Myanmar – Japan Cooperation Programme for Structural Adjustment of the Myanmar Economy

Information and Communication Technology Working Group

March 2003

The Government of

The Union of Myanmar

Japan International

Cooperation Agency

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Foreword

This study was conducted within the framework of the technical cooperation programme of the Government of Japan, in response to the request from the Government of the Union of Myanmar.

The study was carried out as a joint research by taskforce teams, consisted of professionals from both Japan and Myanmar, and assisted by consultant teams from leading institutes in both countries.

The taskforce and consultant teams held a series of discussions, and conducted several field surveys. This report was prepared jointly by Japanese and Myanmar taskforce teams based on a mutual understanding.

I hope that the useful suggestions presented in this report will contribute to the formulation of policies for sustainable development of Myanmar, and it would be my great pleasure if the report would be used practically by organisations, officials and experts concerned.

I wish to express my sincere appreciation to the officials in the Government of the Union of Myanmar and to other relevant organisation and people concerned for their close cooperation and valuable input in the study.

March 2003

Takao Kawakami
President
Japan International Cooperation Agency

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Member List of the Taskforce

I. Final Report

**Myanmar-Japan Economic Structural Adjustment Programme
ICT (Information and Communication Technology) Working Group**

Yangon, Myanmar

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Acronyms

ADSL	Asynchronous Digital Subscriber Line
AFSIT	Asian Forum for Standardisation of Information Technology
AIST	Agency of Industrial Science and Technology, Japan
AMPS	Advanced Mobile Phone System
ATM	Automatic Teller Machine
BCT	Bagan Cybertech
CA	Certification Authority
CAD	Computer Aided Design
CAM	Computer Aided Manufacturing
CDMA	Code Division Multiple Access
CDP	Computing Development Project
CICC	Centre of International Cooperation for Computerisation, Japan
CIO	Chief Information Officer
CMMI	Capability Maturity Model Integration
CRM	Customer Relationship Management
D-AMPS	Digital Advanced Mobile Phone system
DOMSAT	Domestic Satellite
DSA	Digital Signature Act
DTAVE	Department of Technical, Agricultural and Vocational Education
ECA	Electronic Commerce Act
ERM	Enterprise Resource management
ERP	Enterprise Resource Planning
ETA	Electronic Transactions Act
ETO	Electronic Transactions Order
GIS	Geographical Information System
GMPCS	Global Mobile Personal Communication via Satellite
GPKI	Government Public Key Infrastructure
GSM	Global System for Mobile Communication
ICT	Information and Communication Technology
INTELSAT	International Satellite
IP	Internet Protocol
IPRs	Intellectual Property Rights
ISDN	Integrated Services Digital Network

ISO	International Standardisation Organization
JITEC	Japan Information Technology Examination Centre
JITEE	Japan Information Technology Engineer Examination
LAN	Local Area Network
MCF	Myanmar Computer Federation
MCIA	Myanmar Computer Industry Association
MCSA	Myanmar Computer Scientist Association
MERB	Myanmar Education Research Bureau
METI	Ministry of Economy, Trade and Industry (Japan)
MICT Park	Myanmar ICT Park
MLIT	International Symposium on Multilingual Information Technology
MOE	Ministry of Education
MPT	Myanmar Posts and Telecommunications
MRP	Manufacturing Resource Planning
MRTV	Myanmar Radio Television
MSP	Multimedia School Project
OJT	On the Job Training
PKI	Public Key Infrastructure
QAM	Quadrature Amplitude Modulation
RIX	Regional Internet Exchange
SCM	Supply Chain Management
SDH	Synchronous Digital Hierarchy
SDP	Service Delivery Point
SEA-ME-WE 3	South East Asia-Middle East-Europe 3 (an intercontinental submarine cable)
SME	Small and Medium-sized Enterprise
SWIFT	Society for Worldwide Inter-bank Financial Telecommunication
TEDI	Trade Electronic Data Interchange
TRIPS	Trade Related Aspects of Intellectual Property Rights
TTP	Trusted Third Party
UCC	University Computer Centre
UCSM	University of Computer Studies, Mandalay
UCSY	University of Computer Studies, Yangon
UDE	University of Distance Education
UNCITRAL	United Nations Commission on International Trade Law
UNDP	United Nations Development Programme

VSAT	Very Small Aperture Terminal
WAN	Wide Area Network
WAP	Wireless Access Protocol
WDM	Wave-length Division Multiplex
WIPO	World Intellectual Property Organization
WLL	Wireless Local Loop
xDSL	x Digital Subscriber Line

1. Introduction

1. Information and Communication Technology (ICT) is recognised as a key element in implementing political, economic and social objectives in Myanmar. The Information and Communication Technology Working Group (ICTWG) believes that Myanmar can compete effectively in the international ICT industry particularly in the software sector. There are many opportunities for the application of ICT in socio-economic organisations to increase productivity and market penetration, reduce costs and improve services so that they can compete in the global market. Systematic efforts in ICT development would provide Myanmar with opportunities to leapfrog and catch up with the developed countries.

2. Developments in ICT in the last couple of years indicate that there are dedicated and concrete efforts in Myanmar, in both the public and private sectors. But the pace of development can still be improved so that Myanmar can narrow the digital divide.

3. The ICTWG believes that in order to improve the pace of ICT development, Myanmar requires both technical and financial support along with cooperation and collaboration with other countries. Considering the long history of successful cooperation, cultural compatibility, and ICT-related problems and opportunities of Myanmar and Japan, the two countries have much to offer each other if they collaborate effectively in ICT development.

4. Based on the preliminary studies, the ICTWG identified five areas of focus: ICT Infrastructure, ICT Legal Infrastructure, ICT Education, ICT Application and ICT Industry. Five study teams were formed accordingly. This report is based on the findings of the ICT survey on public organisations by the ICT Application Committee of the e-National Task Force of Myanmar, the ICT survey on the private sector by MCF, the survey on telecommunication infrastructure in Myanmar by Japanese experts, and in-depth studies by the study teams.

5. This report describes the present situation and future trend of ICT development in Myanmar. Strengths, weaknesses, opportunities and problems are identified and recommendations are provided for boosting ICT in Myanmar. The ICTWG is confident that implementation of the recommendations would speed up ICT development in Myanmar and provide an excellent opportunity to make great strides in socio-economic development.

6. The report attempts to provide policy recommendations covering all the areas or programs for ICT development in Myanmar. The ICTWG believes that Myanmar and Japan can co-operate in almost all areas for their mutual benefit and that Japanese assistance would be welcome in all ICT development efforts.

2. Historical Background

Early Computerisation Efforts in Myanmar

1. ICT was introduced in Myanmar quite early with the establishment of the University Computer Centre (UCC) in 1971. The Computing Development Project (CDP) financed by UNDP was implemented in 1983. The purpose of the project was computerisation of government organisations. Unfortunately, these early efforts could not be sustained due to various reasons.

Recent ICT Developments in Myanmar

2. The Myanmar Computer Science Development Law was promulgated in 1996 and consequently the Myanmar Computer Science Development Council, headed by General Khin Nyunt, Secretary (1) of State, the Peace and Development Council, was formed. Three NGOs, the Myanmar Computer Scientists Association (MCSA), the Myanmar Computer Industry Association (MCIA) and the Myanmar Computer Enthusiast Association, were formed in 1998. With representatives from these associations, the Myanmar Computer Federation (MCF) was formed in the same year. The federation and associations did an exceptional job in improving awareness of the power of ICT.

3. The Ministry of Science and Technology, created in 1997, is specifically responsible for ICT human resource development. Two universities, one in Yangon and one in Mandalay, plus twenty-four regional computer colleges dedicated to ICT professional education, were established under the Ministry.

4. In November 2000, heads of ASEAN countries signed the e-ASEAN Framework Agreement and the e-National Task Force was formed to coordinate efforts towards the implementation of the Agreement. Six committees were formed: ICT Infrastructure, ICT Legal Infrastructure, ICT Education, ICT Application, ICT Standardisation and ICT Liberalisation.

5. MCF has already prepared and submitted a draft ICT Master Plan to the Council. The draft Master Plan has been approved by the council as the guiding principles for all ICT development efforts in Myanmar.

6. In 2002, a consortium of private companies established the Myanmar ICT Park, a special zone where adequate facilities and support are provided for ICT companies.

Myanmar-Japan ICT Collaborations

7. Myanmar-Japan ICT collaborations started in the mid-1990s and have evolved in parallel with the Economic Adjustment Policy Dialogue between the two countries.

8. Initial contact between ICT industry leaders and experts from both countries was established in 1996. This happened to coincide with the emergence in Myanmar of the ICT associations mentioned above, and was followed by a series of fruitful and mutually beneficial interactions and collaborations between the two countries.

9. In response to the global Y2K problems, Japanese experts visited Myanmar and worked with their counterparts to ensure that Myanmar would be prepared for any Y2K trouble. The visits were made possible by the support of the Japanese Ministry of International Trade and Industry (MITI, the forerunner of the current Ministry of Economy, Trade and Industry, METI).

10. In the field of ICT human resource development, Myanmar has sent trainees to Japan to attend ICT training courses hosted by the Centre of International Cooperation for Computerization (CICC). Although the number of trainees was limited, the programme has promoted mutual understanding.

11. Collaborations were also visible in the field of ICT standardisation efforts. In October 1998, the 13th Asian Forum for Standardization of Information Technology (AFSIT) and the Third International Symposium on Multilingual Information Technology (MLIT) were held in Yangon through the co-sponsorship of MCF and the Agency of Industrial Science and Technology (AIST), a technology arm of MITI. These international symposium were the first ones held in Myanmar in the field of ICT, and were attended by experts from more than twenty Asian countries.

12. The most recent and most important event was the creation of the e-Learning Centre in the Myanmar ICT Park, Yangon. Japanese METI helped to bring about this joint project. The centre has produced more than 200 ICT professionals since its inauguration.

13. Mutual understanding and human resource networks created through these bilateral collaborations have formed a sound basis for fruitful and effective dialogue organised under the ICT Working Group.

Major Milestones

1996   Myanmar Computer Science Development Law promulgated
       Myanmar Computer Science Development Council (MCSDC) formed

1997   Ministry of Science and Technology created

1998   Myanmar Computer Federation (MCF) formed

2000   e-ASEAN Framework Agreement signed by leaders of ASEAN countries
       e-National Task Force formed

2001   ICT Master Plan (2001-2010) approved by MCSDC

2002   Myanmar ICT Park established

       e-Government projects initiated

3. Executive Summary

Summary of Findings

ICT Infrastructure

1. The basic infrastructure is moderately developed. MPT is constructing optical fibre routes linking major cities as the national backbone. Fibre links between Yangon and Mandalay are completed and links between other large cities are in progress. Fibre links between exchanges in Yangon and Mandalay are completed. Digitalisation of switches is progressing.

2. Bagan Cybertech introduced wireless local loop in Yangon and Mandalay and broadband data service using iPSTAR for remote and rural areas.

3. An international linking service is provided by both satellite and SE-ME-WE3 submarine cable, but bandwidth is still very low. Internet access quality in terms of speed and reliability needs considerable improvement. Availability of Internet environment is also needed in rural areas to bridge the digital divide.

4. Improvement of the 'Last-mile Link', which links subscribers with the network backbone seems quite slow.

5. Internet service is still at the initial stage in Myanmar. Dial-up is the main method of access even though some high-end users are installing broadband wireless loop and iPSTAR. Affordability is also a major problem.

