

INFORMATION TECHNOLOGY

INTRODUCTION



Recent years have seen a complete revolution in how information is gathered, archived and used in both business and government around the world. Throughout much of the world, the workplace has been transformed from one based on paper documents, fraught with errors and delays, to one based on information technology (IT). While IT can bring vast improvements in accuracy and timeliness, IT, by itself, does not change the basic problems of personnel competence or administrative inertia.

The use of information technology within Government in Maldives varies greatly from ministry to ministry. Most agencies have acquired workstations for basic office functions such as word processing and spread sheet analyses. Some have installed local area networks and support services such as email and file sharing. A few have also developed and deployed to mission support applications that automate many functions traditionally carried out by



hand. Despite this variation, most ministries have a real desire to take advantage of information technology as part of an overall goal of “doing more with less.”

While information technology can be used to great advantage even in isolation, its real strength lies in the ability to interconnect different systems for the purpose of sharing and exchanging information. At the present time there are no ministries within the Government that exchange information online or in real time. To date, the impact of the information revolution on Maldives has been modest relative to its potential. However, with a small scattered population, an economy based to a great extent on fishing and tourism, and isolation from outside countries the potential benefits from greater IT use, as well as the challenges to it, are significant.

This chapter examines the state of information technology within Government and addresses the relationship between information technology and communications. It develops a number of recommendations to aid Government in taking best advantage of technological changes. It provides a high level view of the type of organization that will be needed to guide and administer technology deployment within Government, and outlines a standards framework through which this can be accomplished.

The successful application of information technology can be viewed as a hierarchy of component building blocks as illustrated in Figure 1. Most successful large application deployments consists of two independent components: the programs, servers and workstations forming the core information technology component that implements the intended system functions, and an enabling communications component that ties the various pieces of the application together. The information technology component consists of the hardware and software, coupled with an overriding requirement for appropriate education and relevant experience. It is really this “soft” component that ultimately determines the degree of success of a particular application. In many cases, IT applications are introduced to modernize operations and administrative procedures. That is, they automate current procedures in accordance with existing policies without having to redesign the underlying concepts. In other cases, the fundamental concepts must first be re-engineered before the use of information technology will succeed. Both extremes have been observed within Maldives.

The other corollary aspect of applying information technology is the communications environment that ties together the application in space. It ensures that information is delivered efficiently so that it is available where and when it is needed. The communication side of IT also encompasses a huge and separate education and training component. Chapter 4 discusses the telecommunications environment in Maldives. In this IT chapter, the emphasis is on the specific communication issues related to IT operations. Local communication must be designed to support the intended IT applications while wide area communication facilities are normally acquired through carriers or other suppliers. The challenge is to decide the specific nature of access that is needed, and the performance levels required of the communication facilities. Others will provide these as end-to-end services.

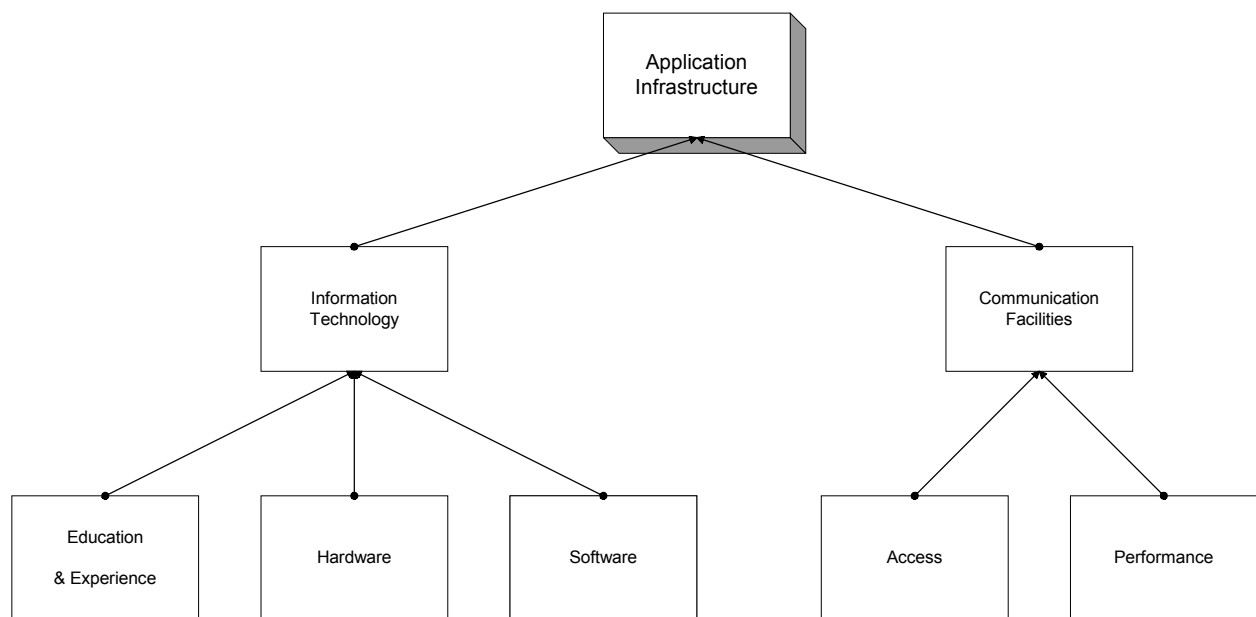


Figure 1 - Information Technology Analysis Breakdown

CAPACITY & NEEDS ANALYSIS

OVERVIEW

As was noted previously, among Government, parastatal and private sector organizations, there is wide variation in the use and development of information technology. While some organizations are fully modern in their use of office automation, mission applications and the underpinning technologies, others remain essentially manual in character. Those agencies that are most progressive (having adopted international conventions) seem to have two common characteristics: (1) they have a well-defined and concrete mission, and (2) they are

associated with (or at least exposed to) international organizations as an ongoing part of their work. It is for this reason that IT is more developed in certain private organizations than in most Government agencies. Those units that have fallen behind in IT adaptation also seem to have two characteristics in common: (1) both their mission methodologies and corporate culture have remained unchanged for a long period, and (2) there is resistance to change at senior levels of the agencies. Those organizations in the middle have begun the introduction of office automation, sometimes on a modest scale, but have been driven forward by idiosyncratic events, such as fear over Y2K problems. In general these “middle” organizations also seem to have more progressive management.

The following provides a synopsis of several organizations whose information technology experiences were reviewed during the course of the study. This is only a sample of Government operations, but clearly reveals the inconsistent use of information technology across the ministries and sub-units.

MINISTRY OF TRANSPORTATION AND CIVIL AVIATION (MTCA)

The MTCA is divided into three sectors looking after land, marine and air related activities. The three groups function separately from an information technology perspective, with minimal overlap or communication.

The marine division is responsible for all aspects of vessel and vessel operator licensing. Dhonis are licensed recording the builder, owner and engine serial number. Vessels are not “type-approved.” There is no marine architect on staff. All operators of vessels that cross the 1½-degree channel require special licenses, except captains of fishing boats who are required to have a separate class of license (involving a three-month programme at the Marine Training Centre). However the MTCA does not operate the Centre or have substantial input into course curricular content for the licensing.

The office has personal computers (PCs) connected in a simple peer-to-peer network used for file exchange, but few other local area network (LAN) facilities. They share email with the land transport division. The belief was expressed that such communication is not necessary. Of the small IT staff in the marine transport office, two are on extended training leave overseas. The belief was expressed by staff that further automation was unnecessary.

The land division is responsible for licensing of motor vehicles and operators. Tracking of drivers and their payments of fines is problematic, as is the recording of transfers of ownership of both automobiles and vessels. Verification that a vehicle is free of liens requires the involvement of several ministries and laborious manual record searching, often requiring a minimum of one week. The land division has a pilot project in which applicants can apply for a license at a server kiosk, apply online and take an operators’ test. These servers will be installed in four locations, but will not be connected back to the Ministry. At the present time the Ministry has a LAN supporting 15 workstations and two servers.

The air division is responsible for civil aviation. The division functions essentially independently from the land and marine divisions. They have a LAN that includes connection to the airport and dial-up Internet access. By the description provided, there appears to be a modern functional IT environment that forms an integral part of the work context.

MINISTRY OF FISHERIES, AGRICULTURE AND MARINE RESOURCES (MFAMR)

The MFAMR is responsible for monitoring, control and surveillance relating to fish catches and stock assessment. To this end, they log daily catch reports for fishing boats operating out of Male' and monthly catch reports for fishing boats based in the islands. Records are limited to gross weight of fish caught without discrimination by species. The same group also administers islands leased for agriculture. In many cases, the leaseholders harvest native crops without farming in the traditional sense. Other islands have been cleared and are used for crops such as papaya and watermelons. There has been little or no citrus crop production in Maldives since these trees were decimated by rust disease several years ago. Re-introduction of lemons and limes has been attempted but without success. The Ministry gathers three classes of information covering agricultural in the islands: production forecasts, crop surveys and market news. There is no sampling system to track information for economic planning and coordination. The last comprehensive survey was conducted in 1995 and encompassed 60 islands. The MFAMR currently does not have a LAN, and indicated that they saw no need to change the existing IT environment at this time. (See Chapter 5 for a broader discussion of S&T issues in the MFAMR.)

