Quality review and finalisation of the GPCS Technical Framework Report.

This activity provided for a final quality review of the GPCS Technical Framework Report prior to finalisation of the report.

3.2 Consultancy Methodology

The methodology used for the development of the GPCS Technical Framework was based upon the IBM Consulting Group's Information Technology Architecture method. Some adaptation of the methodology was carried out to ensure that it considered the objectives, scope and context of the GPCS consultancy. The following activities from the method were used:

- Gather Status & Requirements
- Analyse Requirements
- Develop Architecture Principles
- Develop Evaluation Criteria & Process
- Build Architecture Models

Input for the Technical Framework was taken from "Phase 2 Stakeholder Consultation and Research" and "Phase 3 Develop GPCS Specifications".

3.3 Technical Review Team

In developing the Technical Framework a Technical Review Team was established with the following stated objectives and terms of reference. The members of the Technical Review Team are listed in *Appendix A: Technical Review Team*.

Terms of Reference for the Technical Review Team

The following terms of reference were established for the Technical Review Team.

- Providing input to the development of the Technical Framework through attendance of three Technical Review Team Meetings.
- Timely review of draft Technical Framework documentation produced by the consultants.
- Providing advice to the consultants on the significance and impact of technical issues surrounding the GPCS.
- The focus will be on establishing a generic Technical Framework and as such product-specific considerations should not be introduced.
- Providing Quality Assurance review of the major deliverables as they are produced.

3.4 Reference Documentation

Details of the documentation referenced during the project is contained in *Appendix E: Reference Information*.

Section 4.0 Analysis of Findings

4.1 Introduction

This section presents the key technology architecture findings from analysis of the GPCS scope and functional requirements, research into technology directions and related health industry architectures, and consultation with the Technical Review Team.

The findings relate to the following issues that face GPCS software developers:

- The key technical requirements that have a major impact on the Technical Framework and on the GPCS software developers.
- The level of modularity to be chosen for the delivery of the GPCS functionality by multiple software developers.
- A description of the General Practice environment in which the GPCS must operate.
- Technology directions and health industry architectures that potentially impact the development of software for the GPCS.

The conclusions from the analysis are summarised in *4.3 Conclusions*.

4.2 Summary of Key Findings

4.2.1 Key Technical Requirements

The major objective of the Technical Framework is to provide a technical architecture in sufficient detail to enable the development of highly modular and interoperable applications to form the GPCS. The imperative for a modular and interoperative approach derives from a clear preference for this strategy which was consistently reflected in stakeholder consultation conducted as part of Phase Two and Three of this consultancy.

In addition, the other underlying strategic principles on which the framework is to be developed are:

- The framework must be standards driven and based, “open”, highly flexible and multi-platform.
- Applications for the GPCS are to be designed as network enabled to ensure that the GPCS has the appropriate communications capabilities built in for network connection and information exchange.

The following table presents the key requirements derived from Phases Two and Three of the consultancy that have implications for the Technical Framework. The requirements are described in detail in the GPCS Scope Definition and Stakeholder Consultation Report and the GPCS Functional Requirements Specification Report.

Many of the functions identified within the overall consultancy are associated with the delivery of business (application) functions only. Where an application function requirement can be contained within the application itself then the requirement has not been considered in developing the supporting Technical Framework. The Technical Framework focuses on the underlying shared services needed to support the applications and to address the objective stated above.

Area	Requirement
Reliability	Reliability and robustness of GPCS applications Data reliability
Connectivity / Integration	Linkage to Hospitals Linkage to pharmacies Linkage to other health practitioners and organisations Linkage to Diagnostic Service providers Provision of reliable comprehensive data communication capabilities
Modularity / Interoperation	User requirement for investment protection and choice of application Seamless integration of applications / modules from a range of sources
Data Integrity and Currency	Robustness of electronic health record and other GPCS databases (clinical and administrative) Evidentiary and legal requirements for electronic medical records The ability to ensure that all GPCS applications operate on current, reliable information
User Interface	Variable data input methods, including voice Fast, consistent, reliable, easy, simple to learn and use Transparency of usage to patients
Standards Framework	Data transmission / communication standards Technical / interoperation standards Patient demographics and standard clinical practice datasets
Practitioner Mobility	Use in non-practice locations (eg, home visits, nursing homes, hospitals, working from home) The ability to access, share / interchange data between locations Use in solo, group and multi-disciplinary practices, multiple practice locations and both rural and metropolitan areas
Security and Audit	Appropriate level of data security and protection Controlled access to patient data by authorised personnel Appropriate audit trails of information access and update
System Support	Reliable and foolproof backup and recovery of data and software Timely access to support covering hardware, software and applications

4.2.2 Modularity and Interoperation

The anticipated major benefits for system users of the modular and interoperable approach include the wider choice of applications available to General Practitioners, and the ability to replace modules (“plug and play”) as more advanced alternatives become available for particular functions.

This section provides a framework for assessment of GPCS modularity / interoperation options against a set of evaluation criteria as developed by the Technical Review Team.

Granularity of GPCS Modularity

In developing the GPCS functionality there are a number of options that can be considered regarding the level of granularity of the functions developed.

One “monolithic” option is where the full GPCS functionality is delivered by a single application from one software vendor. In this case there are no application interoperability requirements within the GPCS. However, there is still a requirement for interoperation with the external services specified in the External Information Manager grouping of the *GPCS Functional Requirements Specification Report*. This approach does not permit easy or inexpensive user selection of new system functions from other suppliers.

Other options involve the business functions being divided into multiple building blocks, potentially delivered by different software vendors, each building block will have its local (private) data, but the data to be exchanged or shared between the building blocks needs to be defined in a standard form. Such standardisation typically takes the form of an information model and data dictionary specifying the content and semantics of the data. As the number of building blocks and the *level of granularity* of the system increases the number of interfaces and the scope of the “common data” model grow as illustrated in *Figure 2 Level of Granularity of GPCS Business Function* following.

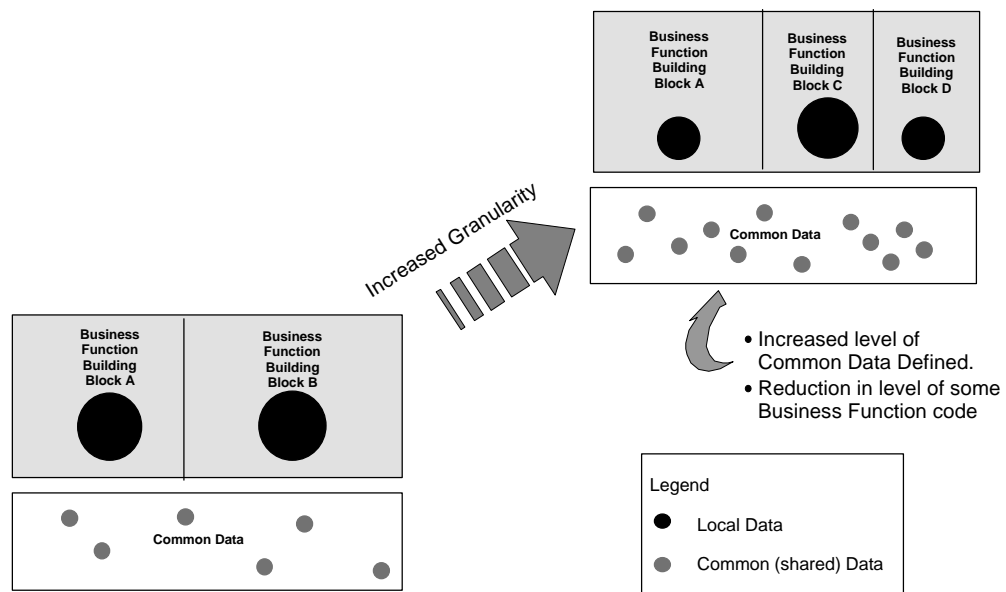


Figure 2 Level of Granularity of GPCS Business Functions

In assessment of the options below, it is assumed that the entire system is being

considered as a whole. However, the overall technical architecture, which is shown diagrammatically in *Section 5.3*, is composed of three major layers. These are:

1. Business Function Layer
2. Application and System Support (Middle) Layer
3. System Platform Layer

It is anticipated that because of the technical complexity of the application and system support (Middle) layer that developers will create platform specific application and system support layers and expose appropriate API's for use by other developers in the business function layers. The level of interoperation required by system users will ultimately depend on the delivery of business functions that are supported by common middle layer services for specific platforms.

Options

The following options for modularity and interoperation in the GPCS have been considered:

- **Monolithic**
The GPCS Technical Framework specifies nothing about granularity but an implementation organisation fosters one or more vendors to develop the full GPCS functionality.
- **Integrated Suite**
The GPCS Technical Framework specifies nothing about granularity but an implementation organisation fosters several vendors to integrate their complementary applications to provide the full GPCS functionality.
- **Coarse-Grained Building Blocks**
The GPCS Technical Framework supports mix and match of two to five coarse-grained business function building blocks.
- **Fine-Grained Building Blocks**
The GPCS Technical Framework supports mix and match of fifty or more fine-grained business function building blocks.

Evaluation Criteria

The criteria for evaluating the above options, as detailed in the table following, were developed by the Technical Review Team with consideration of the criteria provided in *Appendix D: Evaluation Criteria and Process*.

Criteria	Explanation
Development Cost	The cost of development and delivery of the full GPCS.
Comprehensive Functionality	Ability to deliver a comprehensive set of GPCS functionality that meets user requirements as specified in the GPCS Functional Specification Report
Conformance and Interoperation	Quality and level of interoperation possible both within the GPCS and to external systems
Intrinsic System Reliability	Level of reliability and robustness deliverable to users.
Solution Availability	Estimated time required to deliver a full function GPCS. available.
Ease of Migration	Ease of ability to add selected functions of the new GPCS alongside existing systems.
Investment Protection	Quality of protection from the requirement for early system replacement due to technological obsolescence.
Security	Ability to deliver integrated, comprehensive and system security which meets the GPCS functional requirements.
Technology Maturity	Maturity of any underlying technology required and its consequent reduction in technology risks.
Quality of User Interface	Consistency of the user interface between different business functions and the ease and consistency of navigation between functions.
System Extensibility	Ability to add new functions and comply with technical standards of the GPCS as they evolve.
System Scalability	Ease of expansion of the number of system users and level of system use.
Cross Platform Communications	Ability to support cross platform communications within a practice environment.

Evaluation of Options

Against the criteria above, the four main options for delivering the complete GPCS were evaluated based on input from the Technical Review Team. The evaluation of each option was ranked accordingly, as depicted in the table following.

Evaluation of Options for delivering the GPCS Functionality

Option \ Criterion	Monolithic	Integrated Suite	Coarse-Grained	Fine-Grained
Development Cost	High	Medium	Medium	Low
Comprehensive Functionality	High	High	High	High
Conformance and Interoperation	Low	Medium	High	High
Intrinsic Reliability	High	Low	Medium	Medium
Solution Availability	High	Medium	Medium	Low
Ease of Migration	Medium	Medium	High	High
Investment Protection	Low	Medium	High	High
Security	High	High	Medium	Medium
Technology Maturity	High	High	Medium	Medium
User Interface	High	High	Medium	Medium
System Extensibility	Low	Medium	Medium	High
System Scalability	High	High	High	High
Cross Platform Communications	Low	Medium	High	High

Ranking: Low (worst) – High (best)

Conclusions:

1. From a pragmatic perspective, it is considered that delivery of a fine-grained modular GPCS will be the most expensive option and take an unacceptably long time to deliver. The development timeframe is largely impacted by the necessity and anticipated time required for the software industry to specify and agree on a broad set of API's needed for integration of the top business functions with the common application and system services functions (middle layer), the need to develop the "middle layer", and then deliver the full range of GPCS business functions specified in the Functional Specifications Report. This option may initially be unaffordable for some software vendors, as each vendor will have to develop or source a workable middle layer to operate with their application software.
2. Whereas the monolithic approach appears a low risk, low development cost option, it offers a low investment protection for users and does not support the modular "plug and play" selection of applications / modules required by the system users.
3. While the option of taking pre-developed modules from a range of suppliers and creating an integrated suite of applications appears initially attractive, experience with such projects both in Australia and overseas suggests that for reasonable functional integration to be achieved, considerable cost, effort and time is required. In addition, the obvious experience of a number of the world's leading software suppliers in producing integrated office automation suites suggests that this approach has inherent risks in delivering the full range of GPCS

functionality with an acceptable level of reliability and low level of software “bugs”, particularly considering the high level of complexity of the GPCS.

4. The coarse-grained approach appears to hold the middle ground when all the above criteria are considered. It has the distinct advantages of being a relatively low risk approach, offering a high level of interoperability, good investment protection for users and the ability to be developed in an acceptable timeframe at a reasonable cost.

On balance, and recognising both the commercial and practical issues that surround the development, adoption and use of the GPCS, we consider an initial approach based on a small number of major developers producing a relatively standardised ‘middle layer’ and a significantly larger number of developers producing business function modules to be the best compromise between the various evaluation issues outlined above.

4.2.3 General Practice Environment

In addition to the functional requirements identified during Phase 2 and Phase 3 of the consultancy, the Technical Review Team provided input on the characteristics of the users, geographic locations and practice types that should be supported by the GPCS Technical Framework

Types of Users

The types of users to be supported by the Technical Framework are characterised into the following types:

Medical Practitioner

The General Practitioner within the practice responsible for the provision of medical services to patients. A practice may be either a solo or group practice. The requirements of the General Practitioner is similar in both instances. In the case of a Group Practice there is a need for the application functions to support a number of General Practitioners. The supporting infrastructure will be more extensive in a Group Practice to enable the delivery of functions to a number of users concurrently.

The role of the Medical Practitioner may take a number of forms:

- Resident General Practitioner or Specialist in the particular practice
- Assistant General Practitioner on a part time basis (for example only half a day per week in a particular practice)
- General Practice Registrars (trainees) who are associated with a practice on a temporary or short term basis during their training
- Locums, General Practitioners who provide temporary services to a practice

Practice Administrator / Clerical Staff / Receptionist

Administration personnel to carry out the front desk and practice administration functions.

- Provide support for users who wish to access practice administration functions. They do have a limited need to access / update patient medical records where authorised.
- In larger multiple GP practices there may be a specialist Practice Manager or Manager & Administrator function to oversee the running of the practice. Access to more sophisticated practice management services may be required, for example inventory / stock management and asset reporting.

Mobile User

To allow for a GP who may move between different practice locations and who may perform services in a variety of locations.

- All the functions available to a practice based GP are desired while mobile, if at all possible and practical from a technical and cost effectiveness perspective.
- Access to certain administrative functions may also be required by a mobile user, for example, some doctors may want to update / issue accounts while working in a non-practice location.
- There is a need to provide support for the replication of data to enable the support of mobile users. Companion functions to enable the synchronisation of practice and updated mobile data are required.

Types of Locations

Practice locations may vary from metropolitan through to rural and also comprise either single site or multi-site establishments, as illustrated in *Figure 3 Type of Practice Locations* following. The types of locations to be supported have been divided into two main categories:-

Metropolitan

- Typically there is a greater level of specialisation of practice and a greater level of referrals is carried out.
- Access to technology services, for example communications facilities and technical support, is readily available.

Rural (non-Metropolitan)

- Generally the GPs cover a wider scope of practice functions, for example rural doctors may perform many different functions in a variety of locations.
- There are limitations of access to medical infrastructure which may result in an increased focus on the need for communication services.

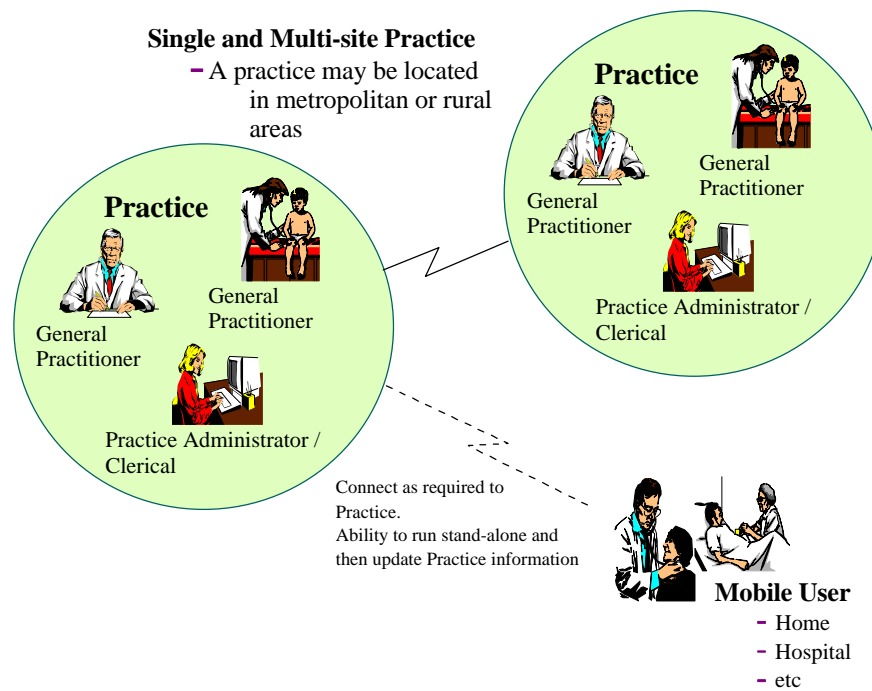


Figure 3 Type of Practice Locations

- There may be some limitation on the access to various communication services due to the locations. Cost of communications services may also limit the justification of some functions.
- There is a need to cover a wider geographic area of the practice and a need for higher mobility is identified.
- There is an implied higher cost for infrastructure support in the more rural locations.

In addition to the geographic location of the practice (metropolitan versus rural areas) consideration must also be given to the requirements for single site practice versus a multi-site practice.

Single Site Practice

- Single physical location.
- All administration services and record keeping performed from the single location.
- A minimum of two workstations to support a GPCS implementation: one for medical practitioner use during consultations, and one for front desk and practice administration functions.

Multi-site Practice

- Practice is spread across a number of physical locations.
- Usually there is a prime location for certain functions such as administration services.
- A need to provide access to the practice administration and medical information irrespective of the particular practice office location.
- A location may be shared between a number of General Practitioners at any one time.

Non-Practice Location

A level of support is also required for activities carried out when outside the practice locations. Most of these functions are defined under the mobile user category but there may be some limitation imposed by the particular location.

- Some remote locations, for example Nursing homes, will not provide access to infrastructure services such as printers and phone connections. This limits the GP access to technology services for external services.
- Home visits may impose restrictions on access to technology services as well.

4.2.4 Technology Directions

Technology directions that are significant to the GPCS environment are:

- Client/Server applications
- Hub and Spoke and Message Brokers
- The Internet and Network Computing
- PC platforms

Client/Server Applications

The Technical Review Team endorsed the need for the GPCS Technical Framework to specify a client/server environment.

The first generation client/server model (with all the application logic on a “fat” client and the server used to run the database management system) is being superseded by a variety of three-tier client/server models¹. The GPCS Technical

¹ *Fat vs. Thin: Overcoming Client Style Confusion, and Two-Tier vs. Three-Tier Trade-offs, Gartner Group TopVIEW and Research Note, Jan 1997.*

Framework and the applications it supports should not be tied to a specific model.