6. The tele-density in Myanmar is 0.6%, the lowest in ASEAN. Other than a fixed telephone network, mobile telephone networks (Cellular, CDMA, GSM) have been introduced, but they are very expensive and difficult to subscribe to.

7. The availability of local content is limited. The role of the private sector is also limited in providing more activities, higher efficiency, lower prices, better quality, and more diversity in services.

8. End-user devices are not sufficient. PC penetration is considered moderate, cellular penetration is still low and WAP service is not available. This coincides with the insufficient development of the overall ICT infrastructure.

ICT Legal Infrastructure

9. The Computer Science Development Law, promulgated in 1996, is specifically designed for ICT development.

10. The e-Legal Infrastructure Working Group decided to develop stop-gap measures to speed up the implementation of e-commerce activities in Myanmar before cyber laws can be

promulgated. The temporary measures include special orders based on detailed studies of existing laws to strengthen e-commerce activities.

11. On July 10, 2002, the e-Legal Infrastructure Subcommittee released a stop-gap measure order that is largely related to the setting up of wide area networks.

12. The first draft of the comprehensive cyber law "Electronic Transaction Law" was completed in November 2002 and is currently under discussion by the subcommittee members. The draft will be circulated among government and private organisations through the e-National Task Force. The law is expected to be released before the end of 2003 after going through all the governmental procedures.

ICT Education

13. Myanmar has set itself the goal of ensuring that every child leaving school is familiar with computers and is scientifically literate.

14. The government has collaborated with the private sector and local communities to establish multimedia classrooms and small computer laboratories in high schools. A total of 991 existing schools were implemented as Multimedia Schools and 3 schools were implemented as 'Smart Schools'. Out of the 991 Multimedia Schools, 238 have been upgraded to Electronic Learning Centres.

15. The University of Computer Studies, Yangon (UCSY) and the University of Computer Studies, Mandalay (UCSM) offer degrees in Computer Science, Masters Degree programs, pre- and post-graduate diploma and doctorate programmes.

16. Twenty-four government Computer Colleges were opened in states and divisions.

17. There are a total of 150 universities and colleges that are administered by 13 Ministries in Myanmar. Out of 152 institutions, 62 are colleges, degree colleges and universities and institutes under the Ministry of Education. A thirty-year Education Development Programme was introduced starting from the year 2000. ICT Learning Centres, Electronic Resource Centres and Computer Training Centres were formed at these institutions.

18. Every student must take 30 hours of ICT literacy courses in an academic year as a compulsory course in universities and colleges.

19. The Ministry of Education with the co-operation of the Ministry of Information launched the Data Broadcasting System for Distance Education. A total of 189 townships have been provided with learning centres - 238 centres at high schools and 66 centres at universities. More than 304 Learning Centres have been established at colleges, degree colleges, universities, institutes and Multimedia High Schools.

20. The Ministry of Education has already established an Education Intranet System in Myanmar

by using fibre optic lines, VSAT and iPSTAR. The Intranet links the Ministry office, the Department of Higher Education (lower & upper Myanmar), the Department of Education Planning, the Department of Basic Education (No. 1, No. 2 and No. 3), colleges, degree colleges, institutes, universities and New Century Resource Centers. Internet access is provided at the university and college level.

21. At present, there are as many as 70 private computer schools in Yangon alone, several of which provide diploma and degree courses.

ICT Application

22. Application of ICT in the government and public sectors is slower than in the private sector.

23. Application of ICT in the trading sector is increasing gradually. Large supermarkets and export/import companies are computerising their activities at various levels, mainly for sales processing, inventory control, accounts and office work. A very low percentage of small- and medium-sized trading enterprises are computerised.

24. Application of ICT is most visible in the financial sector. All private banks have computerised branch activities and some banks are preparing to introduce Intranet systems linking the branches; e-banking systems have already been initiated. One bank has installed Automatic Teller Machines (ATMs) and another one has introduced the Smart Card system. But computerisation in the public financial sector is lagging far behind.

25. Application of ICT in the manufacturing sector has already started, but computerised activities are mostly in traditional areas such as office automation, inventory control, sales and purchases, staff management, payroll and accounts. There are only a few cases of ICT application in Computer Aided Design/Manufacturing (CAD/CAM) and Manufacturing Resource Planning (MRP). ICT applications at the level of Supply Chain Management (SCM), Customer Relationship Management (CRM), Employee Relation Management (ERM), Enterprise Resource Management or Planning (ERP) have not yet been introduced.

26. Myanmar's attempt to use ICT in education is encouraging. The government strongly supports the use of ICT in education. Multimedia classrooms are established in almost all high schools. There are attempts to use ICT to teach not only ICT but also other subjects. However, there is little effort spent on content creation. Internet access has not yet been provided for education, but efforts to establish an educational Intranet are in progress. Only systematic and continuous planning and control will guarantee the effectiveness.

27. Application of ICT in health is at a minimum level. There is preparation for the creation of an Intranet in the Ministry of Health with the goal of improving medical education. There is little effort on application of ICT in improving public health care.

28. Application of ICT in environmental protection does not seem to receive the proper attention. There is little effort on electronic handling of science, social, geographic, natural resources, and population information.

29. Computerised systems are mainly in transaction processing and operational control and the use of ICT in strategic-level planning is very rare.

30. ICT is used mostly in support functions such as accounts, payrolls, and office work. Use of ICT in main activities such as production, supply chain management, customer relationship management, and human resource management is rare.

31. Most computerised applications are standalone. Development of more beneficial integrated systems within and between organisations, between regions, sectors and the national level is still rare. Considerable efforts on cooperation and standardisation will be necessary.

32. The batch processing mode is more common. On-line and interactive processing using the existing infrastructure is difficult and costly.

33. Distribution and application of ICT is concentrated in Yangon and Mandalay, making it very difficult to develop information systems, which need coverage at the regional and national level.

34. The following are identified as main factors that affect the level of ICT application:
    A) Appreciation of ICT power
    B) Financial constraints
    C) ICT infrastructure (e.g. telecommunication and power supply)
    D) Cost of ICT application
    E) ICT education
    F) Proliferation of standards
    G) Government involvement
    H) Economic and social conditions
    I) Legal environment
    J) Management practices

ICT Industry

35. The advantages of Myanmar in developing an ICT Industry, particularly in the software sector, are availability of knowledgeable manpower and comparatively low labour costs.

36. The quality of ICT professionals still requires improvement in order to meet international standards. This gap can be closed quickly only through effective human resource development programmes.

37. Compared internationally, the wage rate of Myanmar ICT professionals is much lower, giving

Myanmar a very good competitive advantage.

38. The hardware market is expanding rapidly. Almost all computers are PCs. Almost all are distributed by local vendors and most of the assembly is done in Myanmar. There are a couple of factories that manufacture computer-related parts, but their contribution to the market is very small.

39. The domestic software market is still very small but is increasing gradually. There are few software developers and only a couple of software houses are receiving outsourcing jobs from developed countries. Export earnings from software is negligible.

40. The content industry is at the infancy stage.

Summary of Recommendations

ICT Infrastructure

41. Strengthen and extend the existing infrastructure including broadband, particularly outside urban areas. A pilot project covering selected villages should be conducted with the installation of appropriate infrastructure, development of applications and training.

42. Construction of a telecommunication infrastructure covering the industrial zone would be very beneficial for industrial development.

43. Construction of a network for the government and some private banks would improve the financial system, which is one of the key elements for e-Commerce and e-Government development.

44. Improve end user device penetration, especially outside the main cities. This should inevitably coincide with the efficient development of the infrastructure using adequate new technologies.

45. For the development of local content, an expanded role of the private sector should be encouraged through adequate industrial policies.

46. The e-National Task Force should coordinate/regulate to provide a single-point interface with citizens and business.

47. Develop plans for national capacity building; attract funding from bilateral and multilateral aid agencies. Institutional capacity building is also necessary. It would constitute one alternative to transforming the telecommunication part of MPT toward a financially independent public corporation-type organisation.

48. Adopt Internet-friendly tariffs, particularly for rural areas and educational institutions.

49. Attract private sector cooperation through the introduction of liberalisation, privatisation, and competition.

50. Improve urban Internet access using broadband services. Affordability is also an important

element for both individual and business users through an adequate access tariff policy.

ICT Legal Infrastructure

51. It should be noted that while e-Commerce laws enable electronic transactions to take place with trust, confidence and certainty in cyberspace, they must be complemented by other related legislation to ensure that the interests of businesses and consumers are protected.

52. Relevant legislation, regulations or codes of practice include:

    A) Data privacy and protection

    B) Consumer protection

    C) Computer crimes/computer misuse

    D) Copyright, trademarks, intellectual property rights

    E) Admissibility of computer output as evidence in court

53. An Internet Code of Practice and an Advertising Code of Practice should also be covered in the comprehensive cyber law.

54. Due to the dynamically changing nature of the technology, where legislation, regulations or codes of practice are inadequate or inapplicable to cyberspace, amendments and updates would have to be carried out continuously.

55. In cross-border e-Commerce, some of the issues that need to be addressed are:

    A) Jurisdiction - Which court shall hear and resolve a dispute between contracting parties from two different countries? Which laws shall be used? Shall the court judgement obtained in one jurisdiction be enforceable in another jurisdiction?

    B) Taxation - Where should the sources of income be from if an electronic transaction occurs in multiple countries? Which tax regime should be used? Which jurisdiction should the taxes accrue to?

ICT Education

56. Development of ICT depends on the effective use of human resources. A national-level programme should be drawn up and implemented. The programme should specify how public and private sectors should cooperate.

57. Certification programmes should be strengthened, which would recognise computer professionals who acquire their knowledge and skill other than through formal education.

58. In all courses, students should have the opportunity to use a computer in both teaching and learning.

59. A programme for providing ICT education for both public and private employees should be implemented. States should provide assistance for conducting in-house computer training

courses. Special computer courses should be arranged for staff from organisations that are not able to conduct in-house training courses.

60. Internet access should be provided at schools and universities.

61. Research and development projects on computer application in education should be carried out.

62. ICT resource centres should be established throughout the country. Internet access should be provided at these resource centres.

63. More effort should be invested into establishing computer labs in universities and schools. These computer labs should be used for improving computer application and increasing problem-solving ability.

64. Implementation of a training programme for ICT trainers should have priority.

65. Multimedia classrooms should be established in every basic education school.

66. Seminars, symposiums and conferences should be conducted throughout the country. These promotional activities can be conducted through TV and radio or by regional computer associations.

ICT Application

67. Promote widespread application of ICT in state management with the intention of providing better services to the public, improving efficiency and reducing costs.

68. Promote widespread application of ICT in business organisations to improve productivity, render better services, penetrate into the international market and reduce costs.

69. Promote widespread application of ICT to improve the educational level of the entire population.

70. Facilitate the growth of e-Commerce at national, regional and international levels. Develop regulatory and legislative frameworks.

71. Launch demonstration projects to display the benefits of ICT application and to motivate public and private sectors and the entire population to use ICT extensively.

72. Provide incentives to business organisations to create better conditions for ICT applications, foreign investment and technology transfer.

73. Develop standards for the development of integrated systems.

74. Make arrangements for local ICT organisations to become involved in major projects that require foreign expertise to provide opportunities for technology transfer.