MINISTRY OF PLANNING AND NATIONAL DEVELOPMENT (MPND)

The IT environment of MPND comprises approximately 80 computers networked together. At almost one PC per staff member, this is one of the highest density installations. The environment is self-contained except for two dial-up accesses for the atoll offices that are used for file transfer.

The Ministry is responsible for the census, which is maintained on a local Paradox database. They also have an involvement in the ADB-financed National Accounts Project, and are nearing completion of a correspondence tracking system. Development of a human resources data system is planned for 2001. Despite the Ministry's role within the government, there is no Geographic Information System. Most maps are obtained from Australia and the United Kingdom. There are no nationally approved navigation charts. It was reported that not all senior managers support the interconnection of the ministries for the purposes of information exchange.

PUBLIC SERVICE DEPARTMENT (PRESIDENT'S OFFICE)

The Public Service Department was established in 1999 as part of a larger effort to reform and modernize the public service. They have a human resources system that encompasses approximately 20,000 civil servants (below the deputy director level) and 26,000 expatriates working in the country. This system is to be expanded shortly with a new job-matching Centre, coordinated with the labour ministry. The group is spread between two separate buildings as some functions have expanded to space in the former Presidential Palace. They are in the process of extending the existing LAN between the two sites. The technical services team consists of one hardware technician and five software support staff.

MINISTRY OF TRADE AND INDUSTRIES (MTI)

Among its functions, the MTI has regulatory responsibility for both trade (State Trading Organization--STO) and electricity (State Electric Company--STELCO). The Ministry also collects operational and financial data annually from each atoll and resort. Both STO and STELCO have independent information technology configurations and are not interconnected with the Ministry.

The Ministry would like to pursue the development of programs that would provide for online application, forms and tracking of trade license applications. This would be based on a dial in server. They would also like to acquire dedicated interconnections through which they could exchange information with Customs and the Bank of Maldives. Unfortunately no funds have been allocated for these projects. The Ministry sees its role as one of enhancing the environment for technology transfer, including, among other things, encouraging industry to adapt to technology-intensive activities. Overall, the MTI will work to make the economy more technology-driven.

The MTI will strive to enhance its internal efficiency of administration and public service through more effective use of IT resources. MTI was a major proponent for introducing the Internet in Maldives and will maintain this progressive approach to new technologies in its own operations. Greater availability of online registration and information access will be combined with broader networking, including potential links to the Customs Service and Inland Revenue. MTI also will encourage greater e-commerce through facilitation of e-commerce infrastructures including secure authentication and payment procedures, digital certification, and protection of consumer privacy.

Recognizing the regional and world competition in IT, MTI will push for rapid development of in the legal, education and training, and communication areas to facilitate expanded IT operations in Maldives. The goal shall be to create a “digital community” within Maldives with high-speed connections provided at competitive rates. The MTI feels strongly that Maldives can find a niche in the arena of the new economy and play an important role in IT industries specifically and in S&T activities generally.

The current information technology environment of the MTI is based on a LAN supporting two NT servers and approximately 48 workstations. Officially, the Ministry has an IT staff of three; however, two of these are overseas for training and not expected to return for between two to three years. The gap between MTI’s goals and its current resources must be addressed soon.

CUSTOMS SERVICE (MINISTRY OF FINANCE AND TREASURY)

The Customs service is responsible for the collection of duties and taxes on imports and exports and for monitoring all official ports of entry. Although its information infrastructure is not large by international standards, it is one of the two most modern organizations visited during the course of the S&T Master Plan project. Rather than go it alone, Customs has adopted the standardized customs classification system (ASYCUDA++) from the United Nations. The system has been supplemented, where necessary, with merchandise classifications that are unique to the Maldives. The system uses Windows 98 client workstations supported with a Windows NT application server. The network supports 20

clients in the headquarters building, and nine more in the passenger terminal and cargo office at the airport. There is also a modem pool to permit heavy users to complete and submit forms online. Until recently the Maldives did not have customs brokers. Customs has a trial system at the airport in which four brokers submit forms online on behalf of their customers. The system processes forms only as electronic funds transfers are not yet available in the Maldives. Cashier positions however, are online. Apart from the ASYCUDA++ system, an additional 20 workstations at the Customs Service are used for conventional office functions.

MALDIVES AIRPORT AUTHORITY (MINISTRY OF TRANSPORT AND CIVIL AVIATION)

Currently, the Male' International Airport on Hulhule is the sole point of entry for air travelers arriving in and leaving from Maldives. The Maldives Airport Authority (MAA) is a fully government-owned company that is responsible for operation of the airport. The MAA also provides technical support to the regional domestic airports. The Male' Airport was the second of two sites visited that had a thoroughly modern and developed information technology infrastructure.

The MAA formed the Information Technology Section in response to the Y2K crisis. A staff of six was dedicated to this role. Prior to that, IT facilities had been provided as service within the Technical Services office. In the past year, focused introduction of information technology has led to a dramatic shift in the MAA's corporate culture. The administration building has been fully wired for 100Mbps Ethernet, with over 80 terminals supported by three servers. Internet access and email accounts are universal. A human resources application is in development, and is expected to become active in April 2001. A procurement support application will be deployed later in 2001.

To further support these administrative initiatives, the Airport Authority is deploying a fibre optic campus backbone network that will eventually interconnect the primary operations buildings on the site. All cabling at the airport is installed, maintained and owned by the Airport.

MINISTRY OF FINANCE AND TREASURY (MFT)

Surprisingly, the MFT appears to be one of the least advanced users of information technology encountered during the study. One reason for this is that the Maldives financial system dates from the 19th century, prior to the advent of double entry bookkeeping. Funds are currently managed through the use of over 1600 separate accounts at the Maldives Monetary Authority. The ADB is currently working on a project to transform the national accounting system to one based on Westminster Accounting practices. The ministry did have servers connected to a small network within a separate computer room. All desktop machines however are stand-alone. There is no ministerial LAN, *per se*.

MINISTRY OF EDUCATION (MOE)

The MOE also has the potential for greater use of information technology even though it does have an office type LAN. Staff prefer face-to-face discussions to email. When needed, machines are used as stand-alone devices for word processing or preparation of spreadsheets.

The MOE operates an intranet like dial-in facility that currently serves approximately 12 schools in Male'. It is used to disseminate statistics, announcements and circulars, and journal articles for head masters. It is believed that there is a potential of 20,000 users for the system; the primary deterrent is communication cost – both access and Internet fees are too high.

At the present time there is no official curriculum for information technology instruction. Nevertheless most schools have developed class material for at least grades 8 through 10, based on general Government guidelines. Five out of six schools in Male' have set up dedicated computer laboratories, often provided and financed by private companies on a fee basis. Concern was expressed that accreditation standards are urgently needed. It estimated that there are many companies offering various computer courses of unknown quality. (See Chapter 6 for more detail on IT issues in Education).

DEPARTMENT OF NATIONAL REGISTRATION (MINISTRY OF HOME AFFAIRS, HOUSING AND ENVIRONMENT)

At the present time, the national identity cards are produced through an entirely manual operation. Registration is required of all persons 15 years of age and older, but national coverage has not yet been obtained and there is concern that the documents are easily forged. The Department of National Registration recently awarded a contract for the automation of the national ID card system. It is expected to be operational by the end of April 2001. Initially, the information stored in the system will be used by the Ministry of Education, the President's office, and for elections and immigration and emigration records.

The plan is to bring the birth certificates under the jurisdiction of the same ministry, and to link with Health and NSS to incorporate death records. For many reasons, primarily related to the manual nature of the various record systems this has not always been done. Under the new system, compilation of the information within the identity card process will begin with the birth certificate.

MINISTRY OF JUSTICE (MOJ)

A key IT concern in the MOJ is the maintenance of case histories (archives). Presently this is done through hard copy records that do not facilitate retrieval or review of earlier decisions and judgments. It can offer a significant improvement in this area. The MOJ has placed a priority on preparing IT resources to serve the needs of Maldives' courts and its citizens.

The first phase of a LAN installation has been completed linking all of the Male' courts and providing a dial up link to Addu Atoll Court in Hithadhoo. A second major MOJ IT project is development of the Justice Information Management System (JIMS). This work is being supplemented by digitalization of internal court documents and use of scanned documents (in Adobe-Acrobat format) to replace the current dependence on microfilm technology. Senior MOJ support for IT efforts are strong and the IT staff is especially competent. However, the MOJ, like most ministries, requires additional personnel and funds to fully implement its IT objectives.

INFORMATION TECHNOLOGY IN THE ATOLLS

Time and transportation constraints during the course of the project limited field visitations to selected islands in the Baa and Raa atolls. Despite this, similarities were such that the observations can be reasonably extended to other islands within these atolls and to other atolls. The use of information technology and communications in the atolls can be broken into four broad classifications: government, education, business and personal. Each of these areas can, in turn, be subdivided into two distinct components (1) the machines and applications themselves, and (2) the communication infrastructure through which applications are interconnected to achieve their ultimate purpose.