- Mobile computing requirements are adding to the use of a model which replicates some data on the client for disconnected use.
- The influence of the Internet and Network Computing is leading to increased use of a model with the user interface and some server managed application logic on the client.
- Gartner Group has raised its earlier prediction on the percentage of three or more tier client/server applications. In January 1997 they predicted that 90% of new client/server applications will be three or more tiers by 2001.

Hub and Spoke and Message Brokers

“Hub and Spoke”² and “Message Brokers”³ are terms that have been applied by industry analysts to the class of systems that act as central switches to transfer messages between heterogeneous systems. A message broker can transform messages at a content level between the different formats used by the various systems. A message broker may also provide a type of workflow capability to, for example, decompose a single message into multiple messages.

- Message brokers have been used mainly in the Health (particularly hospitals) and Finance industries, but are now becoming more mainstream. Gartner Group predicts that by 2001, more than half of all large enterprises will have some form of message broker in production.
- Gartner Group also predict³ that developers will not embrace universal interface standards, and no technology, including components or distributed-object computing, will eliminate the need for message brokering through 2000 (0.9 probability) or 2005 (0.8 probability).
- Message broker technology could be applied to the External Information Manager functions of the GPCS. However, the GPCS potentially sits at the end of a spoke in a health network and the technology is more readily applied to a central exchange function as discussed in *6.2.2 Technical Framework Design*.

² Source: *The Business Promise of 'Hub-and-Spoke' Systems*, McKinsey Quarterly, Winter 1994

³ Source: *Message Brokers: A Focused Approach to Application Integration - Strategic Analysis Report*, Gartner Group, June 1996,

The Internet and Network Computing

The explosive growth in the use of the Internet and a focus on the Network Computing environment is apparent in the marketplace. Its potential impact on the GPCS includes the following:

- GPCS users will want access to the World Wide Web information resources and the global electronic mail of the Internet. While access will provide benefits to GPCS users it also introduces security exposures that need to be addressed. An intranet approach would lessen the security exposures by providing a centralised control and security and firewall capabilities that may otherwise not be justified on a practice basis.
- Internet standards, which are becoming more general de-facto standards in areas such as communications protocol (TCP/IP, and HTTP), document formatting (HTML) and electronic mail (SMTP and POP-3) will need to be supported by the GPCS Technical Framework, at least for access to the Internet.
- Internet standards are evolving through enhanced versions, and through planned new standards such as Portable Network Graphics (PNG) and MIME E-mail encapsulation. The GPCS will need to keep up with these changes.
- The Web Browser has become a familiar user interface and the use of this interface is spreading into areas beyond Internet access.
- Growth in the use of the Internet for home shopping and electronic commerce has increased focus on security and privacy of data transferred over networks, along with strong user authentication and non-repudiation.
- The model of network computing presents some new considerations that will need to be considered with respect to the GPCS Technical Framework in the future. Network Computing provides a faster way to develop applications. On the other hand, the challenge is that these Network Computing type of solutions are often expanded (because they *can* be expanded) to meet additional needs as time goes on.
- Security services in the network computing environment are evolving to support user identification and authentication, access control to resources and services, firewalls, confidentiality, data integrity, non-repudiation of transactions, security management, key recovery, and Java applet security. Public key support based on X.509v3 certificates support this move.
- To ensure the integrity of commercial transactions, services that support the Secure Electronic Transaction (SET) standards developed by VISA and MasterCard, and other leading companies, are being developed. SET provides a secure means for transmitting credit-card information from customers (via a Web browser) to an application and then on to a financial institution for processing.
- The concept of the Java Virtual Machine in both clients and servers provides the base support for much of the programming in the Network Computing environment and provides platform independence for electronic based business activities.

PC Platforms

The increasing functionality and power provided by PC (Intel) architecture systems is continuing to displace other systems and makes PC-based systems a viable alternative to Unix for the GPCS. The GPCS Technical Framework should support consolidation of functions onto servers. Research carried out by the Gartner group⁴ indicates that:

- The desktop environment will primarily be dominated by Intel based PCs and Microsoft Windows operating systems. There will be niche environments where Apple Macintosh and Unix desktop systems are deployed.
- Intel-based servers running Windows NT are now being commonly deployed to support 200 concurrent users and 50 Gbytes of data.
- There are strong directions towards consolidation of functions onto a fewer number of servers within an environment.

The Technical Review Team noted that there is a significant installed base of Apple Macintosh and Unix systems in addition to Intel-based systems in Australian general practices. GPCS should not dictate a single platform.

4.2.5 Health Industry Architectures and Models

Health industry technology architectures that have been referenced in developing the GPCS Technical Framework are:

- CEN/TC251 Healthcare Information Framework (HIF) and Healthcare Information Systems Architecture (HISA)
- RICHE Reference Architecture

A number of health industry initiatives to develop standards for information models have been identified. These models aim to define the content and structure of health records and/or the interchange of data between healthcare information systems. These initiatives include the following and are discussed further in the GPCS Functional Requirements Specification Report:

- Australian National Health Data Dictionary
- CEN/TC251 PT1-011 Electronic Healthcare Record Architecture
- Computer-based Patient Record Institute Record Description of Content and Computer-based Patient Record System Description of Functionality
- Good European Health Record (GEHR) Deliverable 19
- Health Level 7 Reference Information Model and HL7 Version 3 Message Development Framework
- IEEE P1157.1 (MEDIX) Joint Working Group for a Common Data Model

The following sections comment briefly on the technology architectures listed above.

⁴ Source: *Industry Trends & Directions - Strategic Analysis Report*, Gartner Group, Sept 1996.

CEN/TC251 HIF and HISA

CEN/TC251 (European Standardisation Committee, Technical Committee on Medical Informatics) Working Group 1 (WG1) has produced two European Pre-standards that establish general principles for the architecture of healthcare information systems:

- N95-261 PT1-010 Healthcare Information Framework (HIF)
- N95- 285 PT1-013 Healthcare Information Systems Architecture (HISA)

The HIF defines three interrelated views which translate the reality of the healthcare professional and information processing world into the information technology world:

- **Healthcare domain view**, described by modelling a structured set of concepts such as objects, knowledge and healthcare processes.
- **Technology view**, described as three layers:
 - Healthcare application layer
 - Healthcare middleware layer, or enabling services
 - Healthcare bitways layer, or physical infrastructure
- **Performance requirements view**, described by modelling functionality, dependability and controllability.

The main aim of HISA is to facilitate both the integration of products provided by different suppliers, and the gradual evolution of existing systems toward a more open, modular structure. The HISA further defines the middleware layer of the HIF technology view into:

- **Healthcare-related Common Components (HCC)** which support the applications with services relating to the peculiar activities of the healthcare business domain.
- **Generic Common Components (GCC)** which support the applications with general purpose facilities, which are usually common to any information system in any type of business domain.

HISA also identifies a set of six main healthcare-specific HCCs: Patient, Health datum, Activity, Resource, Authorisation and Concept.

The HISA specification is at a conceptual level. The architecture emphasises the need for application modules to interact through public and stable interfaces but does not define these interfaces. The need for additional standards relating to Managerial and Administrative Common Components and to the interaction between components was identified by TC251 WG1, but the authors of this report are not aware of any publications on these subjects.

RICHE Reference Architecture⁵

Groupe RICHE is a European Commission initiative to apply the 'open system' approach to health care. Key characteristics of the RICHE Reference Architecture

⁵ Source: RICHE Architecture Overview , September 1996 and Basic Introduction to the RICHE Reference Architecture, July 1994, Groupe RICHE Technical Committee.

(RRA) are:

- It adopts three layers aligned with CEN/TC251 HIF and HISA:
 - A layer of end-user applications offering services directly to the end-users.
 - A layer of common services, the Healthcare Common Components-HCC (referred to as the Distributed Healthcare Environment in Version 1) offering services to the end-user applications.
 - A platform layer, offering distribution and communication services over heterogeneous operating systems and hardware.
- It defines four main components of the Healthcare Common Components layer to cover patient demographics and movements, activities of care, patient medical information, and organisational and knowledge information.
- Application intercommunication is based on an information model and a minimum common data set.
- It is client/server and object-oriented.
- It focuses on, and is being applied in European hospital information systems.

4.3 Conclusions

Based on the preceding analysis the following conclusions were drawn:

- For the initial release, the GPCS Technical Framework should support a relatively small number of “coarse-grained” applications (referred to as business function building blocks, and consisting of large groups of related business functions) a middle layer and supporting platform. The number of business function building blocks can be increased over time through extension of the scope of the common data model.
- Access to the GPCS functions is required by a General Practitioner irrespective of location (either practice or mobile), and whether in a single site or multi site practice. The locations to be supported comprise both Metropolitan and Rural areas. The GPCS Technical Framework needs to allow for a variety of configurations and communications capabilities.
- The level of security and data integrity provided by the application functions and GPCS Technical Framework components must allow for the protection of the privacy of data and the control of access to the system and its functions. Exposures introduced by Internet access by GPCS users also need to be addressed.
- The GPCS Technical framework must enable a reliable environment with a high level of systems management functions to ensure the operation of the GPCS without undue impact on the normal activities of a practice.
- The GPCS Technical Framework must support a client/server environment with a user interface that is fast, consistent, reliable and easy to learn and use. It should not be tied to a specific client/server model, nor to a single hardware and software platform.
- The GPCS Technical Framework should allow for GPCS user access to the Internet and support the evolving Internet standards and Web Browser user interface.
- Work by CEN/TC251 and Groupe RICHE provides guidance for the GPCS Technical Framework, but their architectures can not simply be adopted as the Technical Framework for GPCS as they focused on the hospital rather than the GP environment.

Section 5.0 Recommended Technical Framework and Architecture

5.1 Introduction

This section presents the recommended GPCS Technical Framework.

- The framework is a product-independent view of the architecture needed to support the GPCS.
- It includes all three layers of a Healthcare Information Framework Technology View (*4.2.5 Health Industry Architectures and Models*).
- The intended audience for the GPCS Technical Framework is Information Technology professionals in the health and medical software industries.
- The framework is based on a set of principles described below, and on the findings and conclusions described in *Section 4.0 Analysis of Findings*.

The GPCS Technical Framework is described in terms of a number of building blocks grouped into categories. These categories are described in *5.3 GPCS Technical Framework Categories*. The building blocks are presented in a conceptual model and an overview of the individual building blocks is given in *5.4 GPCS Technical Framework Building Blocks*. A more detailed functional specification of the building blocks is included in *Appendix C: Detailed Architecture Building Block Specifications*.

In implementing the GPCS, consideration must be given to the range of general practice topology and technology options that exist. The GPCS Technical Framework includes several logical views that illustrate how the conceptual model can support these environments. The logical views are described in *5.5 GPCS Technical Framework Logical Views*.

The key criteria for conformance with the GPCS Technical Framework are listed in *5.6 Technical Standards*.

The GPCS Technical Framework is considered to be an evolutionary framework in that a mechanism needs to be established to ensure the framework is maintained and updated over time. Changing technology options and additional requirements will need to be considered within the context of the Technical Framework. Consideration of a suitable body to sponsor / champion the GPCS Technical Framework is required.

Finally, conformance to the GPCS Technical Framework is discussed in 5.7.

5.2 Architecture Principles

Several requirements from the Electronic Prescribing consultancy and the GPCS Functional Requirements Specification Report were used as guiding principles for the GPCS Technical Framework. These principles are:

- *The ability to offer a scalable solution should be supported by the architecture.*
- *Maximum use of proven low risk and affordable technologies with a standards driven approach.*
- *A business function service rather than technology focus should be taken in developing the Technical Framework and in the establishment of the architectural building blocks.*
- *Emphasis on ease of use and enhancement to the General Practitioner's workflow and working practices.*
- *The framework must be standards driven and based, "open", highly flexible and multi-platform.*
- *Emphasis should be placed on developing a Technical Framework that considers cost effectiveness as well as technology aspects.*

A more specific set of principles were developed from the guiding principles and reviewed with the Technical Review Team. The principles are included in *Appendix B: Architecture Principles*. The Principles and the GPCS Functional Requirements Specification Report were used to define the appropriate building blocks and connections in the Technical Framework, as described below.

5.3 GPCS Technical Framework Categories

Architecture Building Blocks

The GPCS Technical Framework has been described in terms of architecture building blocks. Each building block is a component of the architecture that is sufficiently modular and bounded to be described as a self contained entity. The building blocks cover the logical definition of the Technical Framework. Each building block is independent of the underlying physical implementation, and does not imply, or exclude, a specific physical architecture.

The selection of building blocks is influenced by:

- The need to break the architecture as cleanly as possible into manageable pieces that users of the architecture can understand.
- The GPCS requirements, which are described with reference to the functional framework shown in *Figure 4 GPCS Functional Framework* following, and are documented in the GPCS Functional Requirements Specification Report.
- The architectural principles identified.
- Other findings and conclusions described in *Section 4.0 Analysis of Findings*.

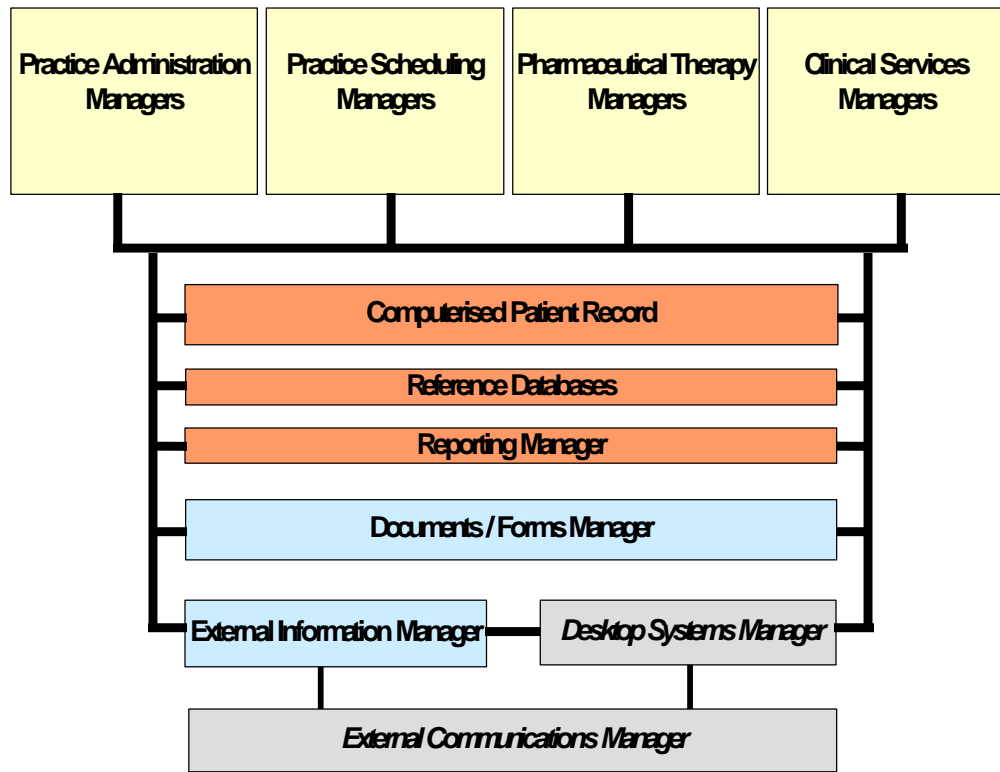


Figure 4 GPCS Functional Framework

Building Block Categories

The architecture building blocks that comprise the GPCS Technical Framework have been placed in a number of categories depicted in *Figure 5 GPCS Technical Framework* below.

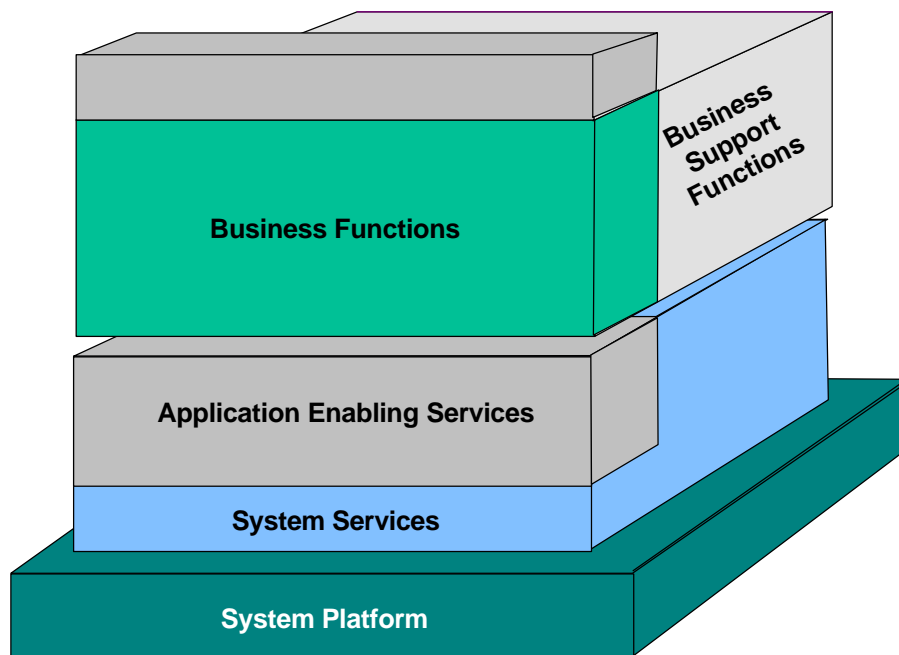


Figure 5 GPCS Technical Framework Building Block Categories

The categories are as follows:

- **Business Functions**
Those building blocks associated with the delivery of the primary business functions of the GPCS. The business functions are organised into groups of related function such as Practice Administration and Clinical Services.
- **Business Support Functions**
Provides functions of a more general nature, such as word processing and reporting, that may support multiple business function groups.
- **Application Enabling Services**
Provides the common application services, such as a Data Access Manager, to allow for the sharing and control of applications and data.
- **System Services**
The core infrastructure services and functions are provided within this category
- **System Platforms**
This category provides the functions in support of the operating systems and hardware.

5.4 GPCS Technical Framework Building Blocks

The building blocks defined for the GPCS Technical Framework are depicted in *Figure 6 GPCS Technical Framework Building Blocks* following. The focus here is on the building blocks that comprise the Business Function Support, services and platform areas of the framework. At the conceptual level of the framework the business functions have been treated as a single functional area referred to as the Business Function Managers.