75. Provide reliable Internet access to economic, education, health and social sectors.

76. Develop programmes to familiarise the entire population with ICT.

ICT Industry

77. Develop the ICT Industry as a main economic sector.

78. As the largest buyer of ICT products and services, the state should act as the main demand force.

79. Promote and facilitate liberalisation in investment, production and distribution of ICT products and services.

80. Develop human resources so that a sufficient number of ICT professionals are available for both ICT industry and ICT application.

81. The development of the software industry and penetration into the international market should be a high priority task.

82. Establish ICT zones for providing financial incentives, research facilities, and adequate ICT infrastructure.

83. The government should provide support for promotional efforts to enable the introduction of software products into the international market.

84. Create an environment in which software developers could share ideas and experiences.

85. For keeping pace with the rapidly changing trends in software technology, software developers should be encouraged and supported to acquire software productivity. Quality tools and information on software technology trends should be made easily available.

86. Certification programmes should be made available to ensure that the high quality of software services and software products exported is maintained.

87. Funding should be provided for study projects to understand the problems precipitated and solutions required for entering the international market. The findings would be publicised through the appropriate media to all software developers.

88. Create a venture capital fund for start-ups and entrepreneurial efforts in the ICT Industry.

89. Encourage services for providing market intelligence on domestic and global services industries to disseminate information such as new trends, market conditions, key indicators, new opportunity areas, etc. Conduct research and suggest the best practices for positioning Myanmar as a software developer, and helping start-ups with marketing plans and contact databases, etc.

Conclusion

90. Based on these findings and broad policy recommendations, the specific areas requiring cooperation between Myanmar and Japan should be identified. Concrete and measurable programmes should be agreed upon and committed to by both sides for successful implementation.

91. For that purpose, the ICTWG would need to conduct pilot projects in order to estimate the extent of effort, time schedule, risk factors and resource requirements.

4. ICT Infrastructure

Introduction

1. Infrastructure is the pre-requisite for digital readiness. Telecommunication infrastructure provides the basic and indispensable element for the development of the entire realm of information technologies. The tele-density in Myanmar was only 0.6% as of 2001, which is among the lowest in ASEAN countries. Myanmar recognises the need to improve the present situation and has put the earnest efforts into rapid development of the telecommunication infrastructure.

Institutionalisation

2. The e-National Task Force of Myanmar recognises the importance of infrastructure. A committee on ICT Infrastructure has been formed to evolve not only the development of in-country infrastructure, but also regional cooperation for a regional information infrastructure.

Regional Cooperation

3. As for cooperation in the regional information infrastructure, Myanmar is one of the signatories of the e-ASEAN Framework Agreement. Among others, one of the initiatives in the agreement is facilitation of the establishment of the ASEAN Information Infrastructure, which includes:

   A) Member states shall enhance the design and standards of their national information infrastructure with a view to facilitating interconnectivity and ensuring technical interoperability between each other's information infrastructure.

   B) Member states shall work towards establishing high-speed direct connection between their national information infrastructures with a view to evolving this interconnection into an ASEAN Information Infrastructure backbone.

   C) Complementing the ASEAN Information Infrastructure, member states shall work towards developing local content.

   D) Member states shall work towards facilitating the setting up of national and regional Internet exchanges (RIXs) and Internet gateways, including regional caching and mirroring.

National Backbone

4. It is natural that Yangon, the capital of the nation, would be the centre of the nationwide network. The backbone network, which connects Yangon, Mandalay (the second largest

city) and other major cities, and lines that connect to the backbone network, must be analysed first. In each part of this nationwide network, the best method and the best facilities must be chosen by comparing the communication capacity and construction costs. Some of the network candidates using current technologies are shown below.

A) Large-scale fibre optic cable system using the technology of WDM (wave-length division multiplex) and SDH (synchronous digital hierarchy)

B) Large-scale microwave communication system using QAM (quadrature amplitude modulation) technology

C) DOMSAT (domestic satellite) and VSAT (very small aperture terminal) system suitable for remote thin-route communication networks

5. Myanmar Posts and Telecommunications (MPT) is constructing optical fibre backbone routes within Myanmar. Fibre links between Yangon in lower Myanmar and Mandalay in upper Myanmar are already completed and links with other major cities are in progress.

6. MPT plans to digitalise the analogue backbone routes. Digitalisation of switches is progressing.

7. Bagan Cybertech (BCT) plans to introduce wireless local loop (WLL), which has transmission speed ranging from 128 kbps to 2 Mbps. The systems would be installed first in business areas and then expanded to cover the entire municipal area of Yangon. The biggest advantage is its affordability; the price is estimated to be 1/5 of the current system.

8. BCT plans to introduce Broadband Satellite Data Service in 2002 using iPstar by means of the Thaicom 4 Satellite. The system is primarily intended to provide network services in rural areas.

International Link

9. MPT plans to build another international switch and earth station in Mandalay, which would increase reliability in the international telephone network.

10. The policy to develop international telecommunication links through SEA-ME-WE 3 submarine cable and INTELSAT earth stations should be maintained. In the case of international links with ASEAN and neighbouring countries, however, it is worth examining the introduction of other more efficient terrestrial telecommunication systems, depending on the future development of political and economic activities with these countries.

Last-mile Link

11. While construction of a national backbone and international links is progressing satisfactorily, improvement of the "Last-mile Link", which links subscribers with the backbone, seems to

be very slow.

12. The method of access line, which connects each subscriber to the backbone network, must be chosen considering the population density and the prospect of future economic development. Copper-wire cable and WLL would be the major alternatives. However, in the case of extensive users such as companies and research organisations, fibre optic cable constitutes a possible alternative.

13. xDSL (x digital subscriber line), which utilises the out-of-voice band of copper cable, is an effective method for Internet access with broadband capability.

14. ISDN (Integrated Services Digital Network) has recently been provided in some parts of Myanmar. In the future, however, the entire telecommunication network will be increasingly IP-based. So, the plan of developing ISDN must be reconsidered.

Internet Services

15. Internet service is still in the initial stage in Myanmar. Dial-up is predominantly used as an access method, but some high-usage subscribers began using dedicated access lines using wireless systems. In the meantime, the dial-up method would be the major way of expansion. The Asynchronous Digital Subscriber Line (ADSL) method could provide another important method as a next step, although the existing copper-wire cable system may have to be replaced in some cases.

16. The expansion of Internet services requires the development of the telecommunication infrastructure and upgrading of the quality. At the same time, policies to upgrade the Internet environment are also important to encourage the participation of the private sector entrepreneurs who would produce service applications and content.

17. Myanmar should make efforts to catch up in this field, and should also work cooperatively with the outside world. For this purpose, the creation of a specialised government organisation to take responsibility in this field, and the strengthening of research organisations, are necessary.

Fixed Telephone Network

18. The delay in the development of the telecommunication infrastructure for fixed telephone is quite visible. The tele-density in Myanmar is 0.6%, among the lowest in ASEAN countries, next only to Cambodia. There are various important reasons for this delay, including the lack of funding for development due to insufficient foreign currency and the current tariff rate structure for telecommunication use. Telecommunication is now the basic social infrastructure and it must be developed under the responsibility of the nation. A long-term

master plan with clear objectives must be formulated.

19. In developed countries, there are cases where the number of fixed-line subscribers have levelled off, or have even begun to decline due to the rapid expansion of mobile phone usage. In Myanmar, though, the development of a fixed-line network must be the first priority in a telecommunication infrastructure. The access line for the fixed-line network does not have to be the installation of the actual line. Nowadays, a viable alternative is a radio-based access line, depending on the location and economic advantage.

20. Until recently, the access line for fixed-line subscribers was copper-wire cable. However, WLL (wireless local loop), the access line of fixed telephone by wave, is an example of new technology with relatively low cost and high performance, and is adequate for rural areas where population is sparsely distributed. Furthermore, the wireless alternative provides the advantage of a shorter installation period in comparison to the wire network.

Mobile Network

21. MPT has introduced the GSM System in Yangon and Mandalay and has further plans to install the GSM system in about 20 cities in border areas, and in coastal areas.

22. AMPS (Advanced Mobile Phone System) and D-AMPS (Digital-AMPS) are the main methods used for mobile phones in Myanmar. CDMA (Code Division Multiple Access) and GSM (Global System for Mobile Communication), the second-generation mobiles (2G), have already been introduced. The prevailing method with cost and quality advantages is 2G mobile phones.

23. BCT plans to provide mobile data service in the future. They are presently negotiating on Global Mobile Personal Communication via Satellite (GMPCS) service.

24. Mobile phones are more expensive than fixed-line phones, so users will be limited in the beginning, although presently the applications well exceed the availability. However, the tariff on mobile phones could become lower if the cost of 2G facilities becomes lower. Then, the usage of 2G mobile phones would gradually expand. There is also a demand for mobile phones for those who can not wait for the completion of a fixed-line network.

25. Regarding third-generation (3G) mobile phone development, it could be introduced as possible ICT terminals in the future, while examining its progress in other countries.

Satellite Link

26. The Myanmar VSAT system, which is called DOMSAT (Domestic Satellite System), is currently operating as a telephone network to connect Yangon and ten to twenty remote cities. However, some of the system equipment has frequent failures, and the usage rate is

rather low. The introduction of a more reliable system is necessary.

27. A satellite communication system will surely become more IP-based in the future in accordance with the tendency of the terrestrial network to be increasingly IP-based. In the future, DOMSAT will have to include Internet transmission in addition to voice communication. Myanmar should examine the introduction of the IP-based satellite communication system, which is advantageous in its usage of frequency resource.

IP-based Network

28. At this moment, the introduction of IP-related technologies is way behind in Myanmar. This is not simply due to technological or hardware problems, but rather due to the immaturity of policies and institutions in promoting and administrating the spread of these new technologies. Conventional telecommunication technologies developed with the involvement of the central government. However, new IP-related technologies have developed in the atmosphere of open discussions of academic groups and the private sector. So, it is necessary to develop this environment of academic and private groups for the future introduction and development of new technologies.

29. In addition to the historical evidence, there is no reason to doubt the international trend of IP-based networks being developed as a common infrastructure for transmission and processing of all kinds of information. From this point of view, Myanmar must keep its eyes on the development of worldwide Internet-related technologies and institutional matters, and must also begin creating an adequate institutional structure.

Interoperability

30. A coordinated programme for increased sub-regional, regional and international connectivity is needed to ensure interoperability of systems and applications across ASEAN and globally.

31. On the other hand, it is necessary that policies and measures allow multiple technologies to compete for communication networks services.

32. Measures are needed to promote awareness of the cost-effectiveness of various technologies for use in diverse situations. R&D programmes and adaptation of cost-effective technologies suitable for the conditions of Myanmar are also needed.

Improving Accessibility to the Public

33. Establishment of public and community ICT key access points, such as post offices, elementary schools, Internet cafes or community multimedia centres should be accelerated.

Academic Network

34. A high-speed national academic network to link universities with regional colleges should be constructed.

ICT Infrastructure for e-Commerce Development

35. Electronic commerce (e-Commerce) can prosper and grow only if people are connected. Proper functioning and affordable communications networks are therefore essential for the development of e-Commerce. Only users who are able to access these networks through proprietary or shared access devices are able to participate in e-Commerce and the larger the number of users with network access, the greater the potential benefits of e-Commerce. Communications networks can be comprised of fixed-line telecommunication networks, wireless networks and cables. While wired networks have been the mainstream of the Internet, a fast growing percentage of access is also provided by wireless technology through traditional cellular, radio-band and satellite networks.