The atoll offices act as a common frontline field agent for many ministries. They collect a wide range of license and other fees on behalf of various ministries and submit these through the Ministry of Atolls Administration offices in Male'. The atoll offices prepare and submit regular administration reports, fishery catch reports, and collect other data on behalf of the government. A means of easy transmission of written information could significantly streamline the operation of the atoll offices and provide more timely information to the various ministries. In some cases, such as the collection of fines and fees, existing legislation requires that all information be kept in a physical account book. Automation without procedural amendments to facilitate the use of information technology would serve only to increase the effective workload.

The atoll offices are provided with personal computers, which are generally used for word processing, spreadsheets, and occasionally graphics. The machines are used as stand-alone devices. Internet access is prohibitively expensive, and available only through dial-up access. No ministries have yet deployed applications that would enable the atoll offices to submit information online. In fact, current legislation often requires a written report, thus limiting the gains from the use of the technology.

From an information perspective the individual atoll administrations operate in a degree of isolation from the various ministries in Male'. The atoll office administers a broad range of activities, acting as a local agent for the responsible ministry in each area. Among its administration functions, the atoll office collects fees and fines, and monitors ongoing trade and resource based industries. Status, findings and progress are reported monthly to the Ministry of Atoll Administration in Male'. In many cases (such as the collection of fines and fees), the Ministry provides a buffer between the Atoll office and other ministries and acts as a single point of contact between the responsible ministries and the atolls.

An island office that was studied at length had a single telephone line equipped with phone and fax. It had no computer of any type, although one is scheduled to be provided within a few months. Neither the Katheeb nor office staff had received any training to use the machine; however, the Katheeb had participated in a private computer-training program at his own expense. The island offices fulfil a similar role to that of the atoll offices but on a significantly reduced scale. Existing procedures do not combine reporting and business activities through the atoll office. Rather the local Katheeb deals directly with (or through) the Ministry of Atolls Administration for most day-to-day functions.

Better use of information technology, coupled with communication capability, would improve the abilities of the atoll health clinics to gather and report health information. At the

present time communication resources are extremely limited. Elementary tele-medicine could expand the ability of the clinics to deal with difficult cases and could reduce some of the need to travel from island communities to atoll hospitals. Should hospital visits be essential, the relaying of patient information could reduce duplication and save time. The health clinic in Eydhafushi, for example, is staffed by two doctors and support staff. It is a self-contained facility linked to Male' by telephone and facsimile. The clinic only recently received its first computer. Its usefulness has been limited to date, as the staff is still acquiring the ability to use the computer effectively.

The court personnel interviewed in the atoll capital expressed a strong desire for access to case histories and current case information to aid its effectiveness in dealing with its primary scope of civil and religious issues. Liaison with Male' is by telephone, fax and hard copy. While most cases are handled locally, the need was expressed for much easier exchange of timely information between the court and the Ministry of Justice. It was reported that the Ministry is currently "alpha testing" an information system tracking current cases and providing an historical archive.

Of the three schools visited, all were eager to expand computer education and increase student exposure and experience. The Baa Atoll Community School was well equipped with a computer lab and active courses. Island schools visited were serving similarly aged pupils, but were much more limited in access to equipment. In general the Ministry had provided each with a single computer but no course material was available. In each case, parents had donated additional computers to the local school. One school had adapted them for shared uses: teachers for lesson preparation and students for direct learning. One school had prepared course material covering basic exposure to elementary programming for grades 8, 9 and 10. Another school had hosted a Male' company to provide an intensive 45-day training course, with costs borne by the students. The company supplied all materials, including 15 workstations. Eighty people (children and adults) from the village of 800 took part.

The atoll or island office tends to be the focus for any Government function that does not maintain a dedicated office on the island. By their nature, these types of activities could be aided greatly through better communications and the use of information technology. A typical example is importation of goods. Shipments are frequently large or bulky, and trans-shipment through Male' is both costly and slow. Some shippers report first to Male', then proceed directly to the destination island for off-loading, accompanied by a customs officer and a National Security Service (NSS) officer. Improved communication including the provision of online access to customs and NSS could greatly simplify such procedures.

Aside from the need for official communications, there is the desire of the people to have better access to telephone and the Internet. Officially, access is available wherever there is telephone service. However, few homes have access to telephone service even if they can afford it. Pay telephones are few and appeared to be in almost constant use. Where the telephone company, Dhiraagu, has an operations Centre (normally placed in the atoll capital), many have been equipped with a workstation providing Internet access. It is understood that there will be a trial of a flat fee for use of these installations. Nevertheless, one access point for a community of a few thousand people can effectively support little more than email, regardless of pricing. Student research or small business use would not be practical. Furthermore, Internet access rates are prohibitively expensive. If Dhiraagu insists on metering line usage, then Internet access should be considered a basic system feature (like

dialling a phone number) with no extra charge. This would place Maldivian access rates on a par with 'pay as you go' rates in most of the world. Still expensive when compared to income, but affordable enough to permit more widespread use.

Overall it was found that improved access for exchanging information with different ministries was a pervasive requirement. **Error! Reference source not found.** provides a snapshot of the needs identified in one atoll capital. A more detailed investigation would almost certainly identify others. It is extremely important to note that only a small number of cases involve a ministry official in the atoll requiring information from the same ministry in Male'. Most requirements cross ministerial boundaries. This type of communication requirement is a strong argument for the development of a common Government Network of the Maldives.

It was not possible to inspect NSS facilities in the atoll; however, it is understood that fulfillment of NSS communication needs is also limited essentially to telephone dial-up and high-frequency radio. Access to a common government network should be attractive for unsecured traffic, especially if it lowers overall communication costs. However, by active participation in the development and adoption of appropriate standards, the operational and technical characteristics of a communications facility should be suitable for all but the most sensitive intelligence traffic. Such an approach would have the additional benefit of increasing security for the traffic of all ministries.

In the next two sections, the needs for a National Computer Centre and for the Government Intranet are presented. These same activities will be presented in Part III of the Master Plan as part of the set of Programme alternatives to be considered for implementation.

Table 1 – Summary of Potential Government Information Requirements in the Atoll

Ministry or Function	Information/Communication Requirement
Justice	<ul style="list-style-type: none"> • Access to case histories from same and other atolls • Access to criminal records
Transportation	<ul style="list-style-type: none"> • Vessel license renewals • Land vehicle license renewal • Renewal of other licenses and collection of fees.
Customs	<ul style="list-style-type: none"> • Local clearance of goods. To avoid trans shipment, ships often pick up customs officer and NSS officer in Male, then clear shipment at the atoll destination. • Poor communication cited as impediment to use of Gan for Int'l flights
NSS	<ul style="list-style-type: none"> • Access to criminal case files and histories • Secure transfer as required
Health	<ul style="list-style-type: none"> • Coordination of health data gathering and reporting • Tele medicine from atoll to Male' • Tele medicine from island clinic to atoll clinic
Fishing	<ul style="list-style-type: none"> • Monthly catch reports to be returned to ministry • Collection and monitoring of fines levied for not maintaining minimum number of days at sea.
Education	<ul style="list-style-type: none"> • Access to internet for instructional purposes and course materials
Atoll Administration	<ul style="list-style-type: none"> • Submission of regular administration reports • Financial reporting for collection of fees and fines • File transfer • Email
Environmental	<ul style="list-style-type: none"> • Weather monitoring and reporting

SUMMARY OF INFORMATION TECHNOLOGY ISSUES

In general, discussions with representatives of various ministries revealed vast differences in the level of information technology development and use. The most advanced were organizations with a specific and well-defined concrete purpose, and that adapted programs and/or practices from relevant international organizations. The Customs Service and the Airport Authority fell into this category. A second intermediate group had deployed basic office automation tools in a networked environment. Email and file sharing were apparent, along with some mission-oriented development. In general, those in this classification had had some earlier development that had been spurred on by Y2K fears. The third group made minimal use of information technology. Inhibitory factors here seemed to be fundamental incompatibilities of Ministry functions with modern business practices, or a corporate culture that seemed reluctant to adapt.

Many in senior positions have a reluctance to use information technology directly. Workstations are clearly on display but are seldom used. This leads to several related operational problems. Information is essentially second-hand, filtered by subordinates. This may mislead executive decisions as information and actions taken in response to information are delayed, with a negative impact on the organization as a whole. Poor understanding of the nature and power of information technology leads to the promulgation of inefficiencies through ineffective policies and procedures.

IT staff are frequently poorly or inappropriately trained for their roles. Advanced postgraduate education is often used as a reward or employee perquisite. While this may be

personally rewarding and beneficial to the individual, it can have a strongly disruptive effect on the development of IT within the organization. IT initiatives seem to be suppressed both while the individuals being trained are away, and in the months prior to their departure. IT staff can be loosely divided into two job-based classifications - support and development. It was observed that, for the most part, ministries tended to blend these functions to the detriment of both.