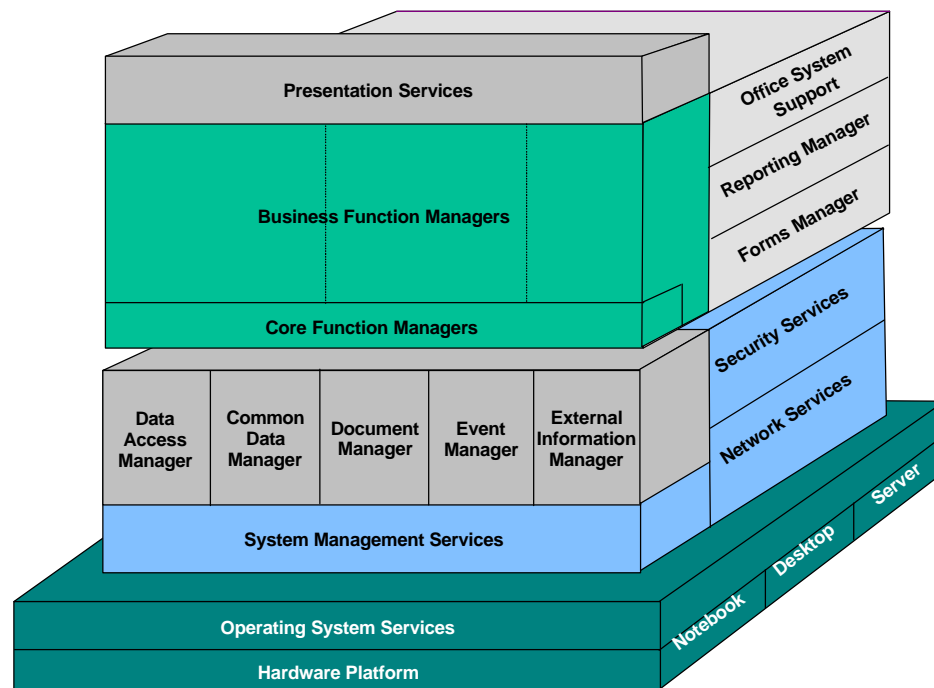


Figure 6 GPCS Technical Framework Building Blocks

The following sections give an overview of the building blocks. A more detailed specification of each building block is included in *Appendix C: Detailed Architecture Building Block Specifications*.

5.4.1 Business Function Managers

These building blocks are associated with the delivery of the primary business functions of the GPCS. The business functions will be divided into groups of related functions, such as Practice Administration and areas of Clinical Services, during the GPCS design phase. For example :

Administration Managers Group

Practice Administration Managers

Practice Scheduling Managers

Clinical Managers Group

Pharmaceutical Therapy Managers

Clinical Services Managers

A description of the required business functions is contained within the Phase Three GPCS Functional Requirements Specification Report.

In the design phase for an initial GPCS a relatively small number of business function building blocks and a limited set of Common Data (the data that is shared between Business Function building blocks) are likely to be defined as discussed in *4.2.2 Modularity and Interoperability*.

Rationale

The grouping of business functions into different building blocks enables multiple organisations to develop different parts of the GPCS business function. A coarse-

grained approach with a limited number of business function building blocks should make it easier for software vendors to modify their existing applications to comply with the GPCS requirements.

The number of defined business function groups may be increased over time by extending the scope of the Common Data.

5.4.2 Core Function Managers

This building block provides for the maintenance of the Common Data (the data that is shared between different Business Function building blocks). For example, the Core Function Managers would include the capability to capture and maintain the patient minimum data set needed for operation of the GPCS. They may also handle the selection of a patient using flexible search criteria, and the display of patient demographic data for the selected patient.

Rationale

Provision of core functions separately from the majority of the business function provides more flexibility in the selection of one or more business function components for a particular practice's GPCS.

5.4.3 Business Support Functions

The Business Support Functions provide business functions of a more general nature, such as word processing and reporting, that are not specific to health systems and that may support multiple Business Function groups.

Forms Manager

The Forms Manager provides a standardised tool for the generation of forms templates and the completion of forms, such as for diagnostic services ordering and private health insurance. Forms may be completed through the inclusion of data from the Electronic Health Record and through user entry of additional fields and free form text. Completed forms may be printed or transmitted electronically.

Business Function Managers may supply their own forms management functions for forms templates supplied with the Business Function Manager. However, for forms where the templates are to be generated or modified by the GPCS user the preferred implementation is to use the word processor component of Office System Support for the generation and completion of the forms.

Rationale

This building block provides a consistent approach for the GPCS user for the generation of templates and the completion of forms using a familiar word processing tool.

Office System Support

Office System Support provides industry standard support for the office system functions commonly applicable to General Practice and also required by other GPCS functions. Word processing, spreadsheet, charting and electronic mail functions are supported.

Through customisation of the word processing capability this building block also supports the Forms Generation requirements identified in the GPCS Functional Requirements Specification Report.

Rationale

This building block will enable the GP to use the same office functions within the GPCS and for other stand-alone usage. The GP can also choose to use other software, within the constraints of the selected GPCS operating system and hardware platform.

Reporting Manager

The Reporting Manager provides ad-hoc and routine reports for the GPCS, including:

- Clinical management, based on data defined by the Electronic Health Record
- Administration / Practice Management, based on data defined by the Patient Financial Record

Rationale

This building block addresses the requirement for a consistent means of querying and reporting on data in the GPCS. It avoids the need to develop specific reports using different tools and languages in the different Business Function building blocks of the GPCS.

5.4.4 Application Enabling Services

Application Enabling Services provides the common application services, such as a Data Access Manager, to allow for the sharing and control of applications and data.

Common Data Manager

The Common Data Manager provides management of and access to the GPCS Common Data ie that data which is shared between multiple Business Function building blocks. It provides access to the underlying data via an Application Programming Interface (API) which hides the database structure from the GPCS applications.

The GPCS Common Data includes a subset of the:

- Electronic Health Record
- Patient Financial Record
- Reference Databases

of the GPCS Functional Requirements Specification Report. The specification of the content and structure of the Common Data requires the development of an information model as part of the GPCS design phase.

Rationale

This building block supports the requirement for modularity and interoperability. It supports the architecture principle relating to Common Data.

Data Access Manager

The Data Access Manager provides an industry standard function for database management in the GPCS. It provides Application Programming Interfaces (APIs) for GPCS applications to access data stored in databases. It delivers the basic system functionality required to create, update and maintain databases while safeguarding the integrity and security of the data.

The Data Access Manager supports shared access to server databases from multiple client workstations. All data which is updated in the GPCS, including the Common Data, should be stored on a server database managed by the Data Access Manager.

The Data Access Manager also provides two-way replication of a sub-set of data between the server and databases held on a client workstation to support mobile users.

Rationale

This building block avoids the overhead of multiple database systems specific to individual applications. By providing a single function for managing the integrity and security of the data it addresses the key requirements of reliability, system support and security (*4.2.1 Key Technical Requirements*).

Document Manager

The Document Manager handles both written and electronic documents within the GPCS. It maintains a database of electronic documents, an index of all documents, and provides a full text search capability.

Rationale

This building block supports the Document Management requirements, including document scanning, of the GPCS Functional Requirements Specification Report.

Event Manager

The Event Manager allows one GPCS program to send information representing the occurrence of an event to another GPCS program. It provides a one-way communication mechanism for one program to send information to another program. For example, the External Information Manager will need to notify a Diagnostic Tests Business Function of the receipt of test results.

The Event Manager supports communication between programs running on

different System Platforms (eg between a Business Function program running on a client and an External Information Manager program running on a server). It also provides for the queuing of information for later delivery to the destination program should the underlying platform connection be unavailable.

Rationale

The Event Manager decouples the communication between GPCS programs to support the requirement for modularity and interoperability in a client/server environment. It thereby simplifies the Business Functions and provides for flexibility in client/server configurations.

External Information Manager

The External Information Manager includes the functions to interface with the services world outside of the GPCS system. These functions can obtain, format and transmit appropriately authorised information from the GPCS to the required destination external service(s). The External Information Manager also receives information from external health services and formats and stores it appropriately for use within the GPCS.

The External Information Manager is an essential component of the GPCS Technical Framework. The External Information Manager provides the services to enable the exchange of information, in the correct format, with external providers, for example diagnostic services.

The types of external information services with which information may be exchanged are depicted in *Figure 7 External Information Exchange* below.

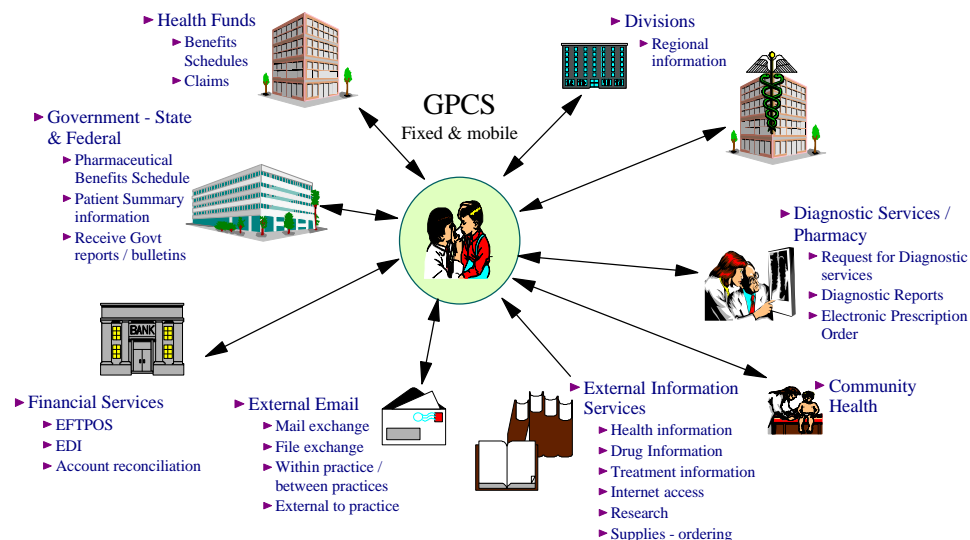


Figure 7 External Information Exchange

The management of the tracking and alerting of requests for external services is also provided and support for the formatting of messages into the required formats (for example HL7 or EDIFACT) is carried out. Control of access to external services is performed by utilising the services of the Security Services building block.

Rationale

This building block consolidates the handling of message formatting and translation into a single area isolating the Business Function Managers from the complexity and likely changes in the external environment. It provides a single point for control of

access to external services and improves the ability to control access into or out of the GPCS.

As a more detailed specification is developed the functions within the External Information Manager may be further sub-divided.

Presentation Services

Presentation Services support the presentation of application and operating system information to the users of the GPCS through industry standard presentation interfaces. Included are functions to present graphical, text and image data. The User Interface needs to be easy to use and quick to learn. The presentation services must support the practice user (clinical and administration) and services to enable the support of the desktop environment (editing of configuration information for example).

Multimedia data, meaning two or more media, one of which is a time based digital medium: audio, animation or video, would also be included in this building block if required. Support for additional technologies, such as Pen Based and voice recognition would also be included if warranted.

The user interface of Business Functions and Business Support Functions should conform to the generally accepted guidelines for the underlying platform, for example Microsoft's *Interface Guidelines for Software Design* for Microsoft Windows implementations.

In addition to supporting the graphical windowing style of interface typified by Microsoft Windows and Apple Macintosh, Presentation Services supports the HTML and Web Browser interface.

Rationale

This building block provides the GPCS user with consistency in the interface with the Business Functions. It supports the User Interface architecture principle. Conformance to user interface design guidelines appropriate to the underlying platform will ensure that all GPCS applications behave in a similar manner.

The Web Browser interface is widely used to access the World Wide Web and HTML has become the standard for publishing information on the Internet. This interface may be an appropriate interface for a number of the information access functions of the GPCS, in addition to its use for Internet access.

5.4.5 System Services

Network Services

The Network Service building block provides for the Local Area and Wide Area communications functions. The support of a defined set of communication protocol stacks is provided. Connection for both permanent and non-permanent (dialled) wide area network connections are provided.

Rationale

This building block consolidates the communication requirements for the GPCS and reduces the need for applications to understand the underlying network layer protocols used for communications. It provides a standards based reliable network transport layer in support of the overlying message and application protocols.

Security Services

Security Services provide for the access controls, authentication of users, password control and maintenance of appropriate user access profiles. The authentication and access authorisation for both local and remote user access is provided within this building block. Application functions should call on Security Services for the authentication of users and for data access control.

The provision of encryption / decryption services is managed from within the Security Services. Where the transmission of data is required it should be encrypted to ensure privacy is maintained. More sensitive data may also be encrypted for storage.

Support of digital signatures (certificates) is provided to allow for the authentication and non-repudiation of electronic messages and documents.

This building block represents a logical grouping of the Security Service functions. As components within the GPCS are defined during the GPCS design phase aspects of the security functions may be provided as part of the Business Function Managers, for example the control of and level of access to applications.

Rationale

This building block provides a central point for authentication and control of access to the GPCS. It also provides a common set of security services that can be called from other modules within the GPCS.

System Management Services

The provision of a manageable technical environment is required. System Management Services provides the functions used in the management of the operational GPCS environment. These services cover the provision of the following functions:

- Change Management
- Configuration Management
- Problem Management
- Back-up and Recovery Services
- Performance Management

The System Management Services building block represents a logical grouping of the Systems Management functions required within the GPCS Technical Framework. During the GPCS design phase and subsequent implementation systems management functions would be incorporated within the particular components. For example, an application may provide product information to enable control of the version and recording of the assets within the system.

Rationale

This building block provides a central point for Systems Management functions to enable the efficient operation, support and maintenance of the GPCS. Function to control the receipt of software updates, and the application of the update, is also centralised within the Systems Management building block.

5.4.6 System Platform

Within the System Platform reside the architecture building blocks which provide the platform services. Typically these services are provided by hardware platforms, microcode or operating systems.

Hardware Platform

The Hardware Platform provides the physical environment within which all GPCS functions operate. It includes processors, memory, fixed and removable storage, input and output devices, etc. The hardware platform must be available in models to allow mobile computing and the GPCS client/server environment. Consideration for utilisation of hardware to supporting the Network Computing environment is also accommodated.

The hardware platform will be deployed in an office-based General Practice environment. Normal office environment facilities (stable power supply, floor space, appropriate temperature range etc) are assumed to be available and there is no requirement for the platform to support a harsh environment, for example dust, extreme heat, strong electromagnetic radiation or fluctuating power supplies.

The **Notebook** platform provides the application, systems and hardware functions to support a mobile user. The Notebook supports both local and remote connection to the GPCS system. Provision for docking station support in the practice environment is required.

In "remote" mode the notebook provides the platform to deliver the required application functions and associated data. Access and data security functions are required to prevent unauthorised access to data held on the Notebook.

The **Desktop** platform provides the application, systems and hardware functions to support a practice based user. The Desktop supports a LAN based connection within the practice and communications to a practice central server.

The **Server** platform supports the provision of data, application, printing and communications support where a practice involves a number of Desktop or notebook workstations. The server also provides support for the appropriate Systems Management services, for example, back-up and recovery.

Appropriate access and data security functions are incorporated.

Rationale

Standardisation on a selected set of hardware platforms will enable the development and reuse of applications and associated services.

Operating System Services

Operating System Services manages delivery of hardware resources and functionality to other building blocks and users in the GPCS client/server environment. A limited set of operating systems and hardware platforms will be supported.

Rationale

Standardisation on a selected set of operating systems for clients and servers will ease the development and support effort associated with GPCS systems and applications. The operating systems should be common across the Australian market place.

5.5 GPCS Technical Framework Logical Views

In implementing the GPCS, consideration must be given to the range of general practice topologies and technology options described in *4.2 Summary of Key Findings*. These practice environments range from single practice / single GP through to large multi site / multiple GP practices. Support for a mobile user is also required.

The GPCS Technical Framework has been developed to enable a number of implementation options. This section presents several logical views that illustrate how the GPCS Technical Framework can support these environments.

5.5.1 Client/Server Logical Views**GPCS Basic Configuration**

A basic configuration for implementation of the GPCS includes two client workstations: one for medical practitioner use during consultations, and one for front desk and practice administration functions. In this context the client may be either a desktop or notebook (mobile) Hardware Platform building block.

The basic GPCS requirement for sharing of patient demographic information between client workstations is met by the Common Data Manager and a shared database on a server Hardware Platform. The server is capable of also acting as one of the client workstations, although this configuration should be subject to a reliability and security risk assessment before implementation.

Placement of Function and Data

The GPCS Technical Framework has been developed to allow for the placement of function on either client or server platforms.

In a client/server environment there are a number of logical configurations that can be established. The placement of presentation services, application logic and data between the client and server distinguishes between these various configurations. Examples of these configurations are given in *Figure 8 Client/Server Models* following.

These models depict a level of co-operative processing between the client and server equipment. With respect to the Functional Requirements established for the GPCS, guidance on the placement of application functions and data would be an outcome of a subsequent design phase with some decisions to be left to the developers of the Business Function Managers. The GPCS Technical Framework does not impose a specific client/server model.

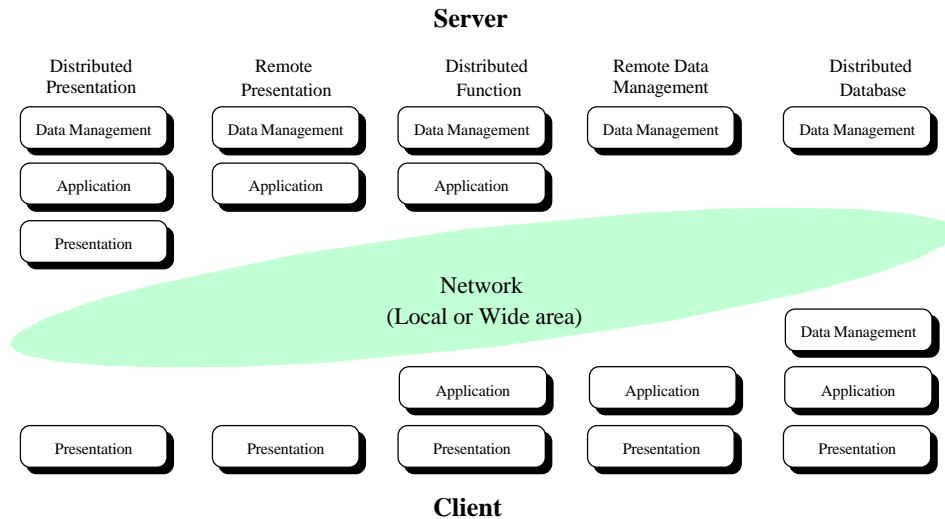


Figure 8 Client/Server Models⁶

Distributed Function Model

A logical view of the GPCS Technical Framework in a typical two tier distributed function client/server configuration is illustrated in *Figure 9 Distributed Function Two Tier Model* below. In this model the building block functions are distributed between client and server as shown in the following table.