36. The demand for bandwidth for applications such as e-Commerce is much greater than for traditional telephony. The limitations on bandwidth availability will restrict the maximum number of users as well as utilisation of the applications. With time, the growth in the number of Internet users and the development of more mature forms of applications will further increase the demand for greater bandwidth.

Telecommunication in Rural Areas

37. Both MPT and BCT plan to expand IP-based VSAT and iPSTAR broadband networks to villages. It is necessary to formulate policies to increase accessibility of rural areas with concrete implementation measures.

38. A pilot project covering a selected number of villages should be conducted. The project would cover installation of appropriate infrastructure, development of applications, training and a study on the effects. The purpose of the project would be to develop a model that could be replicated in other villages.

39. The installation of telecommunication networks in rural areas requires a huge amount of funds. An effective means should be selected, taking into account the prevailing technological trends. It is rather an advantage for Myanmar that the nation does not have a traditional legacy system. It is important to select the site-specific combination of suitable technologies through the accumulation of experience from case studies and pilot projects.

40. Myanmar must correct the difference of tele-density by region. Clear target figures must be shown by region. The selection of the best technologies suitable for each region is also

important. At the same time, future expansion of the IP-based system must be taken into consideration in the strategy of geographical expansion.

Infrastructure for Industrial Development

41. Telecommunication infrastructure in industrial zones needs considerable improvement. Both tele-density and Internet access are insufficient. Development of the telecommunication infrastructure in industrial zones to support development of ICT application in industrial organisations should correspond with industrial development policies and priorities.

Affordability

42. In order to narrow the digital divide, infrastructure charges would need to be affordable for both individual and business users. Traditional voice telephony charging practices may inhibit the growth of Internet/Intranet users, since users are typically connected for much longer periods of time compared to those using voice communication services. The ICTWG recognises that affordability is a major problem. Internet access costs are the highest in Myanmar among ASEAN countries. It is necessary to reduce these costs considerably.

43. In order to minimise telecommunication fees and rates including Internet access prices, it is urgent to develop strategic plans for an affordable pricing mechanism of telecommunication and Internet access services for priority groups such as educational and health institutions and rural areas.

44. Telecommunication tariffs should be changed gradually from the current system to a tariff system based on the market economy.

Liberalisation

45. The worldwide trend is towards the liberalisation and internationalisation of telecommunications. In the ASEAN area, too, Myanmar is committed to liberalising the industry by the target year of 2008. In Myanmar, telephone and the development of telecommunication infrastructure has been under the monopoly of MPT, although in ICT areas such as Internet services, liberalisation has been partially accomplished. Development of the telecommunication infrastructure, which is currently far behind, would have to become the responsibility of the public sector. However, to achieve efficient development, the telecommunication part should have the institutional framework to handle revenue and costs, and it is also necessary to plan the development in an integrated way. One alternative is to transform the telecommunication part of MPT to a financially independent public corporation-type organisation.

46. To speed up telecommunication infrastructure development, reduce telecommunication costs and improve the quality of communication, it is necessary to create a competitive environment and increase cooperation with the private sector.

47. Although the development of the basic telecommunication infrastructure is the responsibility of the public sector, value-added services would be better promoted if they were provided by the private sector. In this field, more activities, higher efficiency, lower prices, better quality, and more diversity of services in the telecommunication sector must be encouraged through policies such as the introduction of privatisation and competition.

48. It would be necessary to review the telecommunication policy framework including licensing, tariffs, interconnection, standardisation, quality of services and consumer protection, etc. Liberal licensing of network and service operators should be considered.

Power Supply

49. There are many areas where commercial power is not yet available. If it is not financially realistic to complete the power system including that for the household sector in the short run, a realistic temporary alternative would be to install stand-alone generating facilities in public telephone offices, tele-service centre, etc. The diesel engine generator is the most commonly used solution for this purpose, considering its sufficient generating capacity. When there is a problem with fuel transportation, however, the combination of solar cell panels and rechargeable batteries provides another alternative. The electrification of the area as a whole is, of course, the long-run precondition for the development of telecommunication infrastructure.

Human Resource Development

50. Training centres for telecommunication technologies operate under the umbrella of MPT. At the university level, however, the educational system is not well enough established to teach technologies and institutional matters on telecommunication. Furthermore, an educational system suitable for the Information Era, where information processing and telecommunication technologies are combined, is inadequate for what is required.

51. The basic framework and the development of an IP-related environment would have to become the responsibility of the government or the public sector. However, its actual introduction and dissemination requires the wide-range participation of the private sector, and the enlightenment of ordinary ICT users. In this sense, it is necessary to examine policies for human resource development in various levels, from upstream to downstream.

52. For the same reason, MPT training centres should add training courses suitable for the ICT

age, and should enrich and intensify its training.

Conclusion

53. Development of a national data communication network connecting local, regional and international networks.

54. Development of a nationwide telecommunication network must be carefully planned with enough consideration to efficient resource usage. A master plan for the telecommunication network must be formulated, reflecting the future development of telecommunication traffic after analysing the geographical density distribution of social and economic activities.

5. ICT Legal Infrastructure

Introduction

1. This part of the report presents the findings on the current status of the legal infrastructure in Myanmar. First, it states the current status of the ICT-related legal system in Myanmar. It also describes the framework for comprehensive e-Commerce laws. Finally, it attempts to determine and recommend the related legislation for making e-commence a practical success.

Legal Infrastructure Development

2. The State Peace and Development Council enacted the Computer Science Development Law on 8 September 1996. Although the law strives to create an overall environment for better ICT usage, specific provisions for e-commerce development are not included.

3. The Working Group for e-Legal Infrastructure was formed by the e-National Task Force. The responsibility of e-Legal Infrastructure is to draft a set of cyber laws or e-Commerce laws.

4. The e-Legal Infrastructure Working Group decided to develop stop-gap measures (special orders) to speed up the implementation of e-commerce activities in Myanmar. The temporary measures include detailed studies of existing laws and attempts to enact amendments to cover e-Commerce activities. As of October 2001, the Working Group had submitted two recommendations for stop-gap measures to the e-National Task Force, which were in turn submitted to the concerned ministries for further action.

5. The e-Legal Infrastructure Working Group has already prepared a draft comprehensive cyber law in order to meet the timeline of the e-ASEAN Framework Agreement. The draft has been submitted to the e-National Task Force for approval.

6. It should be noted that provisions in the Union of Myanmar Foreign Investment Law supports development of ICT Industry. Some features are:

   A) 100% foreign capital allowed

   B) Joint venture allowed with equity ratio of 35% foreign capital

   C) Guarantees no capitalisation

   D) Net profit after taxes transferable abroad

   E) Tax holiday of 3 years with tax relief Section 21(B) to (J)

Reference Framework for Comprehensive e-Commerce Law

7. The framework for a comprehensive e-Commerce law was developed largely based on UNCITRAL's[1] Model Law on Electronic Commerce and Draft Model Law on Electronic Signatures, as well as the following e-commerce laws of ASEAN member states:

   A) Electronic Transactions Act (ETA) of Singapore

   B) Digital Signature Act (DSA) of Malaysia

   C) Electronic Commerce Act (ECA) of the Philippines

   D) Electronic Transactions Order (ETO) of Brunei

   E) Draft Electronic Transactions Bill (ETB) of Thailand

General Principles of Legal Infrastructure

8. Regulatory and legislative frameworks that create development of ICT confidence for consumers and facilitate the transformation of public and private organisations towards the development of ICT should be developed as follows:

   A) The following should be general principles for development of e-Commerce laws:

      i. They should conform to international standards.

      ii. They should be transparent and predictable so that there is no legal ambiguity between transacting parties in an electronic transaction.

      iii. They should be technologically neutral, i.e. no discrimination between different types of technology

   B) The following specific provisions should be made:

      i. National laws and policies relating to ICT should be expeditiously developed based on regional and international norms.

      ii. National laws and policies relating to e-Commerce should be expeditiously developed based on regional and international norms.

      iii. Facilitate the establishment of mutual recognition of digital signature frameworks.

      iv. Facilitate secure electronic transactions, payments and settlements at the national, regional and international level.

      v. Adopt measures to protect intellectual property rights.

      vi. Take measures to promote personal data protection and consumer privacy.

      vii. Establish Authentication Authorities.

      viii. Develop dispute resolution mechanisms for online transactions.

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[1] UNCITRAL (United Nations Commission on International Trade Law) is the core legal body within the United Nations tasked by the UN General Assembly to further the progressive harmonisation and unification of international trade law, including international e-Commerce law.

Features of e-Commerce Laws

9. e-Commerce laws should have the following features:

    A) Electronic Transactions

        i. There is no difference between electronic records and paper documents.

        ii. An electronic record can replace a written document.

        iii. Parties can contract electronically.

        iv. Electronic records are admissible as evidence in court.

        v. If an electronic record is sent, the recipient is entitled to act on the record.

        vi. If the sending of an electronic record is conditional upon acknowledgement of receipt, the record is not sent until the acknowledgement has been received.

        vii. When a sender receives the recipient's acknowledgement of receipt, the electronic record is deemed received by the recipient.

        viii. An electronic record is sent when it enters a computer server/router outside the sender's control. An electronic record is received when it enters the addressee's computer/router.

        ix. An electronic record is sent from the sender's place of business and received at the recipient's place of business.

    B) Trusted Third Parties/Certification Authorities

        i. Provisions governing the duties of trusted third parties (TTPs) / certification authorities (CAs).

        ii. Provisions governing the duties between subscribers and their TTPs/CAs, including the issuance, management, suspension and revocation of digital certificates.

        iii. Provisions governing the regulation and licensing of TTPs/CAs, including the appointment of a controller of TTPs/CAs.

    C) Service Providers

        i. Provisions governing the extent of legal liability of service providers. Network service providers should be exempted from any criminal or civil liability for merely providing access to third-party online content over which they have no editorial control.

Related Legislation

10. It should be noted that while e-commerce laws enable electronic transactions to take place with trust, confidence and certainty in cyberspace, they must be complemented by other related legislation to ensure that the interests of businesses and consumers are protected.

11. Relevant legislation, regulations or codes of practice should include:
   A) Intellectual Property Rights (IPRs)
      i. IPRs and Technology Transfer

         When a country's economy is opened up to foreign countries, preparation of laws concerning IPRs becomes a necessary prerequisite as well as a foundation for attracting foreign companies. Technology transfer is made available only when such a business environment is put into place.

      ii. IPRs and ICT Industry Development

         Copyrights are an essential element in the ICT industry, particularly for the software sector. In countries where illegal copies such as pirated versions, etc. are rampant, the software business is hindered from growing.

      iii. Software Protection and Copyright

         It is a globally-recognised concept that computer software is protected by copyrights. Many countries participate in the Berne Convention for copyrights, and computer software from around the world falls within the framework of copyright protection. An effective copyright protection system is a prerequisite for development of creative works in the electronic medium. Therefore, the Myanmar Copyright Law will be strengthened in this direction. Furthermore, there is a need for global harmonisation of copyright laws. The TRIPS (Trade-Related Aspects of Intellectual Property Rights) agreement and the two WIPO (World Intellectual Property Organization) treaties will be adopted for such harmonisation.