Support personnel do not necessarily need university training, but they do require intimate knowledge of their IT environment, how it works, how to implement fundamental changes, how to tune it for performance and how to fix it quickly in the event of failure. This knowledge is generally available through industrial training programs that are too often viewed less favourably than the more lengthy formal academic education programmes. The high level of commonality among the ministries in hardware, operating systems and basis applications could readily be leveraged to bring industry training to the Maldives.

Application development often suffers because the underlying traditional processes and “ministerial cultures” are fundamentally inconsistent with the nature of information technology. The Ministry of Finance, for example, will likely be forced to replace its present accounting procedures with modern Westminster-based concepts in order to achieve any effective use of information technology. Elsewhere in the world, process redesign is a fundamental element of IT deployment.

Ministries are eager to gather and archive relevant information, but its recovery and use are much less developed. There is a strong reluctance to rely on another ministry’s efforts. For example, the national identification card is not used by either the Health or Transport ministries. This leads to duplication and errors in the combined Government operations. In a similar vein, ministries are distrustful of information provided by others. For example, trade license fees are determined from re-analysis of raw Custom’s data rather than specialized reports that could be prepared by the Customs Service at less cost.

The number of qualified personnel in virtually all ministries and departments was either minimal to maintain the current status, or in some cases the likely cause of poor IT facilities. Sending key personnel for extended periods of education overseas aggravates the immediate staffing situation. It appeared that once this period of education was complete, reassignment was somewhat arbitrary, with little regard as to where the individual could make the greatest contribution. Also, pay levels are inconsistent with those available in the private sector. It is likely that under these circumstances the government will continue to suffer from the untimely departure of many of the best trained people.

Finally, there is little understanding of information technology and how it can be applied at senior levels within Government. While all senior personnel have a PC, few use them effectively. This tends to be extended throughout the use of information technology. Many strive to acquire the technology without understanding that possession of technology does not equate to its effective use. Government does not seem to track the acquisition and use of information technology resources. An annual reporting of IT expenditures, personnel, workstations and servers, network equipment and software by various classes would be an invaluable planning tool for Government.

At the present time there is no central coordination for information technology policies, standards and practices. This is one of the key roles that could be fulfilled by the proposed National Computer Centre (NCC). In addition to policies affecting the “mechanics” of information technology, this should:

- Determine IT policies needed to ensure effective and efficient exploitation of IT use in the private and public sectors such as financial services, media and publishing, tourism and leisure services, retail, wholesale distribution and e-commerce;
- Suggest policies to correspond to new IT requirements (especially on trade policies, privacy of personal data protection against illegal and harmful contents, etc.); and
- Develop policies concerning intellectual property and software use.

Communication costs and the existing regulatory environment are huge disincentives to the expanded use of information technology, especially for wide area application such as electronic commerce. There is clearly a conflict of interest between the regulatory authority and Dhiraagu. The current situation leads to decisions that are not always in the best interest of Maldivian consumers. Three options would seem to offer viable solutions: (1) open competition, (2) Dhiraagu as an independent regulated monopoly, or (3) the restructuring of Dhiraagu into a purely Government operation under the MCST.

Dhiraagu operates a backbone network providing telephone service to each atoll along the length of the country. The network, however, was designed specifically for voice and will require upgrading to be used for high-speed data. It is understood that most sites can be retrofitted without extensive costs or service disruption.

The development of a Government network offers an opportunity to create community telecentres at selected locations throughout the nation. These would provide a common point of access through which people could take advantage of the various Government online services, and query databases for research purposes. Most such sites may be situated in atoll or island offices.

THE NATIONAL COMPUTER CENTRE

The concept of a National Computer Centre has existed within Government for a number of years. It originated within the Ministry of Planning and National Development when that ministry operated the only data Centre in Government. The responsibility for instituting a National Computer Centre was transferred to the Ministry of Communication, Science and Technology when it was formed as part of a major Government restructuring in 1998. In the early days of IT, when all information technology revolved around mainframes and mini computers, the NCC was likely seen as operating a physical computer Centre. However, with changing technologies this is no longer feasible, nor desirable.

As the earlier discussion has indicated, a surprising variation exists in both the use of and reliance on information technology. A more valuable role for the National Computer Centre would be to reduce these variations. This would be achieved as a collaborative effort under a common leadership. That is, the NCC should facilitate an environment through which the stronger organizations can assist those that are less developed from an IT perspective.

The NCC is seen as fulfilling a dual role. First, it would serve as a coordinating body for the development of information technology standards and guidelines. It must first determine where standards and guidelines would be most effective in the development and use of information technology within Government, then develop a suitable plan for adopting, modifying or creating appropriate standards. Second, it would be responsible for the development and administration of the Government Network of Maldives (GNM), discussed below. The GNM is envisaged as a common government network that is designed to facilitate communication among ministries as well as to provide common services as a government Intranet with the goal of containing cost and increasing decision making effectiveness through the provision of accurate and timely data.

Names and Designations. The name “National Computer Centre” is really an anachronistic misnomer relating more to its origin than its future. In other jurisdictions, the functions foreseen for the NCC are carried out by an organization called the Information Technology Ministry or similar name. With virtually universal acceptance, however, the head of such an organization is known as the Chief Information Officer (CIO). Within government structures, the CIO position is usually equivalent to a deputy minister.

NCC Mission Statement. The National Computer Centre should cooperate and coordinate with appropriate bodies and agencies of government and the private sector, to ensure that information technology policies, strategies and programs are consistent with national development priorities and requirements. The mission statement of the NCC can be summarized as follows.

- Promulgate policies, programs and projects that will set the overall strategy and direction to fully harness and exploit IT for economic and social development, especially in addressing the needs of the less advantaged sectors of the society;
- Carry out, in cooperation with industry and other Government agencies, focused policy and technological reviews, studies, as well as research and development (R&D) projects, to accelerate the development of the local IT and allied industries;
- Facilitate the development and implementation of a Government information systems plan to accelerate the application of electronic governance in the country for greater productivity, wider public access to information and faster delivery of basic services;
- Develop and promulgate minimum standards and benchmarks for computerization and other IT-related activities in Government.
- Review (and possibly approve) proposed information systems plans of national government agencies, Government-owned and controlled corporations, and Government financial institutions.
- Provide IT consultancy and other related services to other government agencies, institutions, including Government-owned and controlled corporations and local Government units;

- Conduct a periodic information systems survey to foster a well coordinated and integrated development, Implementation and management of computer-based information systems and networks in government;
- Assist, as requested, Government ministries and agencies concerned in the review and design of IT education and training curricula to ensure a globally competitive human resource base for the sustainability of the country's knowledge-based industries
- Develop and implement a continuing national IT promotion program to improve wider public awareness and understanding of the national plan and vision; programs, projects and activities; and
- Perform such other functions as may be needed or required.

A key role of the NCC is to guide the adoption of information technology standards within Government. Specifically, the NCC should focus on four strategic directions for government standardization:

- Open Systems Interconnection;
- Electronic Services,
- Portability of Applications; and,
- Enterprise-wide Open Systems

The following discussion will attempt to clarify the nature of needed government standards, why they are needed, and what the NCC's responsibility in this area will be.

What is meant by a government standard? An NCC Information and Technology Standard is a standard that has been approved by the NCC following a consensus process that involves establishment, review and balloting and that is open to all ministries. The NCC would not arbitrarily impose information and technology standards on other ministries. Rather it would provide guidance and final approval of standards. The criteria for approval of standards is usually such that:

- Implementation of the standard will result in a significant benefit to the government by permitting open procurement, compatibility and optimization in its information and technology investment; or
- The standard represents a strategic direction that is in line with Government policies and objectives, and international trends.

IT standards cover a wide number of areas ranging from simple data format specifications (such as time, date and currency codes) to complex protocols for the exchange of information between systems of different vendors. Government standards work must be prioritized to emphasize the key areas that support approved strategic directions (such as doing more with less), the government agenda (such as cutting costs) or specific technical or policy requirements (such as protecting information). The NCC should focus on achieving and supporting an Open Systems Environment through standards for systems inter-working, information management, application portability, and IT security.

This consensus based standards development and adoption strategy would follow a three-step review and approval process:

- Standards and guidance documents would be reviewed by designated working groups of experts from participating ministries who determine the implementation and applicability criteria - how, when and under what conditions the standard is to be used.
- The standards are then submitted to a ballot process in which all ministries are invited to participate.
- Following approval and resolution of any comments, the standards are promulgated as NCC Information and Technology Standards and distributed on paper, diskettes, electronic bulletin boards and on CD ROM to ministries and the private sector.

Why are government standards needed? Inter-operability, portability of applications and wide connectivity of systems are essential in a world that increasingly operates electronically. Standards are essential to ensure that ministries are able to interact effectively with each other, government agencies, the private sector, and other organizations at the national and international level. Standards thus play a significant role in protecting a government's IT investment in technology and in preserving government electronic information. The NCC standards program should serve two functions. First, provide an internal coordinating role to promote the adoption of common standards and to harmonize ministerial policies. Second, fulfill an advocacy role with respect to user needs in the marketplace.