⁶ Source: Gartner Group. Strategic Analysis Report *Three-Tier Computing Architectures and Beyond*

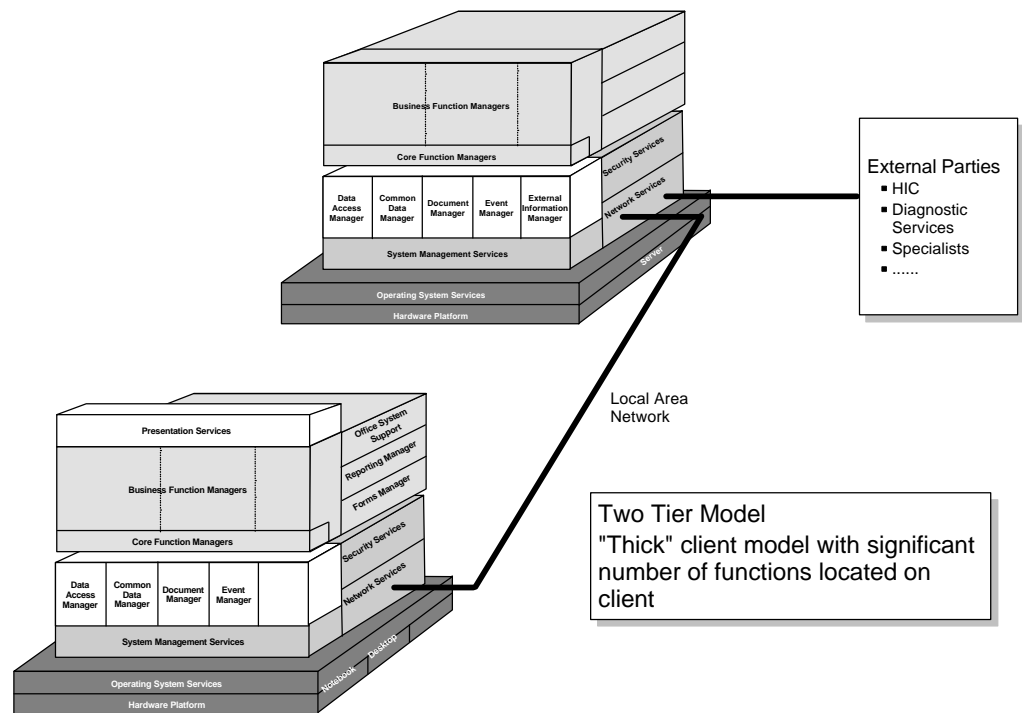


Figure 9 Distributed Function Two Tier Model

Building Block	Client/Server Distribution
Business Functions	
Business Function Managers	Distributed between client and server using Data Access Manager and Operating System Services functions such as Stored Procedures and Remote Procedure Calls.
Core Function Managers	As for Business Function Managers.
Business Support Functions	
Office System Support	Typically a packaged client application, with a server component for E-Mail.
Reporting Manager	As for Business Function Managers.
Forms Manager	As for Business Function Managers.
Application Enabling Services	
Common Data Manager	API service provided on both client and server.
Data Access Manager	API service provided on both client and server. Shared database and most function implemented on server.
Document Manager	Document viewing on client. Document storage on server.
Event Manager	API service provided on both client and server.
External Information Manager	Server function.
Presentation Services	Client function.
System Services	
Network Services	Full services on server. LAN service on client.
Security Services	Full services on server and selected services on client.
Systems Management Services	Full services on server. Change management for the client.

System Platform	
Hardware Platform	Desktop or Notebook platform as client. Server platform as server.
Operating System Services	Desktop operating system as client. Server operating system as server.

Distributed Presentation Model

In contrast to the “fat” client/server implementation with a lot of function on the client, a “thin” client/server implementation has the placement of presentation services and limited application services on the client while the bulk of the application services and data are located on the server.

This type of configuration simplifies the management of the client environment and is representative of the emerging network computing technologies. The client Hardware Platform may be a low end PC or a Network Computer.

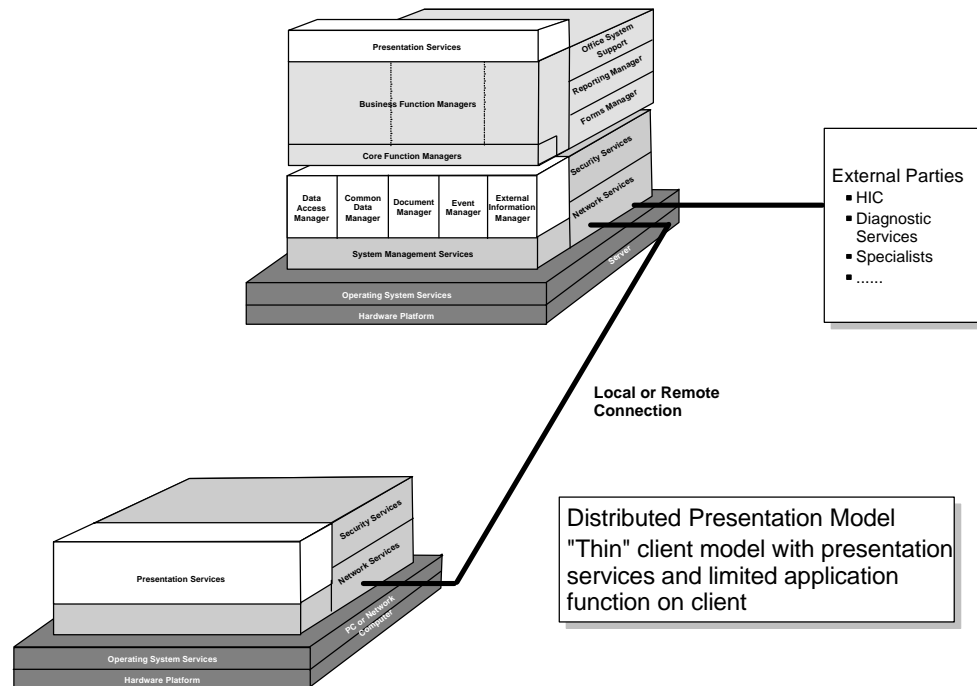


Figure 10 Distributed Presentation Model

In the distributed presentation model all Business Functions, Business Support Functions and Application Enabling Services run on the server, except for Presentation Services, which run primarily on the client with a thin layer on the server. A limited set of System Services supports the Presentation Services on the client. Some implementations allow for limited application functions, “applets”, to run on the client. This model is not yet supported by stable industry standards. However, proprietary implementations exist and standards are emerging.

Client/Server Considerations

The modular nature of the GPCS Technical Framework allows for the placement of functions at the most appropriate place. There are a number of factors to be considered during the GPCS design phase in deciding on the placement of application and data within the client server environment. These factors are:-

- **Notebook workstation.** Where mobility and standalone operation are required then there is a need for an increased level of application and data functionality on the mobile client platform. The mobility may occur within a practice as well as external to a practice. The primary copy of any data replicated to a mobile workstation should remain on the practice server to safeguard the data.
- **Wide area communications.** Where access to wide area communications services provides a limited amount of network capacity then it is particularly important that a majority of application and data functionality should be on the same platform to enable the delivery of an appropriate level of service to the end user. The function and data should be grouped on the client with a distributed data model, or on the server with a distributed presentation model that is optimised for low bandwidth communication.
- **Local Area Communications.** Where the GPCS is deployed in a Local Area Network (LAN) environment most client/server models can support the relatively small number of users with the high capacity LAN communications.
- **Data.** The volume of the data, its volatility and the need for access within agreed service levels will influence the ability to distribute the data. Consideration for the ability to re-synchronise the data needs to be given.
- **Application Functions.** Placement of application functions and the application architecture / design employed, such as Object Request Brokers, Remote Procedure Calls and Stored Procedures will influence the placement of the functions.
- **Security.** The privacy and confidentiality of the medical records kept within the GPCS system places a strong influence on the location and storage of data as well as the control of access to the GPCS system itself and the functional areas. Physical access to the system may influence a move towards a dedicated server environment where it is easier to control the access. In a mobile environment then access to the mobile platform and the encryption of the data contained within become of prime importance.

5.5.2 Location Logical Views

The GPCS Technical Framework must enable the support of the different types of locations where it may be deployed. The Technical Framework provides the ability to support both single site, multi site and mobile environments as shown in the following Figures.

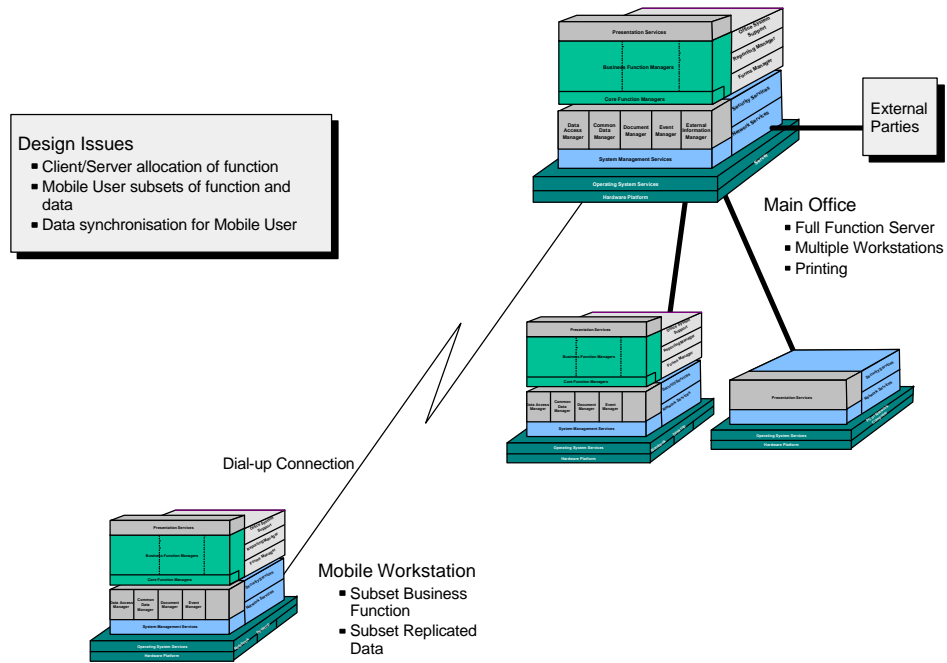


Figure 11 Single Site Practice

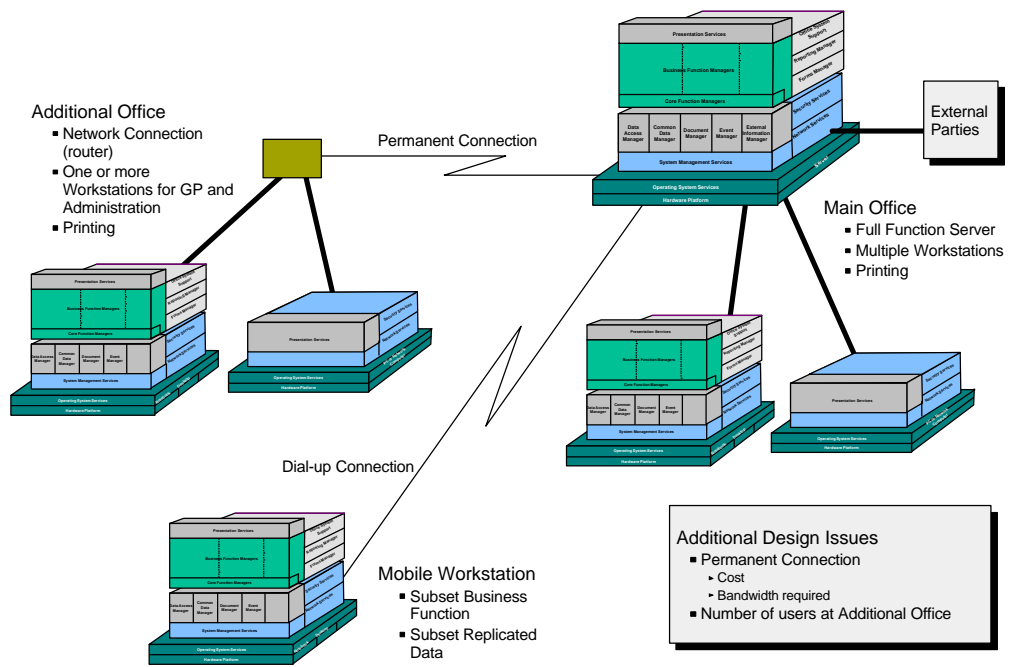


Figure 12 Multi-site Practice

5.6 Technical Standards

Appendix C: Detailed Architecture Building Block Specifications specifies the technical standards applicable to each building block. The following table summarises this information. The scope of this consultancy has not allowed for an exhaustive analysis of all potential standards in the marketplace and the selection between alternative standards.

It is recommended that finalisation of technical standards should take place during the GPCS design phase, using the GPCS Technical Framework Management Process described in *Section 6.0 Technical Implications*. This finalisation of the standards may be carried out by an appropriately constituted body that could be drawn from software developers, government and industry bodies.

The health informatics standards are described elsewhere in the reports from this consultancy.

Building Block	Applicable Technical Standards
Business Functions	
Business Function Managers	None, other than via use of other building blocks.
Core Function Managers	None, other than via use of other building blocks.
Business Support Functions	
Office System Support	<ul style="list-style-type: none"> • Passing fields to the office functions: OLE/ActiveX (Microsoft); JavaBeans (JavaSoft) • Electronic mail applications: MAPI (Microsoft); CMC (XAPIA) • Electronic mail transmission: X.400 (ISO); SMTP, POP-3 (IETF)
Reporting Manager	None, other than via use of other building blocks.
Forms Manager	None, other than via use of other building blocks.
Application Enabling Services	
Common Data Manager	Information model for the Common Data: <ul style="list-style-type: none"> • GEHR Architecture • CEN/TC251 PT1-011 Electronic Healthcare Record Architecture • Australian National Health Data Dictionary API for access to the Common Data: <ul style="list-style-type: none"> • GEHR Exchange Format (GEF) HL7 Version 2.3 Application Protocol for Electronic Data Exchange in Healthcare
Data Access Manager	<ul style="list-style-type: none"> • SQL92 (ISO 9075), SQL CLI (ISO 9075) • ODBC, OLEDB (Microsoft)
Document Manager	<ul style="list-style-type: none"> • HTML, MIME, VRML, HTTP (IETF) SGML
Event Manager	Event Manager API and event services. The following are candidates for the underlying event service: <ul style="list-style-type: none"> • The Object Management Group CORBA services Event Service • Business Quality Messaging (Electronic Messaging Association)

Building Block	Applicable Technical Standards
	Specification of events and message formats: <ul style="list-style-type: none"> • GEHR Exchange Format (GEF) • HL7 Version 2.3 Application Protocol for Electronic Data Exchange in Healthcare • HL7 Reference Information Model and Message Development Framework for HL7 Version 3 • IEEE P115.7 (MEDIX) Standard for Healthcare Data Interchange
External Information Manager	<ul style="list-style-type: none"> • HL7 Version 2.3 Application Protocol for Electronic Data Exchange in Healthcare • IT/14/6 Working Groups (Standards Australia) • DICOM (ACR-NEMA) • EDI UNEDIFACT, ANSI X12 • EFT UNEDIFACT, ANSI X12
Presentation Services	<ul style="list-style-type: none"> • User Interface APIs of the selected platforms • HTML, MIME, VRML, HTTP (IETF)
System Services	
Network Services	<ul style="list-style-type: none"> • Appropriate RFCs describing the current TCP/IP standards for wide area communications • Ethernet LAN protocols :IEEE 802.3
Security Services	<ul style="list-style-type: none"> • AS/NZS 4444:1996 Standard Information Security Management (Standards Australia) • SAA MP 75-1996 Strategies for a Public Key Authentication Framework (Standards Australia) • Public Key Certification X509 • Public key encryption standards.
Systems Management Services	<ul style="list-style-type: none"> • SNMP
System Platform	
Hardware Platform	<ul style="list-style-type: none"> • Intel based processor platforms • RISC based processor platforms
Operating System Services	<ul style="list-style-type: none"> • Microsoft Windows 95, Microsoft Windows NT • Apple Macintosh • Unix operating system in server environment

5.7 Conformance to the GPCS Technical Framework

It is beyond the scope of this report to detail the specifications to a level that would allow for the development of compliant Business Function Managers that will interoperate with one another within the GPCS Technical Framework. The Technical Framework needs to be taken to a logical design level as described in 6.2.2 *Technical Framework Design* in order to specify such compliance criteria.

At the conceptual level the GPCS Technical Framework introduces requirements for conformance in the following areas:

- Conformance with the Architecture Principles listed in *Appendix B*:

Architecture Principles.

- Support for the key functions of the building blocks specified in *Appendix C: Detailed Architecture Building Block Specifications*.
- Use of the Common Data Manager, Event Manager and External Information Manager building blocks for the standardisation of interoperation between components from different suppliers, and between the GPCS and external health systems.

In the development of the GPCS Technical Framework a number of evaluation criteria were established and an evaluation process was described in *Appendix D: Evaluation Criteria and Process*. The criteria and process could be used for the evaluation of components conformance to the GPCS Technical Framework. The criteria and weightings to be applied to various building blocks should be determined as part of the GPCS Technical Framework Management Process described in *6.2.1 Technical Framework Management Process*.

Section 6.0 Technical Implications

6.1 Introduction

In developing the GPCS Technical Framework a number of implications have been identified. Non-technical barriers to implementation are being considered by other phases of the consultancy.

On balance, and recognising both the commercial and practical issues that surround the development, adoption and use of the GPCS, as well as the technical considerations, we believe an initial approach based on a small number of major developers producing a relatively standardised 'middle layer' and a significantly larger number of developers producing business function modules to be the best compromise between the various evaluation issues outlined above.

The key technical barriers to implementation of the GPCS, as discussed below, are:

- The need to establish a process for the ongoing management of the Technical Framework, including the involvement of the GPCS software developers.
- The need to progress the Technical Framework to a logical design level in order to specify compliance criteria and tests for GPCS software.
- The need to build, integrate and test a *GPCS Platform* on which GPCS software developers can deliver their applications (Business Function Managers).
- The need for a secure network infrastructure to support the GPCS.

6.2 Implications of the GPCS Technical Framework

6.2.1 Technical Framework Management Process

The GPCS Technical Framework is intended to have a longer life than the technology components of a particular implementation. A GPCS Technical Framework Management Process is needed. Without this process the Technical Framework will be ignored.

The intent of the management process is to manage the design and evolution of the GPCS Technical Framework and its use by the developers of conforming application software.

To enable the management and maintenance of the Technical Framework a number of processes are required.:

- **A Technical Framework Management Process**
This process for the management of the GPCS Technical Framework, considering business guidance, communicating changes and approving changes and variances to the Technical Framework.
- **A Vitality Process** (change and review): the process by which new

needs and new technologies and standards are assessed and the Technical Framework is enhanced to incorporate them.

- **A Compliance Process** (conformance and deviation): the process by which the Technical Framework is enforced in day to day decision making by users of the framework. This process will normally include a deviation or exception process (including costs and impacts of deviation). For the GPCS it may also include a certification function for assessment of software compliance with the Technical Framework.
- **A Communication Process**: the process by which the Technical Framework is communicated to all of its users. It is essential that all users of the Technical Framework have access to the latest version and that there is a mechanism to make them aware of changes.

6.2.2 Technical Framework Design

The GPCS Technical Framework specified in this report has allocated functions to product-independent architecture building blocks and identified a limited set of interfaces to be used by interoperable Business Function Managers.

However, to provide a detailed specification which will allow these interoperable components to be developed, and to provide specific compliance tests, additional work is required in the following areas:

- Some aspects of the framework must be progressed to a product-specific design level, particularly where product-independent standard interfaces do not exist.
- The scope and format of the Common Data, and of the event notification and external information exchange messages must be defined in a data model, probably allowing for extensions through different release levels.
- Standards need to be selected for the APIs for the Common Data Manager and Event Manager.
- Standards need to be selected to enable interoperability with external services
- Product specific standards and guidelines for the user interface need to be specified.
- Client/server model design guidelines are needed, particularly in relation to an agreed subset of function to be provided in the mobile environment.

6.2.3 GPCS Platform

In order to progress further to a stage of integration testing, an initial *GPCS Platform* is required on which GPCS software developers can deliver their applications (Business Function Managers). The GPCS Platform could be established, for example, by tendering for one or more software developers to undertake the following work:

- High level and detailed design and selection of a set of components to provide the functions of all the GPCS Technical Framework building blocks other than the Business Function Managers. It is possible that some functions could be deferred to a subsequent release.

- Development and testing of the functions of the following building blocks:
 - Core Function Managers
 - Forms Manager
 - Common Data Manager
 - External Information Manager
- Procurement, or development if required, of products to provide the functions of the following building blocks:
 - Office System Support
 - Reporting Manager
 - Data Access Manager
 - Document Manager
 - Event Manager
 - Presentation Services
 - Network Services
 - Security Services
 - Systems Management Services
 - Hardware Platform
 - Operating System Services
- Integration testing of all the above functions into an initial release of the GPCS Platform.