         To ensure that the Myanmar content industry is globally competitive, the royalty terms for licensing the copyrighted contents and the software provided by the global information providers and publishers, will be allowed to be determined by the market forces.

      iv. Domain Names and Trademarks

         Domain names are names that indicate the location of an entity's IP address on the Internet. On the other hand, trademarks are special names, signs, or words for a particular product or service used to distinguish it from other similar products and services. The two are different in nature. However, as the development of Internet business progresses, domain names occasionally serve the same function as trademarks. As a result, lawsuits may arise in which an owner of a trademark will attempt to suspend the usage of their registered name, sign, or word as a domain name. In this regard, a proper management system for domain names should be created.

v. Information Technology and Patents

Recently, an increasing number of countries have come to recognise the importance of patent protection for software. In the ICT industry, the number of applications for software-related patents has been on the rise because patents carry weight in terms of legal protection. Moreover, business model patents are emerging in the US and Japan, covering business techniques realised by ICT and the most advanced financial products.

B) Data Privacy and Protection

Following the advancements in digitalisation and networking of information, personal data is now accumulated, digitalised, and distributed on a scale that transcends national borders. From the viewpoint of marketing, personal data has substantial economic value and the purchase and sale of such information is becoming a problem. For this reason, laws that protect one's personal information have been implemented in many countries.

C) Consumer Protection

With increased use of the Internet, there are more and more cases in which consumers unintentionally enter into contracts during business to consumer (B-to-C) e-Commerce transactions due to misuse of computers. Japanese civil law stipulates that such contracts are invalid; the consumer, however, is unable to have the contract invalidated in cases where he/she is responsible for gross negligence.

Meanwhile, laws regarding electronic consumer contracts and electronic consent notices protect the consumer, and stipulate that such contracts are invalid even in cases where the consumer is responsible for gross negligence.

D) Cyber-crime

As the use of information systems becomes more popular, crimes using computers and networks continue to increase. Some examples are the destruction of computers and digital data, computer-usage fraud, the sale of illegal drugs using networks, and defamation of personal character, etc. To control and crack down on such cyber-crime, revisions to criminal laws and the enactment of special laws/ordinances to prevent illegal access and to protect children from child pornography, etc. are required in addition to technical measures for security.

An Internet Code of Practice and an Advertising Code of Practice should also be covered in the comprehensive cyber law.

Other Issues to be Addressed

12. In cross-border e-Commerce, some of the issues that need to be addressed are:

    A) Jurisdiction - Which court shall hear and resolve a dispute between contracting parties from two different countries? Which laws shall be used? Is a court judgement obtained in one jurisdiction enforceable in another jurisdiction?

    B) Taxation - Where should the sources of income be from if an electronic transaction occurs in multiple countries? Which tax regime should be used? Which jurisdiction should the taxes accrue to?

Need for Continuing Update

13. Due to the dynamically changing nature of the technology, where legislation, regulations or codes of practice are inadequate or inapplicable to cyberspace, continuous amendments and updates will be necessary.

6. ICT Education

Introduction

1. The most important key factor for successful ICT development is availability of qualified ICT engineers. ICT engineers are the main resource for ICT application development and building an ICT industry. A national-level programme for ICT human resource development that covers both formal and informal systems and provides opportunities for effective cooperation between public and private sectors will be needed to make the entire spectrum of ICT development efforts meaningful.

Formal versus Informal ICT Education

2. Formal (universities, colleges and private regular courses) and informal (certification programmes) ICT human resource development systems are considered complementary. The strengthening of both formal and informal ICT human resource development should be given high priority and should be enhanced by sustained effort.

Formal ICT Education

3. There are many efforts in Myanmar to develop ICT human resources. Twenty-four government computer colleges were opened in states and divisions in addition to the two University of Computer Studies, one in Yangon in Lower Myanmar and another in Mandalay in Upper Myanmar under the Ministry of Science and Technology. They offer diploma, bachelor, masters and doctorate courses on ICT. Some of the universities and colleges under the Ministry of Education also offer undergraduate ICT courses.

4. Yangon universities under the Ministry of Education also offer masters courses on ICT and other universities and colleges offer diploma and bachelor courses.

5. These programmes will produce a considerable number of ICT engineers but maintaining the quality of the graduates is questionable. It would be a promising endeavour to systematically maintain the quality of ICT graduates from these universities and colleges.

6. To maintain the level of academic quality, the management of academic matter of government universities and colleges should be in the hands of the professors. A plan should be drawn up to privatise some of the universities and colleges.

7. Private computer training schools also provide ICT professional courses. Some offer diploma and undergraduate courses affiliated to international ICT professional training institutions. They could be improved by becoming more practically oriented. The cost of these courses prohibits producing a large number of ICT engineers. It is very strange that local diploma

and bachelor courses are not offered by private computer training institutions.

8. A scheme for supporting private computer schools and ICT professionals who want to take advanced-level training should be developed by the central or local government. Qualified private computer training schools should be allowed to offer diploma and graduate courses. Establishing private universities and colleges should be considered.

9. A proposal for the establishment of a high-level computer training institute to be implemented by the University of Computer Studies, Yangon under the Ministry of Science and Technology was approved as a high priority project by the government of Myanmar and has already been sent to the Japanese government. The institute would provide the opportunity for graduates from computer universities and colleges who have good theoretical background but lack sufficient practical experience to use the latest development environments and methodologies to become highly qualified ICT engineers. Establishment of the institute should be given highest priority by both Myanmar and Japan and training facilities should start their operation promptly since university graduates would be needed soon as qualified ICT engineers.

10. To establish ICT departments in all the universities and explore the possibility of further education programmes at the professional level.

11. The post-graduate course offered at the University of Computer Studies, Yangon (UCSY) should be upgraded and improved upon.

    A) To this end, an international exchange agreement should be concluded with universities in Japan to facilitate the acceptance of visiting professors from Japan who specialise in technology and information fields in which universities offering ICT courses are currently lagging behind.

    B) Through the above international exchange agreement, more opportunities should be provided to graduate students at UCSY to study at Japanese universities.

    C) Moreover, the introduction of a remote-education system (via the Internet) between the partner universities mentioned in the above international exchange agreement should be discussed and prepared.

    D) The ICT industry in Myanmar should cooperate with universities offering ICT courses and offer opportunities for graduate students to acquire on-site technologies/skills that are not available through academic research.

Informal ICT Education

12. Informal certification programmes were also initiated recently. The MCSA certification programme has been successfully implemented and the Japanese Information Technology

Examination Centre (JITEC) and the Myanmar Computer Federation (MCF) has entered into an agreement to implement a cross certification programme. The first examination, which is comparable to the Japanese Information Technology Engineer Examination (JITEE), will be conducted by the end of 2002.

13. These programmes would provide opportunities to those that can not afford or that want to join formal education and can attract a very large population of participants. Bilateral, regional, international certification programmes such as JITEE should be effectively implemented and systematically promoted.

14. An e-Learning Centre was established in 2001 with support from Japan. The centre presently provides training courses for JITEE. The existing e-Learning Centre should be strengthened to become a full-fledged centre providing all the facilities to support informal ICT human resource development.

15. It should be recognised that the quality of ICT professionals still requires improvement in order to meet international standards. This gap should be closed quickly through effective human resource development programmes.

16. Information processing technology requires theory along with practical experience. Theories learned at educational facilities are mastered only through practical experience and come into bloom as applicable technological ability. ICT engineers in Myanmar are highly skilled and they have the potential to play a significant role in the international market if they are able to accumulate an ample amount of experience.

17. Instead of entirely depending on demand for systems in the private sector, the government should launch initiatives to implement system development projects that provide domestic engineers with not only job opportunities but also practical experience. While nurturing the country's engineers up to a standard recognised around the world, it is necessary to implement system development projects within Myanmar. With cooperation from foreign countries, initiatives should be taken by Myanmar such as undertaking project management, analysis, and the creation of data models and design elements.

18. Japanese language education should be promoted for currently employed information technology engineers as well as for students, in order to improve reading ability and boost comprehension of technical documents written in Japanese.

19. To improve management ability in the software industry and realise process improvement, Japanese specialists in ICT should be dispatched to Myanmar on a long-term basis.

ICT Education for the Workforce

20. A programme for providing ICT education for both public and private employees should be

implemented. A scheme for providing assistance for conducting in-house computer training courses should also be implemented. Special computer courses should be arranged for staff from organisations that are not able to conduct in-house training courses.

21. To promote the dissemination of Information and Communication Technology in the country, a Chief Information Officer (CIO) should be trained for each organisation as key ICT personnel.

e-Society

22. Seminars, symposiums and conferences should be conducted throughout the country to improve the awareness of the power of ICT, cost-effectiveness and ease of use.

23. To formulate and implement a plan for ICT education to ensure that all students receive training for ICT and that they have the opportunity to practice using computers.

24. To develop all forms of training, disseminate knowledge and teach technology in consideration of the application of computers as a working tool for a part of the labour force.

25. There would be a change in the teaching-learning approach. Schools are distinguished from each other by the use of technology to support and enhance teaching-learning. With the aid of multimedia technology, self-accessed, self-paced and self-directed learning could be practised. This would allow students to develop their strengths to a level of excellence and breed a generation of inventors and innovators.

Basic Education Level

26. In 1996, three thousand Apple Computers were imported by the government to be used mainly in basic state high schools. The Multimedia School Project (MSP) is meant to develop Myanmar into a regional and international technology centre. The MSP would propel the transfer of technology and become the test bed for R&D in high-tech industries. Because of the need for knowledgeable workers in the high-tech industries, MSP Schools were adopted as one of the flagship applications. The flagship would support the government's plans to obtain the status of a developed nation and to gain a competitive edge with other developed countries in the global economy.

27. Apart from the role of education to fulfil national development goals and aspirations, the project is also meant to address various educational needs as stated below:
    A) To prepare school graduates for the Information Age
    B) To bring about a systemic change in education, from an exam-dominated culture to a thinking and creative knowledge culture
    C) To re-emphasise science and technology education with a focus on creativity and

innovation

D) To equip students with ICT competence

E) To inspire values among the students and produce a generation of caring, peace-loving and environmentally concerned citizens.

28. New curricular emphases are:

A) Knowledge acquisition

B) Analytical, creative thinking and the ability to make decisions and solve problems

C) ICT competency

D) Proficiency in an international language

29. There are 1712 high schools, 3099 middle schools and 36,004 primary schools in Myanmar. A total of 991 existing schools were implemented as Multimedia Schools. Out of the 991 Multimedia Schools, 238 have been upgraded to Electronic Learning Centres and more schools will be implemented in coming years. The Ministry of Education also encourages efforts by schools to become 'Multimedia School's on their own initiative. This is in line with the MOE's plans as outlined in the Multimedia School Implementation Plan of undertaking the role of 'architect and promoter'. The MOE provides the model and guidelines for setting up a Multimedia School, whilst the cost of implementation is covered by the school through innovative means such as through private sector sponsorship, and fundraising efforts by parents and the community. Obviously, the government is serious about introducing technology to all schools in the shortest possible time, but the provision of hardware, software and technical expertise to schools is an expensive venture. In the meantime, schools are encouraged to study the possibility of acquiring technology through their own initiative.

Vocational Education

30. The Department of Technical, Agricultural and Vocational Education (DTAVE) was under the Ministry of Education until the end of 1996 but has now been transferred to other ministries. This sector of education is responsible for training Myanmar's middle-level technicians, skilled and semi-skilled manpower. Its principal objectives are:

A) To train technicians, skilled and semi-skilled workers

B) To formulate programmes to link teaching with on-the-job experience

C) To set priorities for occupations and skills that will be the most useful in practical fields

D) To organise training programmes in vocational subjects for students who dropped out at various levels of the formal education system

E) To train and nurture skilled technicians and experts who are imbued with a sense of conscientiousness and convictions to cherish the state

31. It is envisaged that technical and vocational education and training would continue to be given high priority in Myanmar for sustainable human resources development.