The future direction is toward a global information infrastructure (GII). All governments have an important role to play in interoperability of the GII by being an advocate for the importance and advantages of interoperability; participating in private sector led standards processes; and using open international standards and specifications in a common framework for government procurements. International consideration is essential because some treaties and international trade agreements impose a requirement to use international standards in procurement.

The NCC Information and Technology Standards activities should parallel those of other administrations (including the US, UK, Sweden, and the EU) in defining the standards to be used for procurement and systems development. This encompasses five different aspects:

- *Evaluation and direction setting:* The NCC would coordinate the development of user focused standards that are harmonized with industry and other countries
- *Policy implementation and review:* It would develop standards policies and assess the effectiveness of these policies
- *Co-ordination:* It would harmonize ministry positions with (national and) international standards bodies;
- *Promotion and liaison:* The NCC would ensure effective promulgation and understanding of standards and related policies; and finally,
- *Partnerships and alliances:* It would collaborate both with other ministries and the private sector to optimize resource utilization by sharing common development, research and technical initiatives.

This will require working closely with the various ministries to determine their priorities and find where standards are most needed; developing mutually beneficial cooperative

agreements or initiatives; and using the collective power of the ministries to achieve the common overall objectives.

As noted previously, it is important to base this effort on a consensus standards process. It is this process that is the core service of the NCC, and not the development of standards per se. The government standards process demands not only consensus of the ministries, but also consensus at the international levels. It is not in the best interests of any country to impose unique government requirements.

The approach that has proven successful in other countries is to work within a national standards system and to harmonize government requirements with national requirements; then to work in international standards committees to have national requirements met in internationally agreed standards; and lastly, to close the loop by endorsing international standards as national standards. The NCC should encourage ministries to be the prime movers in determining how, when and under what conditions such standards will be used within the government. Where necessary the NCC would take a leadership role in key technical or management areas as needed to produce the desired results.

Given the shortage of resources and the growing demands of the IT environment in Maldives, the standards program should rely on developing partnerships, and leveraging available expertise in each of the technical areas. For the most part, Government does not develop standards. Suitable standards that exist within the private sector, at the national or international level, or even in other administrations, would be reviewed and, where appropriate, adopted.

Direct efforts can be supplemented by adopting the investment in standards development that has been made by others. For example, Government, through the NCC, might establish a formal memorandum of agreement with the US National Institute of Standards and Technology (NIST) to obtain full access to the work of the US Federal Information Processing Standards program. It could also establish liaison arrangements with other national governments and the European Union to formally gain access to technical material such as standards, guidance documents and best practice documents. Such documentation could represent a very significant value and cost saving to the government.

What are the NCC responsibilities? The role of the NCC is to recommend and guide the development and deployment of the information technology infrastructure within Government through consensus with the various ministries rather than imposition of regulations. Once this has been decided, the next step is to lay out the scope of the overall work to be undertaken and, from that, determine what resources will be required and where they will be obtained. The scope of this process is limited to a general synopsis of the activities involved. It is strongly recommended however, that all resources needed to develop and maintain the information technology standards environment be ENTIRELY funded by Government without outside aid in ANY form. Total independence of external funding is the only way to ensure that the end result will be appropriately administered and maintained.

Table 2 provides a breakdown of the main areas in which the NCC should provide guidance for the use of information technology within the government. Within each of these general classifications, the table provides a representative sampling of the kinds of standards, specifications and guidelines that will be needed. From the breadth of the required standards base it is clear that this cannot be done in isolation. Not only is interoperability with the rest of the world an important consideration, but the level of effort that would be required makes

an independent approach impractical. Table 2 also illustrates the consensus nature that is essential for the successful integration and use of information technologies. For example, the Ministry of National Registration under the Ministry of Home Affairs, Housing and Environment is instituting a national identification number system to provide a universal identifier for each citizen. Few other ministries have adopted this identification as their common baseline for the provision of services to the public. Apart from immigration and emigration, most agencies have, or are planning to, implement an independent citizen identification reference. The role of the NCC here would be to document the nature of the national identification number and establish criteria for its use.

One possible approach to the planning and development of both information technology and the Government Network of Maldives (GNM) is illustrated in Figure 2. Overall direction and guidance falls to a Chief Information Officer (CIO). He is responsible for the establishment of the standards and guidelines and governing the development and operation of information technology within Government.

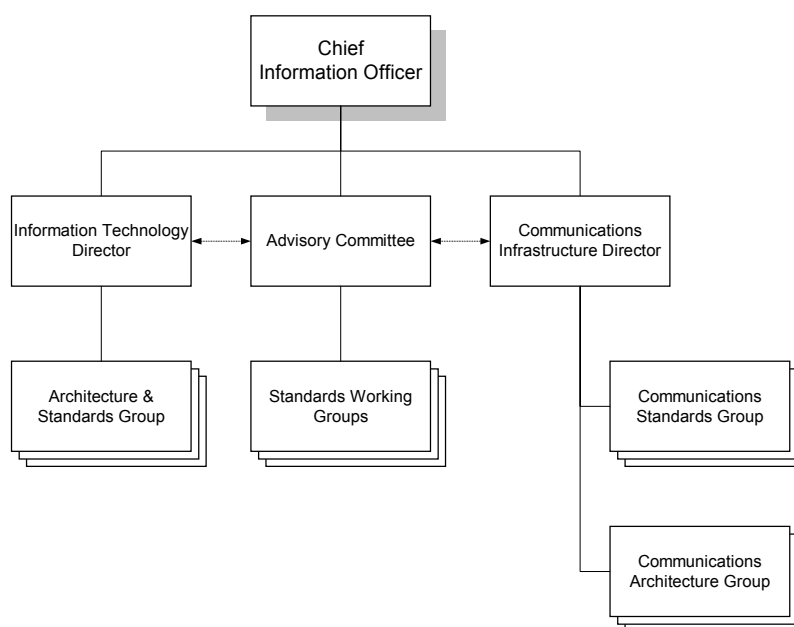


Figure 2 – National Computer Centre High Level Organization

The CIO is responsible for high-level development and planning of the information architecture. The CIO is responsible for the establishment of standards and guidelines within the government. This role encompasses communications architecture and standards.

Communications Architecture The Communications Architecture Group is headed by a communications infrastructure director. The group is responsible for the design and specification of the communication infrastructure that will provide the foundation for the GNM.

Communication Standards The Communication Standards Group is headed by an information technology director. The group is responsible for the development of the standards environment for communications

within the government. Responsibilities should include representation of Maldives on international standards bodies.

The Information Technology division, also headed by a director, is responsible for Information Technology related Architecture and Standards.

IT Architecture & Standards The IT Architecture & Standards group will be responsible for developing a common data processing and application development philosophy for Government. While international agreements or “recommendations” drive the communications sector, the data processing sector is largely driven by private industry. The role of this group is to develop a suite of IT guidelines and recommendations that will provide a common framework for IT development in the government.

Work between the communications and IT divisions is coordinated by an Advisory Committee that is also responsible for striking standards committees and other working groups as needed to build and maintain the standards framework for the government.

Advisory Committee The Advisory Committee will provide an ongoing integrated assessment of communications and data processing within the government. It is the group that will provide the overall vision for IT development. It will also identify areas where common government requirements can be addressed more effectively through common systems. The Advisory Committee comprises a small staff core, supplemented by specialized expertise that is seconded from within the government or contracted from private industry.

Standards Working Groups Standards Working Groups will be created as needed to develop or recommend adoption of communications and data processing standards and guidelines. Committees will be formed by seconding expertise as needed from other ministries and industry. A committee will be formed to deal with a specific issue or requirement, then disbanded once the task is complete.

Standards and guidelines affecting information technology in its many manifestations can be divided into three broad areas: Communications and Information Management; Security; and, Access to Information and Privacy. Table 2 provides a summary of the typical types of standards and guidelines that will be required within each area. Many may already exist; some will be prepared by other organizations, and some by the NCC. This is intended to show the context into which information and technology standards must fit. **Error! Reference source not found.**³ provides a more detailed list of IT specific standards and guidelines that must be developed or adopted. Many of these can be adopted or adapted from existing sources. A few will have to be developed from scratch.