Additional work is required in the following areas:

- Standards need to be agreed for any external interfaces which are in the scope of the initial release, for example message format, communications protocol, security. This work will be impacted by decisions on network infrastructure discussed below.
- Development, testing and certification of one or more Business Function Managers for the initial GPCS release.

6.2.4 Network Infrastructure

A secure network infrastructure is required to support the external communication functions of the GPCS. This infrastructure could be developed in an ad-hoc manner with agreements between individual practices and information / service providers, as has happened to date.

However, such an approach will become a barrier to wide-spread use of a full function GPCS. An alternative, centrally planned, network infrastructure with a “central exchange” function should be considered.

Ad-hoc Network Infrastructure

The deployment of a full function GPCS to practice environments will enable a

practice to connect to the external service of their choice. For example a practice may:

- Utilise multiple pathology services
- Utilise multiple radiology services
- Deal with several hospitals
- Access multiple external information sources and different government departments etc.

Where there are different communication protocols employed by the different organisations the practice incurs an overhead in supporting the multiple protocol stacks and interfaces. Additionally the need for multiple physical communication connections may arise if concurrent access to different services is required.

Similarly, from the medical service provider view point, they have the need to support multiple connections to the various practices. This ad-hoc situation is depicted in *Figure 13 Ad-hoc Network Infrastructure* below.

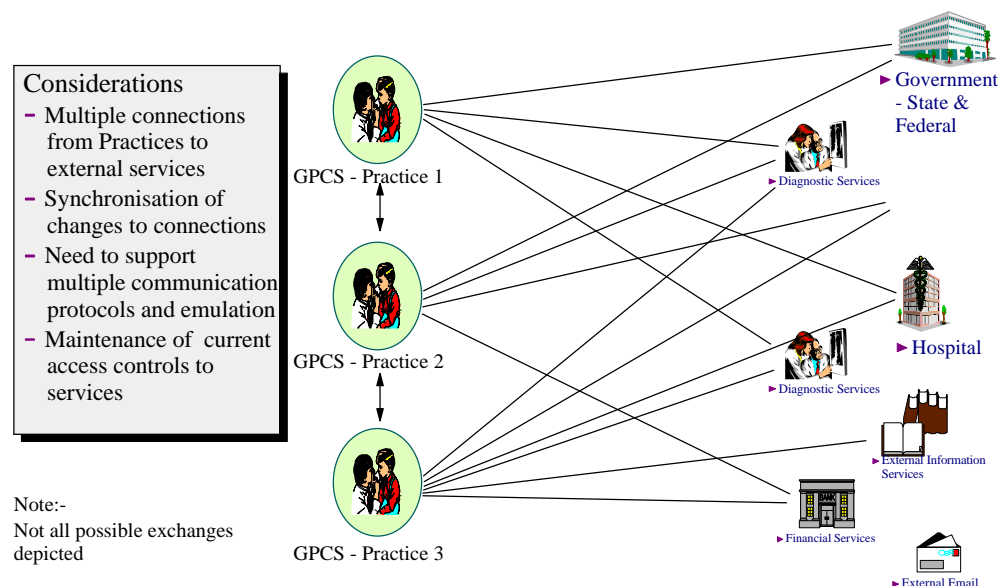


Figure 13 Ad-hoc Network Infrastructure

The Ad-hoc Network raises the following issues which would be a significant barrier to wide-spread use of the GPCS:

- Additional costs and complexity for the practice resulting from multiple connections to service providers.
- The problem of synchronising changes between many practices and many service providers.
- The complexity and potential exposures of managing network security.
- If Internet connections are allowed at the practice level additional security exposures are introduced.

The alternative of implementing uniform communication standards and protocols between all participating organisations would take several years to achieve and the standards would have to be agreed first.

Central Exchange

As an alternative to the ad-hoc or uniform network infrastructure, consideration should be given to the establishment of a “central exchange” function as depicted in *Figure 14 Central Exchange Network Infrastructure* below.

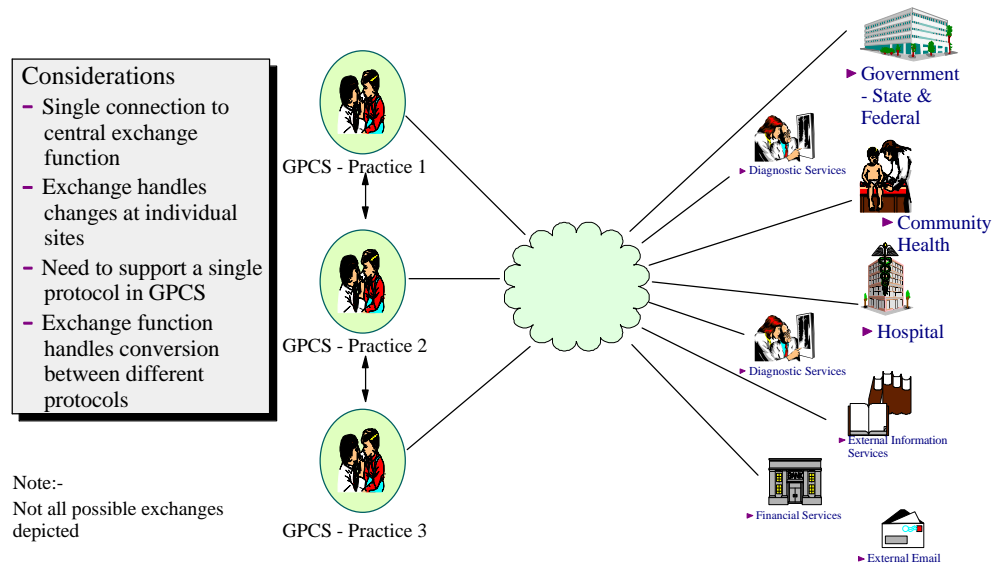


Figure 14 Central Exchange Network Infrastructure

The central exchange handles the exchange of information between the GPs on one side and the information / service providers on the other. The central exchange is analogous to and may use the message broker technology discussed in 4.2.4 *Technology Directions*.

The advantages of this centrally planned network infrastructure include:

- A reduction in the number of communication connections and protocols to be supported on the GPCS platforms.
- Changes made by one provider can be masked from the practices by the central exchange.
- Security can be managed between the exchange and each practice or service provider, rather than the many-to-many relationships.
- A centralised, secured connection to the Internet could be provided.

There is also the potential to centralise some of the functions of the GPCS Technical Framework External Information Manager into the central exchange. This would further reduce the complexity of the GPCS implemented within the practice and increase the isolation of the in-practice system from changes made by providers.

6.3 Steps Required for Detailed Design

It is clearly recognised that detailed technical design of the GPCS needs to be undertaken before further development can proceed.

The objectives of this design are:

- To provide optimal support for delivering the full scope of specified functionality.

- b. To ensure relevance to the technical environment in which the GPCS will operate.
- c. To provide intrinsic robustness and sophistication for the support of functionally rich and transactionally demanding GPCS applications.
- d. To preserve the investments made by software developers and users by selection of strategic, long-lived platforms.

It should be noted that the GPCS Technical Framework specified in this Report has allocated functions to product-independent architecture building blocks and identified a limited set of interfaces to be used by interoperable Business Function Managers. However, to provide a detailed specification which will allow these interoperable components to be developed, and to provide specific compliance tests, additional work is required. This work entails completion of a number of preliminary steps that will be important before the final technical design of the GPCS is concluded:

- Some aspects of the framework must be progressed to a product-specific design level, particularly where product-independent standard interfaces do not exist.
- The scope and format of the Common Data, and of the event notification and external information exchange messages must be defined in a data model, probably allowing for extensions through different release levels.
- Standards need to be selected for the APIs for the Common Data Manager and Event Manager.
- Product specific standards and guidelines for the user interface need to be specified.
- Client/server model design guidelines are needed, particularly in relation to an agreed subset of function to be provided in the mobile environment.

Appendix A: Technical Review Team Members

Technical Review Team

The following people comprised the Technical Review Team

Member	Company
Mr John Barnes	HIC - Senior Technical Specialist – Communications
Mr Derek McGhee	MITA
Drs Tony & Margaret Zahra-Newman	JAM Software
Mr Mark Frances	CPR
Dr Malcolm Ireland	GP & GP Expert Panel Member
Dr Frank Pyefinch	GP and developer of Medical Director
Mr Lionel Richardson	HIC Senior Officer, Pharmaceutical Benefits System
Dr David Rowed	GP & GP Expert Panel Member
Mr Mark Vainshtein	System Analyst - Douglas Hanly Moir

The following IBM Consulting personnel were involved with the development and quality review of the Technical Framework:

IBM Consulting Group:

Position:

Mr. Ross Leighton	Senior Consultant for Technical Framework
Mr. David Sketch	Senior Consultant for Technical Framework
Mr. Paul Clarke	Senior Consultant and Engagement Manager for GPCS project
Dr. David More	Health Industry Specialist for GPCS project
Dr Geoff McDonnell	Managing Consultant

Appendix B: Architecture Principles

Guiding Principles

Several requirements from the Electronic Prescribing consultancy and the GPCS Functional Requirements Specification Report have been used to guide the development of more specific principles for the GPCS Technical Framework. The specific principles are grouped into categories below. The guiding principles are:

- *The ability to offer a scalable solution should be supported by the architecture.*
- *Maximum use of proven low risk and affordable technologies with standards driven approach.*
- *A business function service rather than technology focus should be taken in developing the Technical Framework and in the establishment of the architectural building blocks.*
- *Emphasis on ease of use and enhancement to the General Practitioner's workflow and working practices.*
- *The framework must be standards driven and based, "open", highly flexible and multi-platform.*
- *Emphasis should be placed on developing a Technical Framework that considers cost effectiveness as well as technology aspects.*

Applications

- *Business functions will be divided into groups of related functionality. Within a business function group software developers will determine the program modules and interfaces between modules. The Technical Framework will define interfaces to be used between business function groups.*

Motivation:

Allow the full GPCS functionality to be developed by multiple organisations.

Address the requirement for modularity and interoperability.

Provide GPCS users with the potential for a choice of suppliers of different business functions groups.

Provide implementation flexibility for software developers within a business function group.

Assist developers in converting existing applications to the GPCS Technical Framework.

Implication:

Business Function groups must be defined.

As the number of defined groups increases the scope of interface definitions and use of interfaces will also increase.

Conformance testing, maintenance and enhancement of the Technical Framework will be required.

Applications must conform with the interfaces defined in the GPCS Technical Framework and in the subsequent design of the GPCS technical infrastructure.

- *Application logic should be separate from business rules to facilitate tailoring to individual and future client needs.*

Motivation:

Allow for easier introduction of practice specific requirements.

Faster adaptation of applications to client needs.

Implication:

Application development time may increase initially to implement the new approach.

Effort will be required to develop and maintain the business rules.

- *Applications will meet GPCS defined criteria for ease of learning, use, and support.*

Motivation:

Increase user productivity and acceptance of application functions.

Reduce support costs.

Decrease user training costs.

Improve user support.

Implication:

Useability standards and measurement practices will need to be defined.

User involvement is required during development or acquisition to ensure useability.

Guidelines need to be provided to evaluate the quality of applications.

- *Applications will use the standard interfaces and protocols for Application Enabling and System Services defined in the Technical Framework.*

Motivation:

Enable changes in the implementation of these services without negatively impacting applications.

Minimise the number of distinct components required to implement these services for the full range of GPCS functionality.

Simplify creating external interfaces.

Implication:

Standard interfaces and protocols covering the Application Enabling and System Services need to be selected or defined.

Applications must conform with the interfaces defined in the GPCS Technical Framework and in the subsequent design of the GPCS technical infrastructure.

Data

- *Data should be captured once at the point of creation, and stored and managed, with integrity checking and provenance, to enable appropriate levels of sharing across the practice environment.*

Motivation:

Improve data accuracy and integrity.

Provide an audit trail of the source and changes to data.

Reduce data entry time.

Increase quality and consistency of business information.

Implication:

Data which is shared between business function groups will need to be identified and access to this shared data will need to be standardised.

Applications will need to use the standard data access interface.

As the scope of shared data increases, systems management issues will need to be addressed, for example performance, security, etc.

- *Common Data, data which is shared between business function groups, will be structured to represent the business entity (for example, provider, beneficiary, benefit, etc.). The structure of common data is independent of the applications. Common data will conform to defined common data models and data formats and will be accessed using a standardised interface.*

Motivation:

Allow the full GPCS functionality to be developed by multiple organisations.

Address the requirement for modularity and interoperability.

Allow the scope of the Common Data to be increased incrementally with a minimal impact on existing applications.

Implication:

Common Data will need to be defined and modelled and a standard interface will need to be defined.

Applications will need to use the standard interface for access to Common Data.

Security and Privacy

- *Security facilities must be comprehensive and ensure the privacy of data during its storage and transmission between points.*

Motivation:

Ensure appropriate level of privacy is applied to medical and personal information.

Ensure data assets are protected.

Increase productivity of users.

Ensure client comfort with level of security.

Implication:

Security standards need to be maintained and enforced.

Applications areas will need to utilise security functions.

Systems Management

- *Systems will be designed to provide responsiveness, utilisation, throughput, and*

capacity performance measurements.

Motivation:

Improve the quality of service to users and clients.

Optimise performance of systems.

Implication:

A mechanism for monitoring and analysing the data will need to be developed.

Staff will need to be trained in these processes.

Data will have to be collected and analysed on an on-going basis.

Service levels will need to be defined and agreed to.

- *The system developed should provide system management functions to enable the delivery of a reliable and manageable infrastructure*

Motivation:

Improve the quality and delivery of service to users.

Implication:

System management functions and applications need to be incorporated into products and infrastructure design

Additional expense will be incurred in establishing the infrastructure to support the systems management functions.

User Interface

- *Each user will be provided a consistent, tailorable, and easy to use interface.*

Motivation:

Faster adaptation to new applications through a consistent user interface.

Portability of skills between different systems.

Personal productivity increases through a user tailored "desktop".

Reduce training costs and learning time.

Implication:

This requires the definition of and agreement to user interface standards.

Each user will need access to an appropriate workstation and training to use the new interface.

Effort will be required to develop a conforming interface to legacy systems.

- *Application systems will be delivered to users through a single workstation on their desktop.*

Motivation:

Increase user productivity and morale

Reduce user training and support cost

Implication:

May require use of intelligent workstations or application integration efforts

May require replacement of some existing equipment including workstations, cabling, and network equipment to provide the required application access.

Use of standards

- *Ease of interface between internal and external systems will be sought through use of healthcare and technology industry standards.*

Motivation:

Increase the range of options for clients, carriers, and suppliers

Reduce the time and cost of interfacing to new clients, carriers and suppliers

Implication:

A wide range of standards may need to be supported to meet the needs of diverse external systems

Broad access by external systems will require more stringent security guidelines and rigorous security administration

Standards for system interface will need to be identified and communicated to internal and external users

At a minimum, industry standards will need to be monitored as they are developed

- *Industry **de jure or de facto** standards will be used, when they exist and meet the business defined needs.*

Motivation:

Minimise investment risk.

Increase useful life.

Increase the range of options for clients, suppliers and carriers.

Enable external interfaces.

Implication:

Specific feature and functionality requirements may need to be compromised.

Specific standards will need to be selected.

Networking

- *Standardised networking services will be utilised reducing the need for applications to be aware of the underlying networking facilities and protocols.*

Motivation:

Reduce complexity of external clients and carriers interfaced to / from GPCS .

Reduce implementation time required for client and carrier startups.

Implication:

The network functions must be able to support many external interfaces

Problem determination and resolution standards will need to be developed

Broad access by external systems will require more stringent security guidelines and rigorous security administration

Standards for system interface will need to be identified and communicated to

internal and external users

Industry standards for connectivity will need to be monitored and incorporated as appropriate into the interface standards

Appendix C: Detailed Architecture Building Block Specifications

Building Blocks within the Technical Framework

The Technical Framework is composed of a number of building blocks, as described earlier in *Section 5.0 Recommended Technical Framework and Architecture*. The following tables describe each of the building block in a greater level of detail.

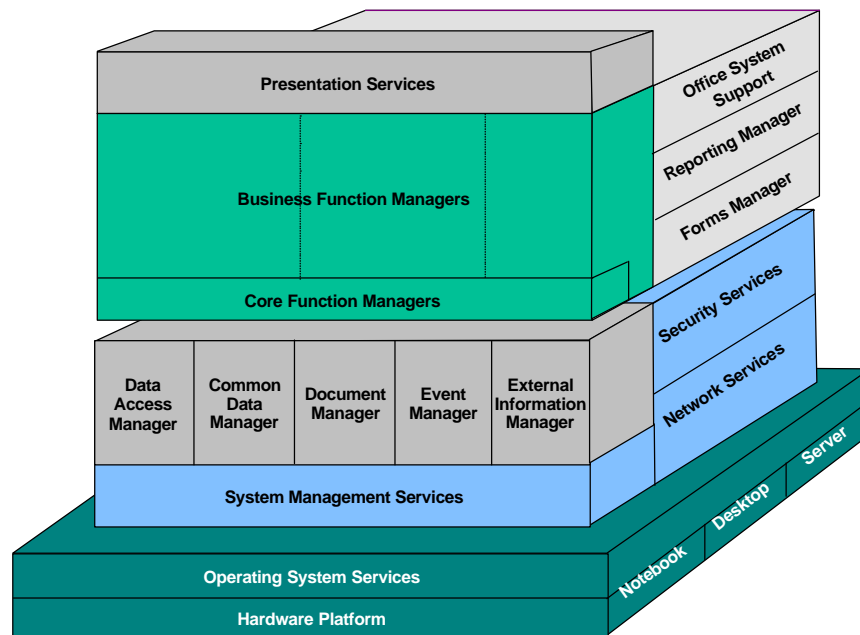


Figure 15 Technical Framework Building Blocks

Business Function Managers

Major Category:	Business Functions
Building Block:	Business Function Managers
<p>Purpose:</p> <ul style="list-style-type: none"> To provide the primary business functions of the GPCS. <p>Description:</p> <ul style="list-style-type: none"> The business functions will be divided into groups of related functions, such as Practice Administration and areas of Clinical Services, during the GPCS design phase. In the design phase for an initial GPCS a relatively small number of business function building blocks and a limited set of Common Data are likely to be defined. <p>Rationale:</p> <ul style="list-style-type: none"> The grouping of business functions into different building blocks enables multiple organisations to develop different parts of the GPCS business function. A coarse-grained approach with a limited number of business function building blocks should make it easier for software vendors to modify their existing applications to comply with the GPCS requirements. <p>Technical Constraints / Dependencies:</p> <ul style="list-style-type: none"> GPCS software developers must conform to the defined interfaces for the linkages below. <p>Linkages to Other GPCS Building Blocks:</p> <ul style="list-style-type: none"> Presentation Services Common Data Manager Data Access Manager Event Manager Document Manager 	