Higher Education Level

32. With a population of nearly 50 million in Myanmar, dissemination of computer knowledge to the vast majority of the student population is one of the steps which some of our neighbouring countries have yet to complete. In addition to the evolution of basic computer training in Myanmar, the University of Computer Studies, Yangon and the newly established University of Computer Studies, Mandalay offer degrees in Computer Science, master degree programmes, pre- and post-graduate diploma and doctorate programmes.

33. Presently, students who have completed their Basic Education High School could now enroll in pre-graduate diploma courses offered by the University of Computer Studies (Yangon) and the University of Computer Studies (Mandalay) for a higher level of computer learning. Efforts have been taken to expand these types of courses in all the states and divisions of Myanmar.

34. There are total of 62 colleges, degree colleges, universities and institutes under the Ministry of Education. A four-year Education Promotion Programme was introduced starting from the year 2000. IT Learning Centres, Electronic Resource Centres and Computer Training Centres were formed at these colleges, degree colleges, universities and institutes. According to the Education Promotion Programme, the Ministry of Education provided 1,499 Pentium computers and 265 printers to these institutions. Every student must take 30 hours of IT literacy courses as a compulsory course.

35. The Ministry of Education in cooperation with the Ministry of Information broadcasts an interactive teaching and learning programme using the Data Broadcasting System for distance education. Learning Centres have been established at the colleges, degree colleges, universities and institutes and other Learning Centres will be established at the Multimedia High Schools to a total of 238. According to this, Data Broadcasting System students can learn live teaching programmes, recorded teaching programmes, PowerPoint presentations and text from the Learning Centres by using Internet Protocol.

36. The Ministry of Education is going to set up an Education Intranet System in Myanmar. The achievements or results expected of this project are the free flow and exchange of information first within each university, college or institute and then within all the institutions in the Ministry of Education. This will enhance their performance as well as facilitate and promote better planning, co-ordination and control at the ministerial level. With access to the World Wide Web through the Internet, free flow of knowledge to and from international educational

communities as well as other communities is also expected with immense potential benefits to Myanmar's education sector.

37. Using the Internet is part of the programme for upgrading the educational system under the Ministry of Education. The institutes, universities, degree colleges and colleges have Local Area Network (LAN); Wide Area Network (WAN) would be set up by combining all Local Area Networks, which would include the office of the Ministry of Education, the Department of Higher Education (Lower Myanmar), the Department of Higher Education (Upper Myanmar), the Departments of Basic Education, and eventually to transform (WAN) into Intranet. The final objective is to connect with the Internet.

Data Broadcasting System

38. The Data Broadcasting System uses Internet protocol and has been built as a WAN. This system uses wireless and satellite communication links. The main server is located at the Myanmar Radio Television (MRTV) office and wireless communication is used between the UDE Resource Centre, which is located at the Myanmar Education Research Bureau (MERB), and the MRTV office. By using the ThaiCom-3 Satellite, one-way communication between the UDE Resource Centre and Learning Centres is possible. There is a VSAT up-link in Sagaing. Because of this up-link, the LAN at Sagaing and LAN at Yangon can be linked two ways at any time. If the number of up-links is increased, a more efficient WAN could be established. The communication bandwidth is wider and multimedia communication would be possible.

MOE Intranet

39. The first Intranet system in the Yangon area uses fibre optic lines, leased telephone lines and ordinary telephone lines to connect with the MOE server. Connection of the MOE server with departments, institutes, universities, degree colleges, colleges and high schools outside the Yangon area use telephone lines. Therefore, the LAN from each institution could be directly connected with the MOE server, which would be located at the Department of Higher Education (lower Myanmar). Universities and colleges outside the Yangon area could connect to the MOE server by using a phone line through a modem.

40. A user in the MOE Intranet System would have limited access to the Internet in the future. Users could also communicate with each other and share information. On-line access to knowledge and research activities would be achieved.

41. Collaborating with Bagan Cybertech, the Ministry of Education is going to upgrade the Intranet. Future programmes include networking all the learning centers and VSAT sites

either by wireless system or fibre optic cables to establish a single upgradable network, developing application programmes for an on-line delivery system of the education sector, on-line management and supervision of various aspects of the education sector, establishing international cooperation programmes for future development of ICT in the education sector and training and transfer of technology for the effective use of ever-changing technologies and knowledge environment. The Ministry of Education would be a Multimedia Society in harmony with 21st century society.

Private Computer Schools

42. The government has approved plans for the private sector to operate computer schools where computer application courses are provided to produce qualified people. At present, there are as many as 70 computer schools just in Yangon. Most of the teachers in these private educational institutions are graduates from the University of Computer Studies, Yangon.

43. Some of these private educational institutions have the capability to develop ICT-related systems such as data communication, database management, automatic billing of electricity, immigration system, geographic information system (GIS) for land management, and Internet service, to promote "e-Government" rather than education.

Recommendations on ICT in Education

44. Education is one of the best prospective investments for countries throughout the world and therefore, education is the foundation of the human resource development process by contributing to national economic progress and nation building.

45. Education plays a major role in economic and social development. Education strengthens peoples' ability to meet their needs by increasing their productivity; achieving their potential will lead to a higher standard of living and gaining the confidence to be creative and innovative in all aspects of life.

46. The above mentioned educational objectives indicate the government's long-term vision of enhancing human resource development and nation building through the education sector. The universities offer certificates and diplomas for ICT-related courses under the HRD programmes.

47. Today the world is witnessing dramatic changes in industry and economy brought about by rapid advancement in science and technology. As a result, there is a corresponding transformation in occupational patterns and job qualifications. Myanmar is well aware of the changing situation and therefore, plans are underway to formulate guidelines and strategies not only to meet the current manpower needs but also to address the human resource

requirements of the future trends in industry and economy.

48. In all courses, students should have the opportunity to use computers for both teaching and learning.

49. Internet access should be provided at schools and universities.

50. Research and development projects on computer application in education should be supported.

51. ICT resource centres should be established throughout the country. Internet access should be provided at these resource centres.

52. More effort should be invested in establishing computer labs in universities and schools. These computer labs should be used for improving computer application and increasing problem-solving ability.

53. The 'Smart Schools' project, which proved to be both operationally feasible and very beneficial for improving education in the pilot project, should be extended to cover as many schools as possible.

54. Implementation of a programme for ICT training should be given priority.

55. Multimedia classrooms should be established in every basic education school.

56. Several developments necessitated the change to a technology supported education system. The first was the need to meet the challenges of the Information Age, especially the needs for an ICT-literate population. In addition, the Multimedia Schools were built and have been operating since 1996. A senior authority has given direct guidance and arranged for computer installations in various high schools and middle schools to initiate and promote the transfer of computer knowledge to the younger generation.

57. Internet/Intranet-based distance learning systems should be implemented.

58. Future programmes should include networking all educational institutions by existing VSAT systems, local wireless loop systems, iPSTAR, fibre optic cables or any other cost-effective means in order to establish a single upgradable network, developing application programmes for on-line an delivery system, on-line management and supervision of various aspects of the education system, establishing international cooperation programmes for future development of ICT in the education sector and training and transfer of technology for the effective use of ever-changing technologies and knowledge environment.

7. ICT Application

Introduction

1. Countries throughout the world fear being left behind in an ICT-driven global economy increasingly characterised by the digital divide. The importance of ICT application is further amplified by the process of economic globalisation, which places a premium on using information and communication to create linkages to international markets and global production networks.

2. Myanmar recognises the potential of information and communication technology for rapid and all round national development. Accordingly, it has taken some initiatives that would facilitate development of ICT in the shortest possible time. The tasks include improving ICT awareness among the general public, business communities and government agencies, improving telecommunication and legal infrastructure, investing in ICT human resource development and application of ICT in education. Unfortunately, only a few efforts have been made to widen ICT application in the public and private sectors.

3. The recommendations in this part of the report flow from the perspective that Myanmar can truly benefit from ICT only if ICT could be put to use in all socio-economic activities in both the public and private sectors. Whatever development strategy is used, staying competitive requires investment in ICT.

e-Government

4. In developing countries such as Myanmar, the government is usually the biggest employer, the biggest buyer and supplier and the largest producer of not only goods and services but also socio-economic statistical information. Socio-economic development of these countries depends on how efficiently and effectively the government agencies are managed and operated. Only with the application of ICT, can governments generate quality information for operation and management.

5. Myanmar recognises the need for application of ICT in the government and, under the guidance of the Myanmar Computer Science Development Council and the e-National Task Force, various e-Government projects (e-Passport, e-Visa, Security systems, e-Procurement, Trade Electronic Data Interchange (TEDI), Certification Authority, e-Tax) were initiated. Application of ICT in the government and public sectors is still very slow and lagging behind the private sector.

6. The government-wide electronic information infrastructure should be created to simplify service delivery, reduce duplication, and improve the level and speed of service to the public.

Data distributed by the public sector should be made available not only on paper but also in electronic media. Then, obtaining public information and communicating with public organisations should be made easy for any citizen. A one-stop service should be provided for accessing information. Re-engineering of the existing government processes and procedures should be implemented to bring about transparency in working, reduce constraining controls, increase efficiency and productivity, reduce cost of service delivery, etc. Integration of projects across various departments to provide a single point of contact for citizens for electronic delivery of services would be put into place. Computerisation should improve communication between the public sector, private sector and the people. The goal should be better fulfilment of the needs of the people.

7. Computerisation of the public sector should also improve policy formulation, coordination and control, and enforcement of laws, rules and regulations. Furthermore, e-Government projects should become examples for other computerisation projects.

8. Studies would be commissioned in the systems already implemented by the Central Government and state governments where the impact on citizen services has been felt. The best practices of implementation systems would be collected and disseminated to all government organisations for replication.

9. Promotion and coordination of governmental information systems can only be achieved through coordinating various governmental agencies by institutions such as the e-National Taskforce. Each governmental agency should appoint a Chief Information Officer (CIO) for the purpose of promoting the use, operation and maintenance of the information systems. The CIO should become an effective liaison between the e-National Task Force and the respective government agencies.

10. Since there are many systems that could be computerised, the first task should be identification of the systems that would provide the most benefits to the general public. Some examples are immigration, tax, population, vital statistics and other registration systems.

11. To promote governmental information systems, comprehensive short-, medium- and long-term plans for information systems should be formulated. During planning, the order of priority should be determined for various information projects according to their level of importance. Each governmental agency should formulate its own individual medium- to long-term information plan based on a general plan by the above organisation for promotion.

12. Studies should be commissioned for obtaining detailed information requirements of citizens (individuals and corporate) to enable identification of areas where ICT interface would help make the life of the ordinary citizen easier.

13. A specific budget frame and other financial resources should be secured for governmental

information systems development and operation. Every government agency should allocate a specified percentage of its budget for ICT application.

Priority Application Areas

14. The following are identified as priority application areas for the first phase of e-Government:
    A) Banking
    B) Natural resource (e.g. agricultural) database
    C) Registration systems (immigration, vehicle, etc.)
    D) TEDI (Trade Electronic Data Interchange)
    E) e-Procurement
    F) Certification Authority
    G) e-Tax
    H) e-Documents
    I) Government accounting

Private Sector Role in e-Government

15. In view of the enormous capabilities of private enterprises, they should be involved in publicly funded projects as much as possible. A Business Model should be evolved for joint partnership of the government and private sector to electronically deliver services. The private sector invests initially, and recovers money on services rendered. This model would be tailored by central government departments and state governments for meeting their individual needs.