Table 2 - A Framework for Information Technology Related Standards and Guidelines

<p><u>Communications and Information Technology</u></p> <ul style="list-style-type: none"> • Communications and Publishing • Information Technology Guideline • Guideline for Management of IT Projects • Management of Information Technology • Information Technology Standards <ul style="list-style-type: none"> • Data Interchange and Media Series • Databases and Documents Series • Operating Systems Services and Utilities Series • Programming Languages and Software Engineering Series • Quality Assurance Standards Series • User Environment Standards Series • Network Services Application and Management Series • Government Information Holdings • Other Information Management Publications <ul style="list-style-type: none"> • Primer on Databases for Managers • Database Guidelines for Managers <p><u>Related Areas</u></p> <p><u>Access to Information and Privacy</u></p> <ul style="list-style-type: none"> • Access to Information <ul style="list-style-type: none"> • Guideline for Access to Government Information • Guideline for Access to Personal Information • Privacy and Data Protection <ul style="list-style-type: none"> • Collection, Retention and Disposal of Personal Information • Employee Privacy Code • Delegation of Authority <p><u>Security</u></p> <ul style="list-style-type: none"> • Primary Security Issues <ul style="list-style-type: none"> • Security Policy • Information Technology Security Standard • Personnel Security Standard • Physical Security Standard • Security and Contingency Management Standard • Security and Contracting Management Standard • Security Organization and Administration Standard • Other Security Issues <ul style="list-style-type: none"> • Certification Policy and Practice Framework • Confidentiality and Privacy Manual • Manager's Security Policy Handbook

Table 3 – Requirement Details for Information Technology Standards and Guidelines

<p><u>Data Interchange and Media (DIAM)</u></p> <ul style="list-style-type: none"> • National Identification Number and Application • Business Identification Number and Application • Coded Character Set for Information Interchange • Codes for the Representation of Names of Countries • Codes for the Representation of Currencies & Funds • Representation of Dates and Times • Bar Coding • Micrographic Standards • Electronic Data Interchange • Electronic Imaging Standards • Smart Card Technologies <p><u>Databases and Documents (DBD)</u></p> <ul style="list-style-type: none"> • Database Language SQL • Standard Generalized Mark-up Language (SGML) <p><u>Operating Systems, Services and Utilities (OSSU)</u></p> <ul style="list-style-type: none"> • Application Portability • Application Program Interface <p><u>Programming Languages and Software Engineering (PLSE)</u></p> <ul style="list-style-type: none"> • Acceptable languages & applicable specs • Software Life-Cycle Processes • Evaluation and Selection of Computer-Aided Software Engineering (CASE) Tools <p><u>Quality Assurance (QA)</u></p> <ul style="list-style-type: none"> • Software product evaluation • QA in development • QA in Final testing and inspection • QA in production <p><u>User Environment (UE)</u></p> <ul style="list-style-type: none"> • Keyboard and presentation standards • English/Dhivehi (Thaana) requirements <p><u>Network Services, Application and Management (NSAM)</u></p> <ul style="list-style-type: none"> • Government Open Systems Specification • Message Handling • Naming and Addressing • Information Technology Security Standard • Cabling Standards •
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DEVELOPING A COMMON GOVERNMENT IT STANDARDS FRAMEWORK

The fundamental premise of the government information infrastructure should be a family of interconnected facilities and services, each implemented to meet specific ministerial needs, yet working together as a single environment. The successful development of this infrastructure will depend on a solid and consistent framework of underlying standards and guidelines. Changing technologies and techniques in the future will require an ongoing

review and revision of this standards framework. The CIO's office would be responsible for developing the initial baseline standards framework, then adjusting this as needed in the future. The key objectives are to:

- Increase the effectiveness and economy in acquiring and administering IT resources by promoting compatibility and inter-changeability of equipment applications and data.
- Establish a common process for developing, approving and implementing standards throughout the government;
- Reduce the duplication of effort and related costs; and,
- Coordinate information in national and international standards organizations and development.

While references to standards and guidelines are frequently used interchangeably, there is a clear difference between the two. Standards, when adopted are mandatory requirements. That is, all ministries must comply, and demonstrate the success or level of compliance in annual reporting. Guidelines, on the other hand, are recommendations. Ministries are free to chose alternatives, but must justify their choices in annual reporting and bear responsibility for these choices. Great care must be taken not to over-regulate. Standards and guidelines should be applied only if there is a clear operational or management advantage in doing so.

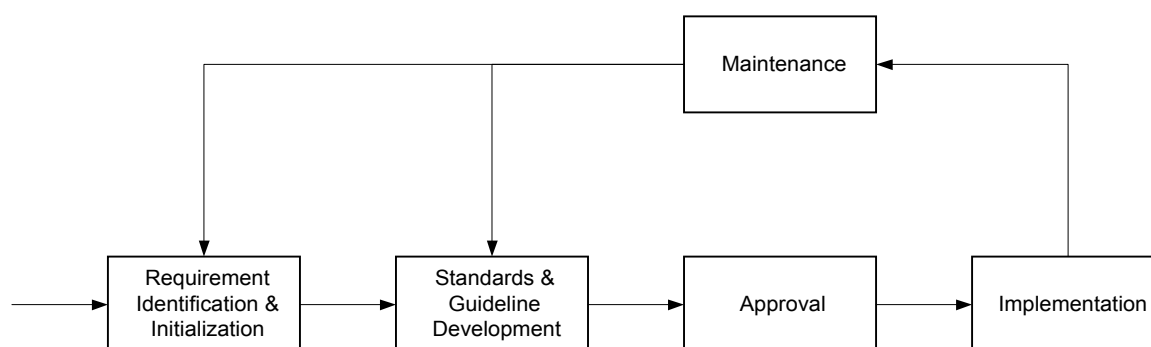


Figure 3 - Standards/Guidelines Development Process

The development of the initial IT environment, and the adoption of new information technology standards and guidelines should involve a five-stage process: initialization, development, approval, implementation, and maintenance. The following paragraphs provide a brief description of each step.

Initiation

Standards should be developed or adopted only when they can be seen to offer a clear benefit to government operations. The objective is to provide a framework where beneficial, while not limiting initiative or originality. Wherever possible, existing national, international or industry standards should be adopted or endorsed as 'government standards'. Independent standards should be created only when there is a specific need.

Development Standards would be developed by working groups convened for that specific task. The working group would assess the requirement, assess the applicability of existing or ongoing work of other standards bodies, and if needed, develop new standards. The working group would be comprised of experts drawn from government ministries and where appropriate, private industry. Working groups are established for a specific task, and disbanded when the development is complete.

The development process should follow an iterative approach similar to that used by other standards bodies. Draft versions would be circulated to voting institutions for review. Objections and recommendations would serve as the basis for the next draft. After consensus has been reached, the proposed standard would be submitted to the CIO for formal approval.

Approval Before CIO approval, the Advisory Committee on Information Management reviews the validity of the development process and comments on the impact of the standard and proposed implementation schedule.

Implementation After the standard and implementation plan have been approved, the CIO undertakes its implementation. Ministries and other affected institutions would prepare timetables for compliance with the standard, and report progress towards compliance in ministerial Information Management plans. Compliance plans and progress may be audited at the discretion of the CIO.

Maintenance Changing technologies and other factors may affect the applicability or relevance of approved standards. Each standard must be reviewed at least once every 5 years. When change is required, the process would be similar to that for a new standard.

Several ministries have already begun developing the communication and information technology environment needed to support administration and program delivery. Some are just beginning, while still others have little of the needed expertise. A key goal of the CIO must be to share expertise to level this playing field. The IT environment within each ministry will evolve independently, yet each ministry will accept the GNM in accordance with the ministry's needs for specific services, capacities and quality of service.

The following paragraphs provide a general overview of an infrastructure architecture that, over the long term, likely will be adopted within the individual ministries. It would divide the information processing environment into seven functional groups as illustrated in Figure 4, interconnected by communication environments that are appropriate to the group-to-group communication needs.

The core data repositories of the ministry reside at the Centre, and are serviced by the highest speed communication facilities and servers. Application servers form a second functional group with high-speed access to data repositories, and communication facilities providing medium to high-speed interconnection among group servers as needed by the specific applications. Analysis and reporting servers form a third group. These have high speed access to data repositories and are interconnected by facilities and services that are appropriate to the communication needs of the users and applications running on other servers. The security servers constitute the fourth function class. These servers regulate the

flow of traffic, provide authentication services, authorization services, and encryption as appropriate. Depending on the security level required, encryption services may be distributed so that information content is encrypted before entering the user LAN environment.

The fifth group encompasses development activities. This group would generally be equipped with a range of communications capabilities needed to develop and test applications in a realistic environment simulation. It would generally be a highly dynamic server cluster, capable of generating high loads and changing configuration as applications are developed, tested or revised. In general the development group should have restricted access to the data repository, with read only privileges. Depending on testing requirements, access to the data repository would generally be controlled by the security group.

Local users, or “headquarters users,” form a sixth group that constitutes the workstations commonly associated with the network. They have access to the server by means of a local area network with performance geared to the needs of the specific users. For example, most users will receive satisfactory performance when served by a conventional 10Mbps Ethernet LAN, either switched or shared. Intensive users could be served with 100Mbps or gigabit LAN services as appropriate to their needs. The headquarters group may actually be a number of physically separate groups, with separate LANs, and possibly in separate buildings.