Functional Requirements:	
Function	Description
Key Requirements	<ul style="list-style-type: none"> As specified in the GPCS Functional Requirements Specification. Use of the Building Block APIs for the linkages specified above.
Users	<ul style="list-style-type: none"> Support all General Practice users.
Technology Options	
Interfaces Provided	<ul style="list-style-type: none"> Not applicable
Data Characteristics	<ul style="list-style-type: none"> GPCS Common Data accessed via the Common Data Manager. Storage and retrieval of recoverable, up-dateable data that is not GPCS Common Data accessed via the Data Access Manager. Access to reference data which is not GPCS Common Data may use the Data Access Manager or Operating System Services.
Operating System	<ul style="list-style-type: none"> GPCS Client and Server
Platform	<ul style="list-style-type: none"> GPCS Notebook, GPCS Desktop, GPCS Server
Connection Requirements	<ul style="list-style-type: none"> Communication between the client and server components of a single Business Function Manager is via a protocol supported by Operating System and Network Services. Communication with other Business Function Managers, Core Function Managers, or External Information Manager is via the Common Data Manager and/or Event Manager.
Standards	<ul style="list-style-type: none"> Refer to the specifications for the Building Blocks with which there are linkages.
Principles	<ul style="list-style-type: none"> Business functions will be divided into groups of related functionality. Applications will use the standard interfaces and protocols for Application Enabling and Systems Services defined in the GPCS Technical Framework.
Additional Comments	

Core Function Managers

Major Category:	Business Functions
Building Block:	Core Function Managers
<p>Purpose:</p> <ul style="list-style-type: none"> • To maintain the Common Data of the GPCS. <p>Description:</p> <ul style="list-style-type: none"> • The Core Function Managers include, for example, the capability to capture and maintain the patient minimum data set needed for operation of the GPCS. • They may also handle the selection of a patient using flexible search criteria, and the display of patient demographic data for the selected patient. <p>Rationale:</p> <ul style="list-style-type: none"> • Provision of core functions separately from the majority of the business function provides more flexibility in the selection of one or more business function components for a particular practice's GPCS. <p>Technical Constraints / Dependencies:</p> <ul style="list-style-type: none"> • The Core Function Managers must conform to the defined interfaces for the linkages below. <p>Linkages to Other GPCS Building Blocks:</p> <ul style="list-style-type: none"> • Presentation Services • Common Data Manager • Data Access Manager • Event Manager • Document Manager 	

Functional Requirements:	
Function	Description
Key Requirements	<ul style="list-style-type: none"> As specified in the GPCS Functional Requirements Specification in relation to maintenance of the data that is specified as Common Data during the GPCS design phase. Use of the Building Block APIs for the linkages specified above.
Users	<ul style="list-style-type: none"> Support all General Practice users.
Technology Options	
Interfaces Provided	<ul style="list-style-type: none"> Not applicable
Data Characteristics	<ul style="list-style-type: none"> Not applicable
Operating System	<ul style="list-style-type: none"> GPCS Client and Server
Platform	<ul style="list-style-type: none"> GPCS Notebook, GPCS Desktop, GPCS Server
Connection Requirements	<ul style="list-style-type: none"> Communication between the client and server components of a single Core Function Manager is via a protocol supported by Operating System and Network Services. Communication with other Business Function Managers, Core Function Managers, or External Information Manager is via the Common Data Manager and/or Event Manager.
Standards	<ul style="list-style-type: none"> Refer to the specifications for the Building Blocks with which there are linkages.
Principles	<ul style="list-style-type: none"> Business functions will be divided into groups of related functionality. Applications will use the standard interfaces and protocols for Application Enabling and Systems Services defined in the GPCS Technical Framework.
Additional Comments	

Forms Manager

Major Category:	Business Support Functions
Building Block:	Forms Manager
<p>Purpose:</p> <ul style="list-style-type: none"> To provide a standardised tool for the generation of forms templates and the completion of forms. <p>Description:</p> <ul style="list-style-type: none"> This building block supports the Forms Generation requirements of the GPCS Functional Requirements Specification Report such as for diagnostic services ordering and private health insurance. It may also provide the capability to produce patient clinical summary information based on templates, as specified in the Clinical Summary Report Generation requirements. Forms may be completed through the inclusion of data from the Electronic Health Record and other data managed by the Data Access Manager, and through user entry of additional fields and free form text. Completed forms may be printed or transmitted electronically. Business Function Managers may supply their own forms management functions for forms templates supplied with the Business Function Manager. However, for forms where the templates are to be generated or modified by the GPCS user the preferred implementation is to use the word processor component of Office System Support for the generation and completion of the forms <p>Rationale:</p> <ul style="list-style-type: none"> Provides a consistent approach for the GPCS user for the generation of templates and the completion of forms using a familiar word processing tool. <p>Technical Constraints / Dependencies:</p> <ul style="list-style-type: none"> Not applicable. <p>Linkages to Other GPCS Building Blocks:</p> <ul style="list-style-type: none"> Office System Support for the generation of templates, completion of forms and electronic mailing of forms. Presentation Services. Security Services for digital signature. 	

Functional Requirements:	
Function	Description
Key Requirements	<ul style="list-style-type: none"> • Capability to generate, manage and modify a set of form templates. • Capability to complete forms from a template using data from the Electronic Health Record and other data managed by the Data Access Manager, and user data entry, including free form text. • Capability to electronically sign documents. • Other requirements of the Forms Generation manager of the Functional Requirements Specification. • Capability to complete forms which represent various patient clinical summaries (Clinical Summary Report Generation requirements)
Users	<ul style="list-style-type: none"> • Support all General Practice users.
Technology Options	
Interfaces Provided	<ul style="list-style-type: none"> • Not applicable
Data Characteristics	<ul style="list-style-type: none"> • Not applicable
Operating System	<ul style="list-style-type: none"> • GPCS Client
Platform	<ul style="list-style-type: none"> • GPCS Notebook, GPCS Desktop
Connection Requirements	<ul style="list-style-type: none"> • Not applicable
Standards	<ul style="list-style-type: none"> • Not applicable
Principles	<ul style="list-style-type: none"> • Applications will use the standard interfaces and protocols for Application Enabling and Systems Services defined in the Technical Framework
Additional Comments	

Office System Support

Major Category:	Business Support Functions
Building Block:	Office System Support
<p>Purpose:</p> <ul style="list-style-type: none"> To provide industry standard support for the office system functions commonly applicable to General Practice and also required by other GPCS functions. <p>Description:</p> <ul style="list-style-type: none"> Office System Support provides word processing, spreadsheet, charting and electronic mail functions. Through customisation of the word processing capability it also supports the Forms Generation requirements of the GPCS Functional Requirements Specification Report. <p>Rationale:</p> <ul style="list-style-type: none"> Enables the GP to use the same office functions within the GPCS and for other stand-alone usage. The GP can also choose to use other software, within the constraints of the selected GPCS operating system and hardware platform. <p>Technical Constraints / Dependencies:</p> <ul style="list-style-type: none"> Not applicable <p>Linkages to Other GPCS Building Blocks:</p> <ul style="list-style-type: none"> Word processor, spreadsheet and charting functions used by the Reporting Manager. Electronic mail function used by the External Information Manager and other Business Functions and Business Support Functions. Presentation Services Common Data Manager and Data Access Manager for filling in forms templates with GPCS Common Data. Document manager for retrieval and storage of documents. Network Services for Electronic mail 	

Functional Requirements:	
Function	Description
Key Requirements	<ul style="list-style-type: none"> • Range of functions of the leading PC Office suites, including word processing, spreadsheet and charting functions and integration with electronic mail. • Capability to define form templates and fill in forms through a combination of program access to data and entry of fields through Presentation Services. Refer to the Forms Manager requirements. • Capability to send and receive electronic mail, including MIME data types both within and external to the practice.
Users	<ul style="list-style-type: none"> • Support all General Practice users.
Technology Options	
Interfaces Provided	<ul style="list-style-type: none"> • Standardised interfaces for passing fields to the office functions. • Standardised interface for creating and retrieving electronic mail items from a program. • Standard interfaces for transmission of electronic mail.
Data Characteristics	<ul style="list-style-type: none"> • Not applicable
Operating System	<ul style="list-style-type: none"> • GPCS Client
Platform	<ul style="list-style-type: none"> • GPCS Notebook, GPCS Desktop
Connection Requirements	<ul style="list-style-type: none"> • Communication between the client and server components of Office System Support (eg for E-mail) is via a protocol supported by Operating System and Network Services.
Standards	<ul style="list-style-type: none"> • Passing fields to the office functions: OLE/ActiveX (Microsoft); JavaBeans (JavaSoft) • Electronic mail applications: MAPI (Microsoft); CMC (XAPIA) • Electronic mail transmission: X.400 (ISO); SMTP, POP-3 (IETF)
Principles	<ul style="list-style-type: none"> • Industry de jure or de facto standards will be used, when they exist and meet the business defined needs.
Additional Comments	

Reporting Manager

Major Category:	Business Support Functions
Building Block:	Reporting Manager
<p>Purpose:</p> <ul style="list-style-type: none"> To produce ad-hoc and routine reports from the GPCS for the GPCS. <p>Description:</p> <ul style="list-style-type: none"> The Reporting Manager provides ad-hoc and routine reporting for the GPCS including: <ul style="list-style-type: none"> Clinical management, based on data defined by the Electronic Health Record Administration / Practice Management, based on data defined by the Patient Financial Record <p>Rationale:</p> <ul style="list-style-type: none"> A consistent means of querying and reporting on data in the GPCS. It avoids the need to develop specific reports using different tools and languages in the different Business Function building blocks of the GPCS. <p>Technical Constraints / Dependencies:</p> <ul style="list-style-type: none"> The data to be used by the Reporting Manager must be stored by the Data Access Manager and descriptions of the data content appropriate to the GPCS users must be made available to the Reporting Manager's data dictionary. <p>Linkages to Other GPCS Building Blocks:</p> <ul style="list-style-type: none"> Data Access Manager Office System Support for passing report data to office tools and to electronic mail. Presentation Services 	

Functional Requirements:	
Function	Description
Key Requirements	<ul style="list-style-type: none"> • Ability to access the data stored by the Data Access Manager. • Data dictionary for user reference. • Interactive report designer with the capability to use pre-designed reports as templates for new reports. • Capability to produce reports on screen, on paper, to a file, in HTML, or passed to the Office System Support tools. • Other requirements in the Ad-hoc and Routine Clinical Management Reporting and Administration / Practice Management Reporting managers of the GPCS Functional Requirements Specification Report.
Users	<ul style="list-style-type: none"> • Support all General Practice users.
Technology Options	
Interfaces Provided	<ul style="list-style-type: none"> • Not applicable
Data Characteristics	<ul style="list-style-type: none"> • Not applicable
Operating System	<ul style="list-style-type: none"> • GPCS Client
Platform	<ul style="list-style-type: none"> • GPCS Notebook, GPCS Desktop
Connection Requirements	<ul style="list-style-type: none"> • Not applicable
Standards	<ul style="list-style-type: none"> • None identified
Principles	<ul style="list-style-type: none"> • Not applicable
Additional Comments	

Common Data Manager

Major Category:	Application Enabling Services
Building Block:	Common Data Manager
<p>Purpose:</p> <ul style="list-style-type: none"> To provide management of and access to the GPCS Common Data (ie that data which is shared between multiple Business Function building blocks). <p>Description:</p> <ul style="list-style-type: none"> The Common Data Manager provides access to the underlying Common Data via an API which hides the database structure from the GPCS applications. The GPCS Common Data includes a subset of the: <ul style="list-style-type: none"> Electronic Health Record (Computerised Patient Record grouping of the GPCS Functional Requirements Specification Report) Patient Financial Record (Computerised Patient Record grouping) Reference Databases grouping <p>Rationale:</p> <ul style="list-style-type: none"> Supports the requirement for modularity and interoperability. <p>Technical Constraints / Dependencies:</p> <ul style="list-style-type: none"> A GPCS Common Data model and API must be defined and agreed. <p>Linkages to Other GPCS Building Blocks:</p> <ul style="list-style-type: none"> Mandatory use by all Business Functions Managers, Core Function Managers and Business Support Functions which access GPCS Common Data. Data Access Manager for database services. 	

Functional Requirements:	
Function	Description
Key Requirements	<ul style="list-style-type: none"> • Provision of a standardised API for access to GPCS Common Data. • Encapsulation of the full GPCS Common Data model so that a Business Function needs knowledge of only the subset of Common Data applicable to its function, and has no visibility of the underlying database structure.
Users	<ul style="list-style-type: none"> • None.
Technology Options	
Interfaces Provided	<ul style="list-style-type: none"> • Common Data access API to be defined with reference to the standards below.
Data Characteristics	<ul style="list-style-type: none"> • To be defined in a GPCS Common Data model with reference to the standards below.
Operating System	<ul style="list-style-type: none"> • GPCS Client and Server
Platform	<ul style="list-style-type: none"> • GPCS Notebook, Desktop and Server
Connection Requirements	<ul style="list-style-type: none"> • Not applicable
Standards	<p>Information model for the Common Data:</p> <ul style="list-style-type: none"> • GEHR Deliverable 19; CEN/TC251 PT1-011 Electronic Healthcare Record Architecture; Australian National Health Data Dictionary <p>API for access to the Common Data:</p> <ul style="list-style-type: none"> • GEHR Exchange Format (GEF); HL7 Version 2.3 Application Protocol for Electronic Data Exchange in Healthcare
Principles	<ul style="list-style-type: none"> • Business Functions will be divided into groups of related functionality • Applications will use the standard interfaces and protocols for Application Enabling and Systems Services defined in the Technical Framework • Industry de jure or de facto standards will be used, when they exist and meet the business defined needs.
Additional Comments	

Data Access Manager

Major Category:	Application Enabling Services
Building Block:	Data Access Manager
<p>Purpose:</p> <ul style="list-style-type: none"> To provide an industry standard function for database management in the GPCS. <p>Description:</p> <ul style="list-style-type: none"> The Data Access Manager provides industry standard Application Programming Interfaces (APIs) for GPCS applications to access data stored in databases. It delivers the basic system functionality required to create, update and maintain databases while safeguarding the integrity and security of the data. All data which is updated in the GPCS, including the Common Data, should be stored on a server database managed by the Data Access Manager. <p>Rationale:</p> <ul style="list-style-type: none"> Avoids the need for multiple database systems specific to individual applications. By providing a single function for managing the integrity and security of the data it addresses the key requirements of reliability, system support and security. <p>Technical Constraints / Dependencies:</p> <ul style="list-style-type: none"> Not applicable <p>Linkages to Other GPCS Building Blocks:</p> <ul style="list-style-type: none"> Used by GPCS Common Data Manager for storage and retrieval of all GPCS Common Data. Mandatory use by Business Function Managers for storage and retrieval of recoverable, up-dateable data that is not GPCS Common Data. Optional use by Business Functions for retrieval of reference data which is not GPCS Common Data. Network Services for client/server communication. 	

Functional Requirements:	
Function	Description
Key Requirements	<ul style="list-style-type: none"> • An industry standard API for data access services, including support for stored procedures. • Two-way replication of data between a server and client database for mobile support.
Users	<ul style="list-style-type: none"> • None.
Technology Options	
Interfaces Provided	<ul style="list-style-type: none"> • Compiled SQL and an SQL call level interface.
Data Characteristics	<ul style="list-style-type: none"> • Both structured (relational) and large objects data should be supported. Support of the requirements of the Document Manager storage functions would avoid a separate system component.
Security	<ul style="list-style-type: none"> • Capability to encrypt data stored in the database • Capability to restrict access to data down to the data element level by an individual or group of users.
Integrity and Reliability	<ul style="list-style-type: none"> • Support for a unit of work to ensure that changes to the database are not made final until all aspects of the change are complete. • Capability to maintain the database in a consistent state following a system restart. • Support for multiple concurrent users (up to 200 in a very large practice). • Capability to run integrity checks and to correct any errors found in the database.
Operating System	<ul style="list-style-type: none"> • GPCS Client and Server
Platform	<ul style="list-style-type: none"> • GPCS Notebook, Desktop and Server
Connection Requirements	<ul style="list-style-type: none"> • Access to a shared server database using the standard API on a client workstation connected to the server via a protocol supported by Operating System and Network Services.
Standards	<ul style="list-style-type: none"> • SQL92 (ISO 9075), SQL CLI (ISO 9075), ODBC, OLEDB (Microsoft)
Principles	<ul style="list-style-type: none"> • Industry de jure or de facto standards will be used, when they exist and meet the business defined needs.
Additional Comments	

Document Manager

Major Category:	Application Enabling Services
Building Block:	Document Manager
<p>Purpose:</p> <ul style="list-style-type: none">• To manage both written and electronic documents within the GPCS. <p>Description:</p> <ul style="list-style-type: none">• The Document Manager maintains a database of electronic documents, an index of all documents, and provides a full text search capability.• It also provides the capability to store and transfer objects using World Wide Web standards. <p>Rationale:</p> <ul style="list-style-type: none">• Supports the Document Management requirements, including document scanning, of the GPCS Functional Requirements Specification Report• World Wide Web technology has become the de-facto standard for publishing and accessing documents electronically. Most word processor and other PC tools can produce HTML versions of documents. <p>Technical Constraints / Dependencies:</p> <ul style="list-style-type: none">• Not applicable <p>Linkages to Other GPCS Building Blocks:</p> <ul style="list-style-type: none">• Use by the Web Browser component of Presentation Services.• Network Services for client/server communication.	

Functional Requirements:	
Function	Description
Key Requirements	<ul style="list-style-type: none"> • Document scanning, storage, indexing and full text search capabilities to support the Document Manager requirements of the Functional Requirements Specification. • An Image viewer if image formats other than those supported by the Web Browser of Presentation Services are required. • HTTP access to HTML and MIME data types.
Users	<ul style="list-style-type: none"> • Image viewer component used by all General Practice users.
Technology Options	
Interfaces Provided	<ul style="list-style-type: none"> • HTTP access to HTML and MIME data types.
Data Characteristics	<ul style="list-style-type: none"> • Text and large objects.
Operating System	<ul style="list-style-type: none"> • GPCS Server • GPCS Client for a proprietary document viewer/editor
Platform	<ul style="list-style-type: none"> • GPCS Server • GPCS Client for a proprietary document viewer/editor
Connection Requirements	<ul style="list-style-type: none"> • Client/server communication between Web Browser and Server via HTTP. • Client/server communication between a proprietary image viewer/editor (if required) and the Server via a protocol supported by Operating System and Network Services.
Standards	<ul style="list-style-type: none"> • HTML, MIME, VRML, HTTP (IETF) SGML
Principles	<ul style="list-style-type: none"> • Industry de jure or de facto standards will be used, when they exist and meet the business defined needs.
Additional Comments	

Event Manager

Major Category:	Application Enabling Services
Building Block:	Event Manager
<p>Purpose:</p> <ul style="list-style-type: none"> To allow one GPCS program to send information representing the occurrence of an event to another GPCS program. <p>Description:</p> <ul style="list-style-type: none"> The Event Manager provides a one-way communication mechanism for one program to send information to another program. For example the Diagnostic Services Communication Manager will need to notify a Diagnostic Tests Business Function of the receipt of test results. It supports communication between programs running on different System Platforms (eg between a Business Function program running on a client and an External Information Manager program running on a server). It provides for the queuing of information for later delivery to the destination program should the underlying platform connection be unavailable. <p>Rationale:</p> <ul style="list-style-type: none"> Decouples the communication between GPCS programs to support the requirement for modularity and interoperability in a client/server environment. Simplifies the Business Functions and provides for flexibility in client/server configurations. <p>Technical Constraints / Dependencies:</p> <ul style="list-style-type: none"> The specific events, event messages, and Event Manager interface must be defined and agreed (see Standards below). <p>Linkages to Other GPCS Building Blocks:</p> <ul style="list-style-type: none"> Use by any GPCS program needing to notify another program of an event. Network Services for client/server communication. 	