Security

16. When governmental information systems are introduced, efforts should be made to secure an adequate level of security through Government Public Key Infrastructure (GPKI) or other means.

17. For the information generated or collected through its various agencies, the government should formulate policy guidelines and a set of standards to classify or declassify the information at the point of origin or compilation. In the case of classified information, the period of classified status would be specified at the point of origin or compilation itself to facilitate automatic declassification of such information upon expiry of the specified period.

Arrangement for Easy Access of Information

18. Service Delivery Points (SDPs) would be set up at convenient locations for citizens to access services. Information Kiosks should be opened in public places such as shopping centres,

post offices, railway stations, and libraries.

Showcase

19. To ensure that the general public is aware of the benefits of computer application, some functions related to the general public should be selected and systematically computerised as a showcase so that the public would understand the benefits of using computers, and to motivate the public and private sectors and the entire population to use ICT extensively. Establishment of a call centre that would provide information to the general public on-line is a good example. As the first step, a survey on identification of public information and creation of a content database should be implemented.

Standardisation

20. Development of standards for the development of integrated systems. Seminars and workshops on standardisation should be conducted.

21. Necessary measures should be implemented to promote the use of various standards such as character sets, terminology, commodity codes, area codes, occupational codes, and industry classification. Application of uniform codes would allow development of systems that could interface with each other.

Public Training

22. Citizens at large should be trained in retrieving required information or transactions they want to perform in addition to training government officials in launching their respective systems. Government officials would be trained in operating their databases, updating and maintaining them.

Economic Data

23. Databases on laws, rules and regulations related to economic activities, data on public and private organisations, market information, direction of trade, etc. should be created. These databases should be kept up to date and facilities provided for easy access.

24. Economic data is spread out in many areas such as public and private organisations, international organisations and foreign countries. A system, which would allow one-stop shopping of information for the user, should be developed.

Agriculture and Forest

25. Information networks for farm products should be created linking producers, distribution

markets, and consumers for the purpose of securing stable prices and establishing an efficient supply chain system.

26. Networks for agriculture-supporting information systems should be created to promote efficient production of farm products, and to provide information on local/extensive-area weather conditions and harmful insects, and on the supply of agricultural chemicals and fertilisers.

27. The creation of monitoring systems should be discussed in order to protect natural resources such as forests and springs and to prevent natural disasters such as floods and wild fires.

28. Agriculture Information Services such as commodity prices of various agricultural products, availability, booking and ordering of agricultural inputs, inventory of state-of-the-art agricultural practices, information about allied activities, etc. could be very useful for farmers of all states. Similarly, information on weather forecasting, subsidies and other government schemes for the benefit of farmers could be disseminated through such an Agricultural Information Service.

Science and Technology

29. Information about its own natural resources is not sufficient for a country as a long-term effective resource. A system should be developed to make not only data on its own technology, natural resources, and environment but also data on other countries easily available at a minimum cost.

Education

30. Myanmar's attempts to use ICT in education are encouraging. The government strongly encourages the use of ICT in education. Multimedia Classrooms have been established in almost all the high schools. There are attempts to use ICT to teach not only ICT but other subjects as well. However, there is little effort on content creation. Internet access cannot be provided yet for education, but efforts to establish an educational Intranet are in progress. Only systematic and continuous planning and control will guarantee the effectiveness.

Health

31. Application of ICT in health is at the minimum level. There is preparation for the creation of an Intranet in the Ministry of Health with the goal of improving medical education. There is little effort, however, on the application of ICT in improving public health care.

32. A database containing data required by public and private hospitals, clinics, doctors, nurses, lab technicians, patients, persons related to patients, sources of funds, public health

enforcement and health education agencies, producers and distributors of drugs, etc. should be created and kept up to date. The database should also include health information such as indigenous and international medicines, prevention methods, diagnosis and treatment methods, research findings, vital statistics and should be readily available to the public at a minimum cost.

Environmental Protection

33. Application of ICT in environmental protection does not seem to receive the proper attention. There is little effort on electronic handling of science, social, geographic, natural resources, and population information.

Social and Cultural Aspects

34. Cultural information on various races and indigenous groups and historical data should be collected, organised and stored in computer databases for easy access.

35. Myanmar is known for its rich and diverse cultural heritage. It also possesses a vast wealth of traditional knowledge, which is mostly in the language of Myanmar and should be promoted and preserved for posterity. The government should, therefore, through appropriate projects, take initiatives to create electronic images of the information on Myanmar arts and culture for wider dissemination and research.

e-Commerce

36. Efforts on the development of e-commerce have already been initiated. e-Government projects such as e-Procurement, TEDI, Certification Authority and preparation of cyber laws would certainly create a better environment for e-commerce development. However, there are quite a lot of things to do, such as improving delivery systems, improving infrastructure to allow the general public to use the Internet, handling taxation issues, etc., necessitating the collaboration of the government and the private sector.

e-Society

37. Provide reliable Internet access to economic, education, health and social sectors.

38. Develop programmes to familiarise the entire population with ICT.

Manufacturing

39. The application of ICT in manufacturing has already started, but computerised activities are mostly in traditional areas such as office automation, inventory control, sales and purchases,

staff management, payroll and accounts. There are only a few cases of ICT application in Computer Aided Design/Manufacturing (CAD/CAM) and Manufacturing Resource Planning (MRP). Applications on the level of Supply Chain Management (SCM), Customer Relationship Management (CRM), Enterprise Resource Management or Planning (ERM or ERP) have not yet been introduced. The government and private sectors should cooperate and collaborate for expanding application of ICT for industry development. The first step may be educating the people involved in industry development so that they are aware of the advances in ICT application in manufacturing and the benefits of computerisation.

Banking and Finance

40. The application of ICT in the financial sector is the most visible. All private banks have computerised branch activities and some of the banks are preparing to introduce Intranet systems linking the branches. One bank has installed ATMs and another one has introduced the Smart Card system. But computerisation in the public financial sector is lagging far behind.

41. Information systems should be promoted at the Central Bank, which focuses primarily on financial policies and functions. Also, a Central Bank network system should be built to facilitate efficient settlement/transactions among private-sector banks.

42. Necessary measures should be implemented to promote information systems at private-sector banks for office-related tasks, the development of transaction systems such as Automatic Teller Machines (ATMs), IC cards, home banking systems, and the creation of network systems between head offices and branches as well as among private banks.

43. Transfer of funds and capital from foreign countries should be made more efficient by improving systems for foreign exchange settlement with foreign countries. In this regard, international connections using the SWIFT (Society for Worldwide Inter-bank Financial Telecommunications) network should be enhanced.

Trading

44. Application of ICT in the trading sector is increasing gradually. Large supermarkets and export/import companies are computerising their activities at various levels, mainly for sales processing, inventory control, accounts and office work. A very low percentage of small- and medium-sized trading enterprises are computerised.

45. The key element in trading and transportation of commodities is the standardised article number system. In order to introduce this system, a nation-wide body to allocate and maintain article numbers in a unique manner should be created. This numbering system should be in

accordance with global standards set by international article number associations such as EAN International.

Application of ICT in Business

46. There is an urgent need to promote wide-spread application of ICT in business organisations to improve productivity, render better services, penetrate the international market and reduce costs.

47. An incentive scheme for encouraging computer application in business organisations should be established. The government should provide assistance to organisations already using or planning to use computers, such as provisions for loans and other financial incentives. It would also be meaningful to provide incentives for foreign investment and technology transfer.

48. The government should support business organisations in conducting feasibility studies for extensive computerisation. A scheme to provide opportunities for SME, especially industrial organisations for computerisation, should be developed. As the initial step, selected SMEs should be provided technical and financial assistance for conducting feasibility studies for computerisation. The studies would improve awareness of ICT power and the feasibility reports would provide motivation for computerisation.

49. For national economic development, it is necessary to strengthen local business organisations so that they can compete in the international market. Present market economic policy necessitates being competitive not only locally but also internationally. Immediate access to information, making goods and services available on the market, receiving feedback information from the market, quick decision-making based on analysis of the information and fast response are key elements for penetrating the international market.

50. In further expanding the currently growing e-mail services and Internet provider services that allow people to enjoy the benefits of information-communication systems, necessary measures should be implemented for related fields in the private sector.

51. Education activities and other necessary measures should be implemented to promote application of information systems to business administration and marketing in domestic/ foreign markets, etc.

Myanmar Language-based systems

52. The Myanmar language-based systems are crucial for spreading the impact of ICT on a grass roots level. All government-funded software tools, developed for handling information in Myanmar languages, should be actively promoted for widespread use and should be

made available at nominal cost.

Regional

53. Distribution and application of ICT is concentrated in Yangon and Mandalay, making it very difficult to develop information systems, which need coverage on a regional and national level coverage.

Information on R&D Works

54. All the reports generated from the R & D works funded by the government and its agencies would be made available for wider dissemination and commercial exploitation. It would be mandatory for all the universities or deemed universities in the country to host every dissertation/thesis submitted for research degrees on a designated website.

Hosting in Myanmar

55. The government should encourage and promote Myanmar companies and organisations to host their content only on web servers located in Myanmar with Myanmar domain addresses and these should be made available at internationally competitive prices. The government may specify guidelines on information that is hosted on these sites.

56. There is a need to promote and encourage hosting of non-commercial materials related to linguistic, social and cultural aspects of the people by public or private organisations. The government should take initiatives for providing web sites, free of cost, for such purposes.

Digital Library

57. A pilot project on digital library development, based on indigenous software, should be initiated. The project should be implemented at one of the suitable existing libraries to serve as a model. The software so developed can be distributed to other organisations to accelerate the development of digital libraries across the country. National, regional and other public libraries should be required to develop databases of their holdings, which would be hosted on a designated web site with free access to users.

Factors Affecting the Level of ICT Application

58. The following are identified as main factors that affect the level of ICT application:
    A) Appreciation of ICT power
    B) Financial constraints
    C) ICT infrastructure (e.g. telecommunication and power supply)

D) Cost of ICT application

E) ICT education

F) Proliferation of standards

G) Government involvement

H) Economic and social conditions

I) Legal environment

J) Management practices

8. ICT Industry

Introduction

1. Information and Communication Technology (ICT) is extremely important not only because of its huge contribution to socio-economic development, but also because it has become the biggest economic sector. Furthermore, it is growing at an incredibly rapid pace.

2. Many Asian countries, including developing countries, have had impressive results in the development of the ICT Industry. The ICT industry is a major source of economic output, exports and jobs in countries such as Japan, Taiwan, Singapore, Hong Kong, China and Korea, due mainly to opportunities created in the hardware industry. Countries such as India, China and the Philippines are also finding opportunities in the software industry thanks to the large number of ICT professionals. The quality of ICT professionals in these developing countries is well recognised internationally.

3. If Myanmar can develop sufficient ICT human resources, there is a fairly good chance that Myanmar can compete effectively in the international software industry because the main input for this industry is human resources.

4. Even though some ICT Industry segments such as hardware and telecommunications are virtually closed off by the leading players, the software and services industries still offer opportunities for new entrants and they are the fastest growing segments of the ICT industry. There is an acute shortage of ICT professionals in developed and newly industrialised countries and their cost is already very high and increasing.

5. Myanmar should strive to develop an ICT industry, especially a software industry, to establish itself as one of the main economic sectors.