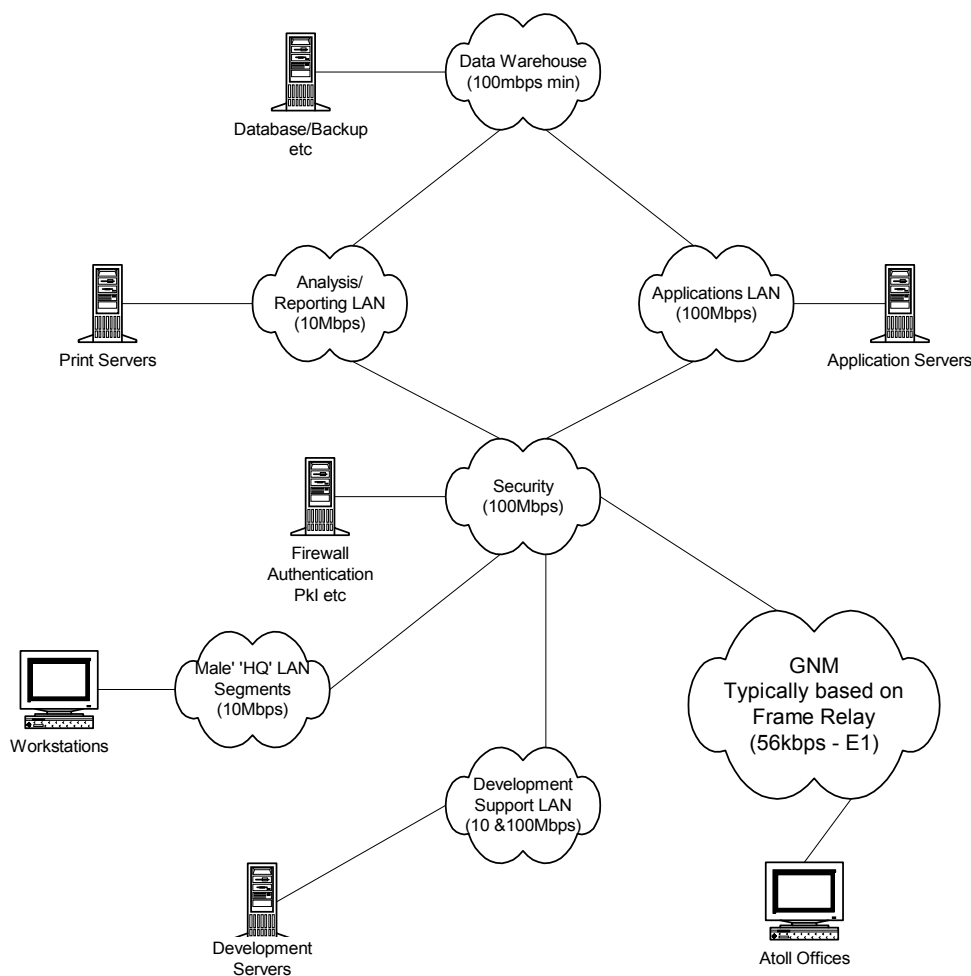


Figure 4 - Overall Communication Concepts within a Large Ministry

The mission of the CIO is to provide overall development planning and direction for the Government information infrastructure. This should begin with the creation of a common framework of IT policies, standards and guidelines. This should be achieved by drawing on, and assigning specific components to ministries where appropriate expertise already exists. It would include participation in the development of international and industry standards through participation in international standards bodies. Based on this framework, and the deployed service infrastructure, the CIO must undertake an ongoing planning program to ensure that the Government infrastructure will maintain its reliability and efficiency as technologies change.

The development of the Government information infrastructure will have far-reaching effects on Government as a whole and on individual ministries. It will bring improved efficiency in program delivery, and more reliable, accessible and accurate information. In turn, these will bring a requirement for new skills, and will have a fundamental effect on the overall working culture within the government. The development plan must address each of the affected areas, identify potential risks, and determine a path that will avoid or resolve problem areas. The work would be conducted as a series of independent, yet coordinated studies – in essence “black box” studies with their own inputs and outputs. Those studies that affect the fundamental concept and philosophy of the Government infrastructure should be conducted

internally. Others relating to technical and non-policy issues could be contracted out to consultants. In either case, Government must ensure that the individuals involved have appropriate expertise and experience.

The development process, as illustrated in Figure 5, is divided into four high level phases: situation analysis, preliminary design, detailed design and implementation. Each comprises several component tasks and projects with specific inputs and objectives. As part of the planning process, each of these high-level phases will, in turn, be divided into component phases, and these subdivided into separate projects and their component tasks. A brief overview is provided in the following paragraphs.

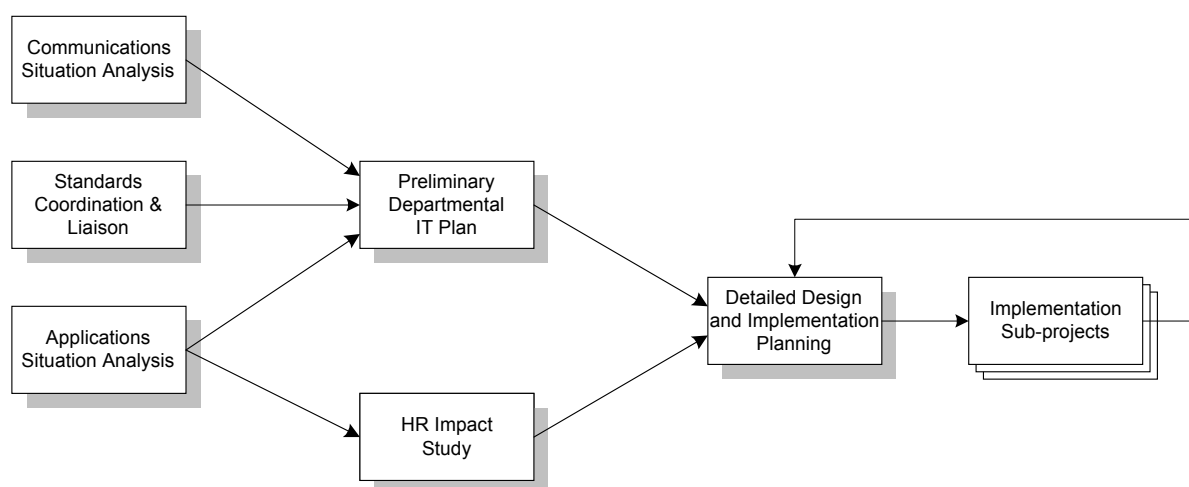


Figure 5 - High Level Network Implementation Plan

Phase 1 – Situation Analysis

Phase 1 provides an overall situation analysis that defines the baseline for development. It will require several independent studies to be undertaken, covering applications, communications and standards.

Communications This study will conduct an assessment of the existing communication environment within Government including both LANs and wide area networks. It can be assumed that the existing facilities support current needs. The objective of this study is to provide a base line reference for the deployment of new applications. The study should produce a community of interest or similar traffic model, along with an associated cost model.

The final study will enable Government to determine cost impacts as new services and applications are added, and the networks are expanded to support new points of service. An outside consultant would likely carry out the communications study.

Applications An application study would catalogue the infrastructure needs of existing applications. It must determine the net cost and operational

impact of new applications as they are developed. This study will not determine which applications are needed or should be developed. Rather, it starts with the assumption that each application has already been subjected to a separate and independent ministerial cost/benefit/risk scrutiny.

The study would identify those applications that are common to all government ministries, and assess whether centralization could bring savings or improved service levels to Government operations. Assessments of the component applications for each application would be done by the most appropriate ministerial representatives or private resources

Standards

The objective of the standards study is to develop an overall standards and guidelines framework for Government's IT environment. It will define a timeframe within which legacy systems will be modified to conform to overall government criteria. The standards study will determine how ministries would adopt the governments recommended guidelines, and determine a project framework for conformance. Standards will encompass a broad range of IT areas from communications to databases to operating systems. The work should be carried out in-house in close coordination with the ministries. This function will retain an ongoing presence. Its influence and direction will be not only at this stage, but will be ongoing in areas such as determining minimum LAN performance standards, workstation hardware/software standards, security issues, and all other areas where common approaches and minimums must be established and maintained.

Phase 2 – Preliminary Design

Phase 2 of the development will encompass two interdependent areas: a human resources impact assessment and the preliminary design of the information infrastructure. The final result will be a pair of studies that form the basis for final decisions concerning the nature and deployment of the ministerial information infrastructure.

Preliminary Design The preliminary design will provide a concept to Government of the information infrastructure. It will present and classify options, and, in concert with the human resources element, recommend an overall architecture. It will provide the first level definition and recommendations for a wide range of options and decisions. These will include the nature and general architecture of ministerial LANs and wide area network. It must recommend the basic services that will be needed to supporting the operating environment, including directory services, security, access, backup, and the whole range of services that will be common to the ministry as a whole. It must also include the related support services and systems such as help desk and mechanisms to support moves, adds and changes.

This major undertaking will provide sufficient detail for final cost analysis, as well as peer review that will choose among the options presented and establish priorities. This work should be allocated to an outside

contractor. The contractor can provide the needed cross-section of skills, since not all may yet reside within a given ministry. It should be expected that recommendations arising from this work might be controversial. Acceptance, and cooperation, throughout the ministry may be improved if the more contentious recommendations come from outside.