Functional Requirements:	
Function	Description
Key Requirements	<ul style="list-style-type: none"> Support for an industry standard API for event services.
Users	<ul style="list-style-type: none"> None
Technology Options	
Interfaces Provided	<ul style="list-style-type: none"> Event Manager API to be defined with reference to the standards below.
Data Characteristics	<ul style="list-style-type: none"> Event Manager should understand only the event type and destination information. It should be capable of passing any type of embedded data between the programs.
Operating System	<ul style="list-style-type: none"> GPCS Client and Server
Platform	<ul style="list-style-type: none"> GPCS Notebook, Desktop and Server
Connection Requirements	<ul style="list-style-type: none"> Client/server communication between Event Managers via a protocol supported by Operating System and Network Services.
Standards	<p>Event Manager API and event services:</p> <ul style="list-style-type: none"> The Object Management Group CORBA services Event Service, and the new Business Quality Messaging (Electronic Messaging Association) are candidates for the underlying event service. <p>Specification of events and message formats (formats not significant to the Event Manager):</p> <ul style="list-style-type: none"> GEHR Exchange Format (GEF) HL7 Version 2.3 Application Protocol for Electronic Data Exchange in Healthcare; HL7 Reference Information Model; Message Development Framework for HL7 Version 3; IEEE P115.7 (MEDIX) Standard for Healthcare Data Interchange
Principles	<ul style="list-style-type: none"> Industry de jure or de facto standards will be used, when they exist and meet the business defined needs.
Additional Comments	

External Information Managers

Major Category:	Application Enabling Services
Building Block:	External Information Managers
<p>Purpose:</p> <ul style="list-style-type: none"> Provides the interface to external information sources and services and the handling of message formatting in support of the application level communication standards. <p>Description:</p> <ul style="list-style-type: none"> The functions to handle the exchange of information and data with external health services, diagnostic service providers and health related information sources are provided. Prepare message for transmission in format appropriate for destination services / system. Provide the control functions for access to external sites and for remote users access to GPCS. <p>Rationale:</p> <ul style="list-style-type: none"> Consolidate the handling of message formatting and translation in one area to remove the need for other functional areas having to understand all possible message formats. Provide a single point for control of access to services external to the GPCS. Provide a single point for control of access to GPCS from external systems or remote users. <p>Technology Constraints / Dependencies:</p> <ul style="list-style-type: none"> The set of interfaces and communications standards to be supported (message, protocol and security) needs to be defined and agreed with the corresponding parties. <p>Linkages to Other GPCS Building Blocks:</p> <ul style="list-style-type: none"> Common Data Manager Event Manager Document Manager Networking Services for external communication. 	

Functional Requirements:	
Function	Description
Key Requirements	<ul style="list-style-type: none"> • Provides data conversion functions to map data messages between the format of the GPCS Common Data Manager and the format required by the external service • Receiving functions for diagnostic reports and health related information. • Alerting function when results or messages are received and the ability to store the information in a temporary (suspense) file until acted upon by GP or appropriate staff. • Ability to record and track request for external services and the receipt of related results / reports. • Support exchange of messages and data with Hospitals, Financial Institutions, Government bodies (Health Insurance Commission) and other medical practices, for example HIC MedClaims. • Ensure secure transmission of the information by utilising functions from the Security Services building block. • Provide access to external services such as Email and Internet based services allowing the exchange of notes and files. Access to Bulletin Board and News Group services is required • Support for both message based and file based data transfer between GPCS and external locations. • Support for message and data exchange between multi-site practices.
Users	<ul style="list-style-type: none"> • None
Technology Options	
Interfaces Provided	<ul style="list-style-type: none"> • Not applicable
Data Characteristics	<ul style="list-style-type: none"> • The External Information Manager deals with data at a field level to transform messages to the appropriate formats. Large objects are also handled.
Operating System	<ul style="list-style-type: none"> • GPCS Server
Platform	<ul style="list-style-type: none"> • GPCS Server
Connection Requirements	<ul style="list-style-type: none"> • Uses Network Services for external communication.
Standards	<ul style="list-style-type: none"> • HL7 Version 2.3 Application Protocol for Electronic Data Exchange in Healthcare • DICOM (ACR-NEMA) • IT/14/6 Working Groups (Standards Australia) • EDI UNEDIFACT, ANSI X12 • EFT UNEDIFACT ANSI X12

Principles	<ul style="list-style-type: none">• Ease of interface between internal and external systems will be sought through the use of healthcare and technology industry standards• Industry de jure or de facto standards will be used, when they exist and meet the business defined needs
Additional Comments	<ul style="list-style-type: none">• There will be an ongoing need to monitor the development standards in the Health Informatics areas and to update the standards supported by the External Information Manager.• Monitoring of messaging standards in the financial and communications arenas should also be carried out on an ongoing basis (once every 12-18 months).

Presentation Services

Major Category:	Application Enabling Services
Building Block:	Presentation Services
<p>Purpose:</p> <ul style="list-style-type: none"> To present application and operating system information to users of GPCS through a consistent, tailorable and easy to use interface. <p>Description:</p> <ul style="list-style-type: none"> Presentation Services support the presentation of application and operating system information to the users of GPCS through industry standard presentation interfaces. Included are functions to present graphical, text and image data. Multimedia data, meaning two or more media, one of which is a time based digital medium: audio, animation or video, would also be included in this building block if required. The user interface of Business Functions and Business Support Functions should conform to the generally accepted guidelines for the underlying platform (eg Microsoft's Interface Guidelines for Software Design for Microsoft Windows implementations). The HTML and Web Browser interface is also supported. <p>Rationale:</p> <ul style="list-style-type: none"> Provides the GPCS user with consistency in the interface with the Business Functions. Supports the User Interface Architecture Principle. The Web browser interface is widely used to access the World Wide Web and HTML has become the standard for publishing information on the Internet. This interface may be an appropriate interface for a number of the information access functions of the GPCS, in addition to its use for Internet access. <p>Technical Constraints / Dependencies:</p> <ul style="list-style-type: none"> User interface standards must be defined and agreed. <p>Linkages to Other GPCS Building Blocks:</p> <ul style="list-style-type: none"> Mandatory use by all Business Functions, Business Support Functions, Application Enabling and System Services that present information to a GPCS user. Network Services for the Web Browser to communicate with the Document Manager. Operating System Services for interfacing with the Hardware Platform and possibly for providing the API support (eg Windows). 	

Functional Requirements:	
Function	Description
Key Requirements	<ul style="list-style-type: none"> • Support for the industry standard graphical user interfaces. • Support for Web Browser functions including handling HTML, GIF and JPEG data types, and Java and ActiveX program execution.
Users	<ul style="list-style-type: none"> • Support all General Practice users.
Technology Options	
Interfaces Provided	<ul style="list-style-type: none"> • User Interface API - typically platform specific • HTML/HTTP Web Browser Interface to the Web Server
Data Characteristics	<ul style="list-style-type: none"> • Not applicable
Operating System	<ul style="list-style-type: none"> • GPCS Client
Platform	<ul style="list-style-type: none"> • GPCS Notebook, GPCS Desktop
Connection Requirements	<ul style="list-style-type: none"> • Client/server connection required for a distributed presentation model.
Standards	<ul style="list-style-type: none"> • User Interface APIs of the selected platforms • HTML, MIME, VRML, HTTP (IETF) SGML
Principles	<ul style="list-style-type: none"> • Each user will be provided a consistent, tailorable, and easy to use interface. • Industry de jure or de facto standards will be used, when they exist and meet the business defined needs.
Additional Comments	

Network Services

Major Category:	System Services
Building Block:	Network Services
<p>Purpose:</p> <ul style="list-style-type: none"> To enable the communications between IT components internal and external to the practice. <p>Description:</p> <ul style="list-style-type: none"> Network services provides the services to enable both local and wide area communications and provides the means for transmission of data between components and locations. Provision of fast, effective, reliable and standards based communications links. <p>Rationale:</p> <ul style="list-style-type: none"> Provide the means to allow network traffic to and from GPCS and its components. Provide a reliable network transport layer over which applications layer protocols can be carried. <p>Constraints / Dependencies:</p> <ul style="list-style-type: none"> Local Area communications protocols need to be selected. Wide area communications protocols need to be selected. <p>Linkages to Other GPCS Building Blocks:</p> <ul style="list-style-type: none"> Links to Hardware and Operating Systems Services to provide communications services and allow for the exchange of traffic. 	

Functional Requirements:	
Function	Description
Key Requirements	<ul style="list-style-type: none"> • Provide network protocols and services to enable LAN and TCP/IP wide area communications • Allow for connection to external health information service providers • Support access to Internet Service Providers using either SLIP or PPP access • Functionality to allow a remote user to appear as if attached directly to the Practice LAN environment, allowing access to all applications, accepting the limitations imposed by wide area communications link that may restrict the performance or access to high bandwidth applications such as image viewing
Users	<ul style="list-style-type: none"> • None
Technology Options	
Interfaces Provided	<ul style="list-style-type: none"> • Operator interface to allow for Customisation of network configurations
Data Characteristics	<ul style="list-style-type: none"> • Not applicable
Operating System	<ul style="list-style-type: none"> • Communications services to be provided as part of the Operating System functionality on the GPCS Client and GPCS Server
Platform	<ul style="list-style-type: none"> • GPCS Notebook, Desktop and Server
Connection Requirements	<ul style="list-style-type: none"> • Support LAN based Ethernet connections at the link/network layer • Support leased line connections to external services • Support communications between locations within the context of a multi-site practice • Support switched (dialled) connections to external services and remote users
Standards	<ul style="list-style-type: none"> • Appropriate RFCs describing the current TCP/IP standards for wide area communications • Ethernet LAN protocols :IEEE 802.3
Principles	<ul style="list-style-type: none"> • The Technical Framework must be standards based and “open” • Ease of interface between internal and external systems will be sought through the use of healthcare and technology industry standards • The network functions will reduce the need to the application areas to be aware of the networking protocols.
Additional Comments	

Security Services

Major Category:	System Services
Building Block:	Security Services
<p>Purpose:</p> <ul style="list-style-type: none"> To provide access controls and data encryption services to users and modules within the GPCS system. <p>Description:</p> <ul style="list-style-type: none"> Provision of user authentication and profiling for access to GPCS data and functions. Provision of data encryption / decryption services for stored and transmitted data. Support for digital signatures (certificates) to allow for the authentication of electronic messages and documents. <p>Rationale:</p> <ul style="list-style-type: none"> Provision of a central service for the control and maintenance of user ids, password and data access controls that can be called from a number of modules within GPCS. Allow for the control of user access to applications and data and the type of access allowed. <p>Technology Constraints / Dependencies:</p> <ul style="list-style-type: none"> Other application functional areas must call on the Security Services for user authentication and access permission's. Existing application package may have their own security functions built in and will have to be modified to call the security services. The definition of an application programming interface to support the exchange of information between the Security Service and applications functions is required. A tool to automate the management of multiple Id's and passwords for existing application packages may need to be evaluated. Access to Internet facilities will require the deployment of Internet firewall services to ensure a level of security is maintained. This building block represents a logical grouping of functions. As components within the GPCS are defined during the GPCS design phase aspects of security functions may be provided as part of the Business Function Managers, for example the control of and level of access to applications. Private Key Access Facilities and X500 standards for management of public keys will be required <p>Linkages to Other GPCS Building Blocks:</p> <ul style="list-style-type: none"> In the longer term called from all application and data modules within GPCS. 	

Functional Requirements:	
Function	Description
Key Requirements	<ul style="list-style-type: none"> • Provide user authentication and profile maintenance • Password maintenance and control with appropriate standards for type of password and currency controls. • Storage of passwords must be in an encrypted format and passwords can not be reused once expired. • End user ability to change / reset password at their initiation, but password must conform to established standards. • Provide individual user and group user access controls and profiles. Ability to control a users access to screen, function and data element levels. Access control for remote users accessing the GPCS system • Provide encryption services for use when transmitting information over the wide area network and when storing information on a mobile platform
Users	<ul style="list-style-type: none"> • End users accessing the GPCS system will sign-on via Security Services
Technology Options	
Interfaces Provided	<ul style="list-style-type: none"> • Character based interface to the administration functions associated with maintaining the user ids and profiles • Simple user interface for sign-on
Data Characteristics	<ul style="list-style-type: none"> • Security profiles and passwords to be encrypted when stored
Operating System	<ul style="list-style-type: none"> • GPCS Client and Server
Platform	<ul style="list-style-type: none"> • GPCS Notebook, Desktop and Server • Hardware and disk level passwords required for mobile platforms
Connection Requirements	<ul style="list-style-type: none"> • Client/server communication via a protocol supported by Operating System and Network Services.
Standards	<ul style="list-style-type: none"> • AS/NZS 4444:1996 Standard Information Security Management (Standards Australia) • SAA MP 75-1996 Strategies for a Public Key Authentication Framework (Standards Australia) • Public key encryption standards.
Principles	<ul style="list-style-type: none"> • Security facilities must be comprehensive and ensure the privacy of data during its storage and transmission between points
Additional Comments	

Systems Management Services

Major Category:	System Services
Building Block:	Systems Management Services
<p>Purpose:</p> <ul style="list-style-type: none"> • Provision of the Systems Management Services in support of an operational GPCS environment <p>Description:</p> <ul style="list-style-type: none"> • Provide the system services for managing the GPCS system and supporting infrastructure, covering problem, change, configuration, asset and performance management areas. • Functions should be available to allow for the maintenance of a personalised workstation setup and the restoration of the configuration if required <p>Rationale:</p> <ul style="list-style-type: none"> • Provide systems services to enable a central point for the delivery of systems management functions to allow for the operation and maintenance of the GPCS <p>Technical Constraints / Dependencies:</p> <ul style="list-style-type: none"> • To manage application functions the applications must be able to supply product information and alerts to the managing software • Hardware components deployed must be able to be managed from a Systems Management platform (locally or remotely) • Implementation of the systems management functions will increase the cost of some components but reduce the effort in the operation of the system and assist in the delivery of appropriate levels of services to the users • This building block represents a logical grouping of functions. As components within the GPCS are defined during the GPCS design phase aspects of security functions may be provided as part of the Business Function Managers, for example the control of and level of access to applications. <p>Linkages to Other GPCS Building Blocks:</p> <ul style="list-style-type: none"> • Operating System Services • Hardware Platform Services • Application Enabling Services • Business Support Functions 	

Functional Requirements:	
Function	Description
Key Requirements	<ul style="list-style-type: none"> • Problem notification, recording and reporting services • Change control support for software and hardware allowing for the addition and / or removal of updates if required • Ability to receive and apply changes from external sources electronically, with appropriate management and security controls • Management of the configuration of the GPCS system within the clinic (single or multi-site) • Ability to record and track the infrastructure assets within the context of the GPCS, where assets comprise the hardware, system and application software. Products should provide "Vital Product Data" to the Systems Management System • Capability to simply store all configuration data in one location to allow for the restoration of a failed system, if required • Provision of manual / automated backup capability and associated restoration functions in the case of a system or component failure. The backup function must be able to be run on a scheduled basis. • Recording of appropriate performance information at the LAN and desktop level to allow for the monitoring of performance and to assist in the delivery of established service levels • Provision of the ability to store and retrieve personalised user interfaces and setup to allow for the individual customisation / tailoring of a workstation
Users	<ul style="list-style-type: none"> • Operations support staff and trained Clinic support staff
Technology Options	
Interfaces Provided	<ul style="list-style-type: none"> • Graphical interface with ability to support character base commands as required
Data Characteristics	<ul style="list-style-type: none"> • Receipt and storage of alerts and error information from the infrastructure components • Database for storage of configuration information
Operating System	<ul style="list-style-type: none"> • GPCS Server
Platform	<ul style="list-style-type: none"> • GPCS Server
Connection Requirements	<ul style="list-style-type: none"> • Support LAN connection for management of LAN attached resources • Support remote switched access to allow for the remote operation of a workstation
Standards	<ul style="list-style-type: none"> • SNMP
Principles	<ul style="list-style-type: none"> • Systems will be designed to provide responsiveness, utilisation, throughput, and capacity performance measurements
Additional Comments	<ul style="list-style-type: none"> • The ability to provide remote support and management of the GPCS infrastructure should not be precluded by the systems implemented.

Hardware Platform Services

Major Category:	System Platform
Building Block:	Hardware Platform Services
<p>Purpose:</p> <ul style="list-style-type: none"> • Provision of the appropriate hardware services required to support the GPCS and attached devices <p>Description:</p> <ul style="list-style-type: none"> • Delivery of hardware services (processor, memory, storage, display, communications) to support a mobile user • Desktop hardware services for clinic based users • Server and communications hardware supporting local area networks and communications to external services <p>Rationale:</p> <ul style="list-style-type: none"> • Standardise on a selected set of hardware platform types to allow for the development and portability of required application suites • By standardising on a selected hardware platform support and operational issues may be reduced <p>Constraints / Dependencies:</p> <ul style="list-style-type: none"> • Not applicable <p>Linkages to Other GPCS Building Blocks:</p> <ul style="list-style-type: none"> • Used by Operating System Services 	

Functional Requirements:	
Function	Description
Key Requirements	<ul style="list-style-type: none"> • Notebook: Mobile computing platform with ability to operate on battery as well as power cord. Supports inbuilt communication services (PCMCIA slots). Supports character and graphical user hardware • Desktop: Desktop based hardware and display services to enable the running of operating system and GPCS application functions. Supports GUI display, multimedia and image • Support for docking stations when in a practice environment. • Server: Provides data storage, application and communication services for a number of client desktop stations.
Users	<ul style="list-style-type: none"> • None
Technology Options	
Interfaces Provided	<ul style="list-style-type: none"> • Provided via Operating System Services
Peripherals	<ul style="list-style-type: none"> • Notebook, Desktop: Printers, optical scanners, SMART and MAG stripe cards, CD-ROM drives. • Server: Printers, external modems, optical scanners, RAID disk arrays, CD-ROM drives.
Operating System	<ul style="list-style-type: none"> • Not applicable
Platform	<ul style="list-style-type: none"> • Intel or RISC based processor platforms
Connection Requirements	<ul style="list-style-type: none"> • Support communication adapters for Ethernet (802.3) LAN attachment • Support wide area communications adapters: RS232 interfaces, internal or external modem attachment, Network Terminating units, ISDN
Standards	<ul style="list-style-type: none"> • Intel based processor platforms • RISC based processor platforms
Principles	<ul style="list-style-type: none"> • Industry de jure or de facto standards will be used, when they exist and meet the business defined needs
Additional Comments	

Operating Systems Services

Major Category:	System Platform
Building Block:	Operating System Services
<p>Purpose:</p> <ul style="list-style-type: none"> To manage the delivery of hardware resources and functionality to other modules / resources within the context of the GPCS. <p>Description:</p> <ul style="list-style-type: none"> Provide a functional and stable operating system to support the delivery of the required application and supporting services functions. <p>Rationale:</p> <ul style="list-style-type: none"> Standardise on a defined set of operating systems where the operating systems functions can be exploited by the application for the delivery of key capabilities, for example presentation services, management of hardware devices and peripherals. The operating system should be common across the Australian marketplace and have a wide level of application support. <p>Technology Constraints / Dependencies:</p> <ul style="list-style-type: none"> Selecting a limited set of operating systems for GPCS may require the migration of some existing applications packages in the market place to those selected operating systems. <p>Linkages to Other GPCS Building Blocks:</p> <ul style="list-style-type: none"> Provides support to overlying System Services. Interfaces to Hardware Platform services. 	

Functional Requirements:	
Function	Description
Key Requirements	<ul style="list-style-type: none"> • Provide support for underlying hardware platform and peripheral input / output devices • Manages delivery of hardware resources and functionality to other resources and users, such as diskette, CD-ROM etc • Provide functionality to allow for the capture of preventative maintenance information for attached devices • Support for the utilisation of uninterruptable power supplies to allow warning of power outages and allowing for controlled shut-down • Provide for Advance Power Management functions for mobile computer platforms
Users	<ul style="list-style-type: none"> • Operations support and trained Practice Administrators.
Technology Options	
Interfaces Provided	<ul style="list-style-type: none"> • Character based interface for establishing operating system parameters and commands
Data Characteristics	<ul style="list-style-type: none"> • Not applicable
Operating System	<ul style="list-style-type: none"> • Operating systems covering Mobile, Desktop and Server platforms
Platform	<ul style="list-style-type: none"> • Support Intel and RISC based hardware platforms
Connection Requirements	<ul style="list-style-type: none"> • Not applicable
Standards	<ul style="list-style-type: none"> • Microsoft Windows 95, Microsoft Windows NT • Apple Macintosh • Unix operating system in server environment
Principles	<ul style="list-style-type: none"> • Industry de jure or de facto standards will be used, when they exist and meet the business defined needs
Additional Comments	<ul style="list-style-type: none"> • Support for defined Network Computer standards may be incorporated as these standards emerge.

Appendix D: Evaluation Criteria and Process

The primary evaluation criteria for the selection of Technical Framework components are outlined below.

Developing and maintaining evaluation criteria and a process for decision making is a key element in translating the Technical Framework into a design and components. It enables more consistent decision making and focuses the decision making process on business related issues, reducing the number of technical decisions for technology's sake.

Usage of Evaluation Criteria

The evaluation criteria and process described in this section should be used by all those who are charged with evaluating and recommending products for inclusion in the GPCS Technical Framework. The criteria examples in this section are meant to serve as the basis for developing specific evaluation models for specific decisions, not all criteria are appropriate to a given component evaluation.

Generic Criteria

The following criteria should be applied, during choice of the solution, to the entire solution (as opposed to specific components). However, it must be recognised that there may be instances where specific products are to be used.

Costs

All the costs associated with a solution must be identified to ensure accurate cost/benefit analysis:

- **implementation;** for example, the cost of giving all users access to a LAN server when the majority have non-programmable terminals on their desks
- **package** acquisition versus **in-house** development
- **transition;** for heritage applications which are written for particular environments, the cost of transition to a new platform must be balanced against the benefit this will bring
- **maintenance and ongoing costs,** for example minor updates must be included
- **Itemisation** of each components cost to allow comparison with other equivalents

Conformance and Interoperability

The purpose of producing the Technical Framework for the GPCS is defeated if the components do not work smoothly together. To sub-optimize, by selecting the best individual components regardless of their ability to work together, leads to unsuccessful implementations. The efficient and effective operation of the platform as a whole will almost always be more important than the working of a single component, particularly as interoperability is a major objective.

Each product's conformance to definitions, interfaces and protocols set out in the Technical Framework must be considered, which includes its conformance to widely accepted Health and industry standards.

Functional Suitability

Functional suitability must be seen in the context of the ability of a single component to work effectively and harmoniously with other components of the GPCS Technical Framework. This also implies that combinations of components (solutions) must be capable of supporting the business functions required by the GPCS. An assessment of prerequisites must be made.

Investment Protection

Solutions should be chosen with an eye to future evolution of the business and technical framework, so that they can cope with probable new environments, as far as these can be foreseen at the time of acquisition.

Performance

The fastest machine or program is not necessarily the best but, in complex systems, an unduly slow component can have a disproportionate effect on the speed of the whole. Performance will be critical in some components and for some business needs. The focus must be on the supply of the appropriate level of service to the end user (GP or administrator).

Reliability

Reliability must extend beyond hardware and application functions to interfaces with other elements of the architecture. The reputation of the supplier and stringent testing can provide some assurance.

Scalability and Ease of Migration

The hardware and software components selected should be capable of delivering or supporting a wide range of data capacities, processing power and transaction rates. Consideration must be given to the provision for growth potential. However, it must be recognised that not all solutions will have this requirement. Consideration must also be given to the ability to offer solutions that are scalable in terms of cost.

Solution Availability

How long will it take to deliver a full function GPCS solution? The solution will require application development and integration with components of the GPCS Technical Framework and integration with external services. While there is an immediate requirement indicated by the users, there are a number of other dependencies discussed in the consultancy reports that could be more significant than the solution development time.

Software Products and Package Criteria

In addition to the generic evaluation criteria highlighted above, there are certain criteria that apply specifically to the selection of software products, including system software, packages and application tools:

Ease of Customisation or Modification/Extension

Customisation should ideally be via parameters, through an easy to use administrator's interface. This is particularly important when selecting a package which, for example, could potentially be used by a number of GPs within a practice.

Installation, Operability and Maintainability

This includes the ease of installation and automation of management functions and backup and recovery facilities.

Does the product have a clear, defined upgrade policy? Are changes easy to make? How much user effort is involved in changes? Are bugs and fixes documented and communicated to all users? How frequently are new releases produced? Is it possible to select releases, and catch up with those omitted? Are releases cumulative?

Documentation Quality

Is the data and application architecture adequately documented? Does the documentation include user guides and quick reference cards? Is it written in simple language and easy to understand? Is on-line help provided, of sufficient quality that the user need rarely, if ever, refer to hardcopy documentation?

Education and Training

Is adequate education and training provided? Are there adequate training materials for the installer to use?

Security, Audit and Control

Issues such as access control, database maintenance, data integrity, field level security and auditability must be taken into consideration.

Useability and Quality of the User Interface:

The standard defined within this Technical Framework includes a graphical user interface (GUI) and candidate components will meet this standard to varying degrees of completeness. The importance of non-conformance may vary by class of user, for example some people may have very little use for, or empathy with, a full GUI. At the same time specialist technical staff may be happiest with interfaces which would confuse ordinary users. Even in these cases, there may be a need for novice and expert interfaces. Whatever the user interface requirements, there should be a threshold GUI conformance below which a product is considered unacceptable.

Packages, which will be used extensively, should be subjected to formal testing in a useability laboratory.

Technology Criteria

Centralised Systems Management

The degree to which the product provides for central management of distributed resources. This would include collecting and forwarding management statistics to a central point, providing tools for analysis of aggregated data, and the ability to initiate changes or fix problems from a central site.

Communications / Connectivity

What communications capability is available either as integrated features or add-on adapter cards? This would include availability of Local Area Network cards and modems. The analysis should include any limitations on the number and variety of concurrent attachments and the maximum communication speed or capacity.

Communications Functionality

The ability of the solution to support access to a variety of communication services and functions. For example support for both switched and leased line wide area communications connections and protocols, support for data compression and encryption technologies.

The provision of an API that would allow for automated access to remote databases, or access to FAX and E-Mail services should also be considered.

Cross Platform Communications

The ability to support communications between different platform types, for example windows and Unix, within the context of a practice environment. This may enable the support to legacy systems or the introduction of specialised servers as a practice expands.

Computing Environment

The product being considered should support the required client server or remote environments in which the GPCS will be deployed.

Database Administration

Refers to the ability to perform database administrative functions such as user adds and deletes, or user view definition. The degree of automation and impact on other database functions should be included in this analysis.

Database Management

The ease with which database management functions, such as backup and recovery or reorganisation, can be performed. The analysis should include looking at how automated various functions are and what the impact of performing a function is on the operation of the database,. for example one database may allow on-line recovery of a table while another requires the entire database to be taken off-line to recover a single table.

Documentation and Training

In addition to the quality of product usage documentation, this criteria includes how well the interfaces, usage rules and resource requirements are documented. The availability of on-line documentation and context sensitive help in software should also be considered here. The training analysis should include the quality and availability of classroom training and facilities, self study courses, and computer based instruction.

Ease of Migration / Integration

How easy will it be to migrate from a current product providing this function to the new one? How will the new product integrate into the existing environment? Will data or application conversion be required? What installed products will be made obsolete by the new product? Will the new product provide all the functions of the product being replaced?

Environmental

This criteria is aimed at understanding physical environment requirements such as raised floor, additional air conditioning, floor loading requirements, physical size and clearance restrictions, or special electrical power. As such, it applies only to hardware decisions.

Network Protocols

What network protocols are supported? Is there a limit to the number of protocols that can be run concurrently? To what extent is network support integrated into the product vs. needing to buy add on packages (eg., Windows for Workgroup vs. Windows 3.1 or Win95)?

Operating System(s)

What operating systems does the hardware support and what specific enablers or restrictions does the hardware offer for each environment.

Peripherals

What peripherals such as tape drives, CD-ROM, scanners, Personal Data Assistants (PDAs) or other external devices are supported. The analysis should be limited to those peripherals anticipated to be needed in the planned and current environments rather than an exhaustive list of all available peripherals.

In some cases, specific brands and types of devices will need to be supported and therefore should be considered in the analysis. If the peripheral uses supplies, the degree to which those supplies are interchangeable and available should also be considered.

Performance / Scalability

The analysis of this criteria should focus on the system capacity vs. performance requirements. Special attention should be placed on identifying performance bottlenecks such as I/O paths in systems or single threaded access to resources in an operating system. The analysis should then consider the options for overcoming these bottlenecks to provide application and data transparent horizontal growth.

Reliability / Availability

Reliability is a measure of how often the system or a component will fail, often expressed as mean time between failure. Availability considers the ability of the system or component to recover and continue providing full or degraded function in the event of a failure.

In addition to looking for data or experience that indicates proven reliability and availability, this analysis should consider the availability of features in the product which can assist in managing and improving availability. For example, if a system must be taken out of service for microcode updates or other vendor scheduled maintenance, this may not be reflected in reliability or availability data but would certainly have a significant impact on availability of the system to the GP and Practice.

Remote Data Access Connectivity

Refers to the ability of the database to allow client systems access to its data. (eg., SQL Net for Oracle, ODBC drivers for Access) Would also include the database's support of industry or vendor standard access interfaces such as OLE or SOM/DSOM.

Replication / Synchronisation

The ability of a database to manage replicated data. The propagation and synchronisation of changes to the database across multiple systems, for example multi-site practices and mobile users, to ensure data integrity at any given point in time is a key consideration. For example, it must be able to perform back-out and recovery across the multiple databases in the event of a failure of any one of them, keeping them all in sync.

Security

How well does the product support security management. For hardware, this may include physical security features to prevent theft or physical alteration as well as hardware passwords. For operating systems and other software, user authentication and authorisation capabilities should be considered. Consideration should be given to the ability of the product to support a single user logon to multiple applications/systems in a network.

Supported Languages

What languages are supported by the application development tool? Some tools, such as window controls, might work with multiple C and C++ compilers and visual development environments as well as with Visual Basic.

Supported Platforms

What platforms support this product? For example, some development tools will support development to Windows, Windows NT, MAC, OS/2 and Unix from the same source code. Some databases will run on Novell and Unix with essentially the same application interface. Systems management tools may run in a Unix environment and support management of other Unix systems as well as OS/2 and Windows systems.

Systems Management

How well does the product being considered support required systems management

functions. Does the product provide for collection of information related to its activities that would be used by any of the systems management processes? What is the availability of tools for systems management in the product's environment?

Systems Management Standards Conformance

To what extent does the systems management tool support network and systems standards, interfaces, and protocols such as SNMP, TCP/IP

System Requirements

What processor, memory, disk, operating system and other system features are required for the product to deliver the desired function. Are there any unique system functions required for the product to work?

System Support Software

What tools are available to enhance the operating system environment? Are there tools which make the management of files, detection and eradication of viruses, or recovery from system failures easier? Are there tools which enhance the basic user interface to the system functions (eg tools such as Norton Utilities) ?

Technology Maturity

Is the technology used by the solution proven in comparable uses and environments? Are unannounced products, alpha or beta releases, etc. required?

User Interface

What type of user interface does the product provide? This criteria is designed to evaluate the interface to the product, not the product's user interface capabilities. For example, even though an operating system provides a GUI interface for its applications, the user interface for system functions may be character based.

Vendor Evaluation Criteria

In selecting a product for inclusion in to the GPCS Technical Framework the vendor of the particular product needs to be considered. The following sample criteria are provided to reflect on the main areas that need to be considered with respect to a vendor.

Experience in Environment

Refers to the amount of experience the vendor has in delivering quality products in the given environment. While experience delivering a particular type of product for the environment is most relevant, if the vendor has significant experience delivering other types of products in the environment and this is a new offering, it may be relevant that the other products were or were not considered good.

Predominance / Market Share

Assesses a vendor's size relative to others in the same product market. What share of installed systems or licenses does this vendor have relative to its competitors? What do market watch services such as Gartner Group say regarding their ability to capture future market share? Is the vendor a leader in proposing and delivering standards or late to deliver products that implement industry standard solutions?

Product Direction

An assessment of whether it is likely that a vendor will continue to offer a particular type of product. Is there a history of product releases? Are there future product plans which would indicate a commitment to the market segment or product type.

Reputation / References

Assesses a vendor's reputation in the marketplace. Does the trade press target this vendor as the subject of stories regarding poor service or product responsiveness or does it usually rate praise for innovative products and support strategies? For major decisions, it is advisable to obtain references on the vendor for a discussion of the vendor's support, service, training and responsiveness and the overall quality of their products.

Service Availability / Quality

Refers to the availability and quality of service to perform maintenance activities or provide defect support. Does the vendor have committed maximum response times, do they provide service themselves or through a third party, can they deliver software fixes electronically, what is their callback rate, etc.

Support Availability / Quality

Refers to the availability and quality of non-defect oriented support as might be supplied by the marketing team or technical support staff in assisting in defining and implementing desired usage of the product.

Training Availability / Quality

Does the vendor supply a wide variety of installation and usage training? Is it available locally or will the staff have to travel? What is the quality of the instructors and training materials? Is the training offered on-line or as part of the product itself?

Vendor Relationship with Other Chosen Vendors

If the vendor of a product has a marketing or joint development relationship with another vendor which has been chosen to provide related function, there is a good possibility that their products might better compliment each other or that they might be more willing to work together to meet unique requirements.

Viability and Financial Performance

Refers to an assessment of a vendor's long term prospects of survival in the marketplace. Size, profitability, years in business, and other business and financial assessments should be done here.

Vendor Location

Assess the locations where the vendor has offices or support facilities and how these relate to the geographic location of the Gps. This becomes important with respect to the rural practices.

Commitment to Standards

Does the vendor show a level of commitment to industry standards? Does the

vendor participate in the standards activities and associated bodies?.

Evaluation Process

The evaluation criteria described previously should be utilised within the structure of a defined evaluation process. for example the evaluation process may consist of the following general steps:

Finalise Evaluation Criteria

Each decision will involve different business requirements and a different set of technology options. This requires the evaluation criteria to be refined or even redefined for each decision. This can be done by starting with the general criteria and adapting them for the individual situation. The functionality and function related categories will require the most tailoring and should be developed with the specific business requirements and technology being evaluated in mind. The other categories should be refined as needed and more specific criteria added if necessary.

Assign Weights and Minimum Scores to Categories

Once the evaluation criteria are agreed to, each should be assigned a weight of 0 to 5 based on the following scale:

- 0 = Not Applicable
- 1 = Of Little or No Importance
- 2 = Somewhat Important
- 3 = Important
- 4 = Very Important
- 5 = Extremely Important

These weighting's may vary from decision to decision and should be revisited each time.

Each criteria should be assigned a minimum acceptable score which, if a product does not meet, would eliminate that product from further consideration. (eg., when analysing databases, the ability to maintain referential integrity may need to be Very Good to be acceptable. A score of Good or worse would disqualify the product.)

Identify and Analyse Options

Relevant technologies that can reasonably meet the documented business requirement(s) should be identified and an analysis plan developed. This may include:

- trade press research
- requests for information(RFI)
- vendor presentations
- reference site visits
- demonstrations
- proof of concept pilots

Factors such as business risk, breadth of impact, and cost of the decision should be weighed when deciding on how extensive the analysis should be.

Score each Criteria for Each Option

Based on the analysis in the previous step, each product option is scored on its ability to meet the evaluation criteria based on the following 0 - 5 scale:

0 = Does not meet criteria or does not have this function

1 = Poor

2 = Fair

3 = Good

4 = Very Good

5 = Excellent

It is important that each criteria be well defined so that different evaluators will be able to score each criteria with a high degree of consistency.

Calculate Weighted Scores and Select Solution

Finally, the individual raw scores (S) are multiplied by the weighting factors (W) to yield the weighted scores (WS).

$$WS = W \times S$$

Next, the weighted scores(WS) in each category are summed and divided by the sum of the weighting factors(SWF) to obtain the category weighted score (CWS).

$$CWS = \text{Sum}(WS) / \text{SWF}$$

The category weighted scores should each be between 0 and 5. They are transferred to the product evaluation summary sheet where the same calculations are made to determine the best product (highest score).

Appendix E: Reference Information

The following reference information was utilised during the course of the study

Previous IBM Consultancy Documents

- *Electronic Prescribing & Medicines Information consultancy. Final Report. Vol 1 & Vol 2* IBM Consulting Group.
- *Development of Functional Requirements Specifications and a Technical Framework for Clinical and Administrative General Practice Computer Systems. Project Charter. Version 1.0, Release 01.* IBM Consulting Group
- *Clinical & Administrative General Practice Computer Systems Consultancy. GPCS Definition Report.* IBM Consulting Group
- *Clinical & Administrative General Practice Computer Systems Consultancy. GPCS Functional Requirements Specification Report.* IBM Consulting

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- *OMG/CORBAMED DTF White Paper on Integration Services for Clinical Data Exchange.* Doc number corbamed/97-01-01. Editor Rachael Sokolowski, Kurzweil Applied Intelligence
- *Inventory of Health Care Information Standards. The Health Insurance Portability and Accountability Act (HIPAA) of 1996 - American National Standards Institute.* Web site:- <http://aspe.os.dhhs.gov/ncvhs/hisbinv.htm>. Dated January 1997
- *Object Orientation; A Natural Evolution for HL7.* Authors: Wes Rishel, Wes Rishel Consulting. Dated May 17 1994
- *The Healthcare Information Challenge.* Microsoft Corporation. Web site: http://www.microsoft.com/industry/output_noframes/fordev/fordev431.htm
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- *Basic Introduction to the RICHE Reference Architecture,* Groupe RICHE Technical Committee.
- *RICHE Architecture Overview.* Groupe RICHE Technical Committee
- *CEN/TC251 PT1-010 Healthcare Information Framework, 1995*
- *CEN/TC251 PT1-013 Healthcare Information System Architecture, 1995*

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- *Two-Tier vs Three Tier Trade-offs, Part 1*. Gartner Group. Dated January 23, 1997
- *Two-Tier vs Three Tier Trade-offs, Part 2*. Gartner Group. Dated January 23, 1997
- *Three-Tier Computing Architectures and Beyond*. Gartner Group. Dated August 25, 1995
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