Human Resources A human resources study must be conducted to determine the overall impact of IT changes on ministry resources. Personnel with appropriate skills and experience will be required for application support, communication design, operation and maintenance, help desk and related functions. Many of these needs currently exist within the ministry. More importantly will be the impact of planned applications on the nature of the ministry. Skills will be made obsolete, new skills will be needed. Retraining and ongoing education will become ever more important as manual traditions are slowly superseded. The focus of this study is to assess the impact on the present environment, to identify strengths and weaknesses among existing personnel, and identify how to acquire needed skills through training or recruitment.

Phase 3 – Detailed Design and Implementation

The third phase is the detailed design and planning. During this phase, the preliminary design recommendations will be resolved and finalized. The work breakdown provided by the preceding studies must then be translated into sub-project specifications that can be tendered, and statements of work for those elements to be conducted in-house. The supporting organizational structure and job descriptions must then be developed within this phase, and contracts awarded for procurement of essential systems.

A critical component of the final review is to establish priorities among recommendations arising from the preliminary design and human resources impact study. Priorities and schedules must also be established for the deployment of applications and services. The project team must also identify recommended elements that will not be undertaken as part of the initial deployment. Finally, all of these must be integrated to provide a seamless transition (in so far as possible) from the existing environment to the new operational concepts. This would include a combined plan for the release of new applications, the introduction of new software and similar introductions that will change administration or mission delivery characteristics.

Figure 5 illustrates the detailed design and implementation planning resulting in a family of sub-projects that can be contracted out for implementation. In most cases, these subprojects will have been designed and specified by completely independent application and operations groups. The planning input will not remove existing controls from these projects. Rather, it will provide an implementation schedule and framework, and receive feedback to resolve unforeseen operational issues as they arise. The objective is to ensure that individual applications can be deployed smoothly, and that needed facilities are in place for their use.

Feedback to the program from the application implementation subprojects would flow through the planning group, which provided the initial contribution for standards and liaison under Phase 1. It is envisaged that this group would be, or become, the standards body within the ministry, and work closely with overall telecommunications policy development.

THE GOVERNMENT NETWORK OF THE MALDIVES

The concept of a common government network has been under active consideration for some time. In early 1999, a project document was prepared for the Ministry of Communication, Science and Technology to lay the foundation for the development of a common data communication network to be known as the Government Network of Maldives (GNM). It is not within the scope of this current program to update and expand on this work; however, a number of observations are appropriate.

14. The study surveyed the extent of information technology penetration within Government organizations. It summarized the existing networks and technologies along with the major uses of information technologies and tailored applications within the government. As part of the current program several of these ministries and agencies were interviewed. In summary, the previous work was extremely optimistic. With few exceptions, the penetration and effective use of information technology is far below the level that was purportedly observed in early 1999, almost two years ago.

Several ministries were found to be operating local area networks. Some of these were peer-to-peer networks used for file sharing. Many provided basic services such as email, but the organizations actually made minimal use of such facilities. In some cases the “network” was confined to a few machines in a single room with no connection to any other workstation in the facility.

Certain ministries have established the foundations of modern workplace information technology environment that are noticeably more advanced. The common thread seems to be that there had been previous use of information technology and the fear of Y2K problems had spurred independent learning, modernization and expansion. In a few cases, the information technology environment was found to be comparable to other facilities in any other part of the world. The impetus for these organizations seemed to have been active involvement with external regulatory bodies (Airport Authority) or use of internationally standardized applications that were then tailored to better fit unique Maldivian needs (Customs).

The Government Network of the Maldives will be a facility designed to support communications through virtual private networks within ministries, communications to support the exchange of information between ministries, and to provide a secure gateway between Government and the Internet. The network would comprise two separate components: a metropolitan network serving ministry offices located within Male’, and, a wide area regional network extending from Male’ to serve the atoll capitals and eventually island administration offices.

The metropolitan component of the network will be a high-speed facility whose performance can grow in controllable steps to accommodate the changing demands of the each ministry. This will be an essential feature to maintain costs during the initial years of network operation. Few ministries currently have a developed information technology infrastructure. Both the physical infrastructure and applications must be developed before a ministry will be in a position to use the GNM for more than email or Internet access. In many cases these technological changes must be matched by changes in corporate culture. This latter requirement may prove to be more difficult to achieve.

The wide area network will follow once the metropolitan network has been established and major applications are in place and fully operational. If funds permit, the wide area network could be deployed in parallel with the metropolitan network. It is likely however, that the use of the network at this stage would be for email and Internet access.

The foundational system will be a metropolitan network serving ministry offices in Male'. Other documents have recommended the development of a network based on gigabit Ethernet technology, however this approach is NOT recommended. In fact it would be unwise for the MCST to become involved in the day-to-day operation of the network without a significant infusion of experienced personnel to the Ministry. It is essential that the network operates with the availability and performance normally expected of a carrier operation. Anything less will erode confidence and ultimately delay information technology development throughout the government.

Elsewhere, networks of this size and projected scope are frequently implemented using frame relay. This is a mature technology that can provide adequate capacity for ministerial needs, coupled with quality of service metrics and controls. Unlike an Ethernet environment, it essentially provides a virtual private line network that inherently supports virtual private networks. Thus if desired, the GNM could be designed to provide the largest ministries with their own virtual private network (even country wide if needed), while permitting the operation of a common intranet to serve overall Government needs. The main drawback is that Dhiraagu controls access to key sites in the atolls, but does not presently offer frame relay. The most likely reason for this is lack of demand resulting from low IT use throughout the country. The first step in the development of the GNM must be to strike an appropriate and mutually beneficial arrangement with Dhiraagu.

The physical architecture of the GNM should be based on a fibre optic star topology, using the Telecommunications building as the initial distribution site. The Telecommunications building is centrally located and already configured for telecommunications use. It has ready access to Male's existing communication duct network beneath the street. Use of the duct system would facilitate cable installation while minimizing construction cost.

The detailed design of the network would determine an initial community of interest (COI) and assess how the COI will evolve over the short and medium terms as the different ministries progress with their individual IT development plans. This sequencing would then be blended with priorities of national importance to establish a construction community of interest. The network construction would be staged, extending network links to ministry offices in various buildings based on a hierarchy of communication need.

The expansion of the GNM to the atolls would be carried out progressively. The GNM link to any given atoll capital would be designed to serve the needs of the atoll office. As resources permit, access capacity could be made available to the atoll school to provide Internet access for instructional purposes. Deployment of the GNM atoll extensions would likely comprise one of three types of facilities as dictated by communication needs. At the basic level, the atoll office would have a dial connection to the GNM in Male' for email, file exchange and access to applications. All communications would use secure 56-bit encryption and be protected by an appropriate password facility. The supporting server in Male' must provide sufficient storage capability to hold the anticipated traffic for a minimum of 48 hours without information loss. Each user in the atoll office would be provided with an individual

access with appropriate security restrictions, as well as a unique email account. If the atoll office has more than one workstation requiring access to the GNM additional dial connections would be required. Depending on the observed email traffic, a workstation in the atoll office could fulfill a double role by also managing email, making periodic connections to upload or download traffic. Based on the information available to date, including known ministerial applications, all atoll offices would initially require only dial access.

Atoll offices with higher traffic requirements would be linked to the GNM access server by means of a dedicated private line. It is assumed that the transmission speed would be a basic 64kBps. Communications over private lines would not need to be encrypted unless there is a specific operational requirement to do so. In that case, there should be a cost/complexity review that could decide to encrypt all communication with that office. If more than one workstation requires access to the GNM, then a router would be added within the atoll office to provide the appropriate resource sharing and security features.

It is likely that traffic volumes to and from the GNM will be cyclic. For example, the link may be used near capacity near month end yet sit virtually unused at other times. At these times it may be possible to permit the local schools or health centres to use this spare capacity for accessing the Internet. This would require special accounts and security measures to be used to ensure that students and other such users are denied access to Government information. Any research project involving the collection of data from the ministries would be routed through the Internet.

As the traffic load increases beyond the ability of the private line to provide adequate performance, the connection would be upgraded to frame relay technology or the equivalent replacement at the time. An appropriate router and server configuration would be installed to serve the office and minimize line traffic while providing the throughput needed for day-to-day operations. Assuming the GNM evolves into a fully functioning Intranet, the server would also cache frequently accessed sites to minimize unnecessary traffic. It is likely that atoll offices with this type of requirement will also have to be equipped with a small LAN to serve strictly local needs. Here, too, it may be possible to allow excess capacity to be used for educational or other public purposes.

Island offices would connect directly to the GNM in Male' using a 56KBps dial-up link with 56bit encryption. A separate account would be provided for each person at the island office. If simultaneous access were required by more than one workstation, then separate dial-up connections would be required.

IT is not conterminous with the S&T applications that concern this Master Plan. Many S&T applications (e.g. science education, health procedures, transport innovations) are functionally separate from IT. However, IT is the most pervasive of the current S&T initiatives and, in the aforementioned areas such as education, health, and transport (and in most others), IT will have a critical role to play. In Maldives, IT utilization has evolved relatively slowly and inconsistently. A critical role for Government and the private sector generally, and for the MCST specifically, is to facilitate a more effective IT environment as a foundation for broader S&T development.