Advantages of Myanmar

6. For the foreseeable future, human resources will remain the key input to the software development process. Myanmar has a large pool of highly qualified human resources and with dedicated effort in both formal and informal ICT human resource development, Myanmar has the potential to become a country with highly qualified ICT engineers.

7. Labour costs in Myanmar are much lower than in developed countries and considerably less than ICT human resources supplied by developing countries such as India and the Philippines. Due to the low cost of space and other overhead, the total software development cost in Myanmar is more than ten times cheaper than in developed countries. It is estimated that software development costs in Myanmar are still less than half of that in developing countries with a developed software industry.

8. For the developed countries, outsourcing to low-wage countries is considered an opportunity for further development of ICT. There are numerous legacy systems in developed countries that need to be re-engineered to be cost-effective. Furthermore, there is a shortage of software engineers in the developed countries. Technological development such as new development methodologies (client/server, object oriented, web-based systems, multimedia systems) and new development environments (Linux) create the need to upgrade existing systems by integrating old and new technology or migrating to new systems. Consequently, outsourcing from developed to developing countries is increasing. This downsizing or rightsizing of jobs together with new requirements created by the rapidly changing socio-economic environment is a very good opportunity for developing countries such as Myanmar.

9. Networks such as the Internet allow the transmission of software and data to any area in the world. Software development activities need not be limited by location. Software engineers anywhere can work on a real-time on-line basis.

ICT Human Resource Development

10. ICT engineers are the key input required for the establishment of the ICT industry. There are many efforts in Myanmar to develop ICT human resources. Twenty-four government computer colleges were opened in states and divisions in addition to the two University of Computer Studies, one in Yangon in Lower Myanmar and another in Mandalay under the Ministry of Science and Technologies. They offer diploma, bachelor, and masters and doctorate courses on ICT. Some of the universities and colleges under the Ministry of Education also offer undergraduate ICT courses. Yangon Universities offers masters courses.

11. These programmes will produce a considerable number of ICT engineers, but maintaining the quality of the graduates is questionable. It would be a promising endeavour to systematically maintain the quality of the ICT graduates from these universities and colleges. To maintain the level of academic quality, the management of academic matters of government universities and colleges should be in the hands of the academicians. A plan should be drawn up to privatise some of the universities and colleges.

12. Private computer training schools also provide ICT professional courses. Some offer diploma and undergraduate courses affiliated to international ICT professional training institutions. They can be improved by becoming more practically oriented. The high cost of these courses prohibits producing a large number of ICT engineers. It is very strange that local diploma and bachelor courses are not offered by private computer training institutions. There is no government support to the private ICT training institutions.

13. A scheme for supporting private computer schools and ICT professionals who want to receive

advanced-level training should be developed by the central or local government. Qualified private computer training schools should be allowed to offer diploma and graduate courses. Establishing private universities and colleges should be considered.

14. Informal certification programmes were also initiated recently. The MCSA certification programme has been successfully implemented and a cross certification programme with JITEC, Japan will be implemented by the end of 2002. These informal certification programmes should be systematically promoted to provide an opportunity to those who can not afford or who want to join formal education; the programmes would attract a very large population of participants.

15. It should be recognised that the quality of ICT professionals still requires improvement in order to meet international standards. This gap can only be closed quickly through effective human resource development programmes.

16. Information technology training requires theory along with practical experience. Theories learned at educational facilities are mastered only through practical experience and come into bloom as applicable technological ability. Instead of depending entirely on the demand for systems in the private sector, the government should launch initiatives to implement system development projects that provide domestic engineers with not only job opportunities but also practical experience. While nurturing the country's engineers up to a standard recognised around the world, it is necessary to implement system development projects within Myanmar. With cooperation from foreign countries, initiatives should be taken by Myanmar to undertake project management, analysis, and the creation of data models and design elements. ICT engineers in Myanmar are highly skilled, and they have the potential to play a significant role in the international market if they are able to accumulate an ample amount of experience.

Technology Transfer and Sharing

17. For keeping pace with the fast changing trends in software technology, software developers should be encouraged and supported to acquire software productivity; quality tools and information on software technology trends should be made easily available.

18. Funding should be provided for study projects to understand the problems precipitated and solutions required for entering the international market. The findings would be publicised through the appropriate media to software developers throughout Myanmar. It is necessary to create an environment in which software developers can share ideas and experiences.

OJT Programme

19. Myanmar is participating in the OJT programme sponsored by METI, Japan. The first group of OJT trainees are already in Japan. OJTs from Myanmar will be able to compensate for the shortage of software engineers in Japan. At the same time it is a good opportunity for them to obtain working experience in the Japanese software development environment and achieve international-level expertise. OJTs can become the link pin between Japan and Myanmar ICT companies becoming business partners. But the number of OJTs from Myanmar is still very low and it would be difficult to obtain the desired effect. Strengthening the OJT programme should be given high priority.

e-Learning Centre and High-level Computer Training Institute

20. The existing e-Learning Centre established by the assistance of METI is now becoming a key source of ICT human resource from the informal side. On the other hand, establishment of the higher-level Computer Training Institute, which would provide practical training for graduates from universities and colleges, has not materialised as planned. Both are key elements in the ICT human resource development plan. The existing e-Learning Centre should be strengthened to become a fully equipped training institute from the informal side. Establishment of the Computer Training Institute should be given high priority.

Language Ability

21. Japanese language ability is important in forging cooperative relations with Japanese companies in the ICT industry. Those holding a Japanese language examination Class 3 Certificate and those with equivalent ability stand a very good chance of being employed at a Japanese software house.

Improving the Software Development Process

22. It is important that software development processes are systematically managed so that development, acquisition and maintenance of product and services can be cost-effective. The quality of the software is assured only with these systematic development methodologies. There is a tendency that only those software developers that apply international standard models for software development process management, such as CMMI and ISO, are selected as candidates to be outsourced. To enter into the international software development market Myanmar software houses need to not only apply these standards but also be certified.

Cooperation between ICT Industry and ICT Educational Institutions

23. Presently there is little cooperation between ICT educational institutions, such as universities, and ICT companies. However, there are many examples of fruitful cooperation between these institutions. Researches and studies can be carried out by universities on behalf of a particular ICT company or for a particular technology for the entire ICT industry. On the other hand, ICT companies can provide industrial attachment programme for university students so that they have both a good theoretical foundation and practical experience while attending the universities. This would reduce the time and cost for on-the-job training and narrow the gap between what is expected by the industry and what is being provided by education.

Financial Support

24. In their drive to increase international credibility, software companies need to invest in the development environment and sufficient human resources for putting into place all the necessary means for meeting strict delivery schedules and customer satisfaction. As the initial payment for outsourcing projects would not be sufficient for building the required development environment, software companies would need financial support so that they could accept large projects that need considerable initial investment.

25. A venture capital fund should be created for funding start-ups and entrepreneurial efforts. Public and private banks can form a syndicate and, under the guidance of the Central Bank, create a venture capital fund for financing the ICT sector.

26. The banking and financial institutions should be advised to recognise content development activity as an industry, and be encouraged to provide venture capital and develop appropriate norms for financing this industry. A special venture capital fund should be created exclusively for the electronic content industry.

27. Financial incentives should be offered in terms of tax breaks and favourable tariffs on ICT equipment; favourable import/export conditions should also be established. In addition, problems related to financing and loans for businesses should be resolved. It is reportedly difficult to receive loans from private banks, and a special loan system operated by government-owned financial institutions would therefore be an effective incentive for the ICT industry. A special loan scheme with flexible lending methods and low interest rates should be established. Special loan schemes provided to industrial zones and the agricultural sector should be made available to the ICT sector as well.

Market Intelligence and Access

28. The government should provide support for promotional efforts so that software products could be introduced into the international market.

29. Encourage services for providing market intelligence on domestic and global services industries to disseminate information such as new trends, market conditions, key indicators, new opportunity areas, etc. Conduct research and suggest the best practices for positioning Myanmar as a software developer, helping start-ups with marketing plans and contact databases, etc.

ICT Zones

30. Establishment of ICT zones to provide adequate facilities and favourable conditions for ICT development is a proven strategy. For developing countries such as Myanmar, it is impossible to provide facilities such as broadband Internet access and reliable power to ICT companies located in various places. It is much cheaper and more feasible to concentrate the facilities in a limited area where ICT companies can come in.

31. With the full support of the government, a consortium of private companies has established the Myanmar ICT Park (MICT Park), which provides a very good environment for software and information services development with high-speed Internet access and other facilities. The Park was officially opened in January 2002. Presently, the park can accommodate only 32 companies and the available space is fully occupied. The second phase has already begun and by the end of 2002, 36 more rooms will be available. Establishment of an ICT park in Mandalay is in progress.

32. A major reason why neighbouring countries strive to construct facilities similar to the MICT Park is that they hope to attract leading foreign high-tech companies in order to boost the international competitiveness of domestic industries and to help modernise their nation. The MICT Park is already competitively involved with neighbouring countries having similar facilities in terms of attracting foreign companies, and it is unrealistic to expect that many leading foreign countries will arrive simply by opening up an Internet-related environment. The government and the private sector should jointly endeavour to make the MICT Park more attractive by studying similar facilities in other countries as well as various incentives offered. The park should not only provide adequate facilities, such as electricity, telecommunication facilities, and high-speed Internet access but also tax exemptions or reduced rates and special loans. The zone authorities should act as the single-window service provider especially in coordination with the government agencies.

Hardware Industry

33. The hardware market is rapidly expanding. It is estimated that PC penetration is 5 per 1000 (i.e. 200,000 PCs in total). But the market is growing quickly and it is estimated that at present 20,000 PCs are distributed monthly. The growth is in both the public and private sectors. Almost all of the PCs are distributed by local vendors and most of the assembly is done in Myanmar. There are a couple of factories manufacturing computer-related parts, but their contribution to the market is very small. Careful studies should be carried out before Myanmar enters into the international hardware and telecommunication market.

Content Industry

34. The content industry is at the infancy stage, but most new companies seem eager to enter this promising industry. There are many products to be developed for local markets that would meet the needs of local language, cultural and business environments.

35. The creation of a knowledge base requires trained manpower for the collection, compilation, analysis and production of value-added information products and services. Specialised training programmes, through existing institutions, should be initiated to meet the requirements of trained professionals in these areas. Traditional curriculum being offered by the universities and educational institutions in various fields related to content industry should be suitably modified, such as library science, journalism and mass communication.

36. Multimedia and the Internet are the foundations of the future content industry. The creation of multimedia products requires specialists in multimedia designing, editing, programming, etc. Training programmes for these core multimedia professionals should be initiated in Engineering Colleges, Polytechnics and other concerned institutions.

37. The government would fund and sponsor research on various aspects of content development, including related market studies and develop a short-term as well as a long-term vision and growth strategy for the sector. Detailed research studies would be undertaken to identify specific areas for content creation and its marketing at regional, national and international levels.

Liberalisation

38. Myanmar should promote and facilitate liberalisation in investment, production and distribution of ICT products and services. Information control is one major factor that will lead the nation to lose its trustworthiness. Liberalisation involving the Internet should be promoted. The formation of brands in Myanmar requires the opening up of information and the results of development in the country should be widely publicised via the Internet and

other various media.

Government as the Main Source of Demand

39. Domestic demand should be created to start off the growth of the ICT Industry before maturing to enter into the international market. The main source of demand, as in most of the developing countries, would come from the government first. National-level projects with potential for providing better services to the public should be initiated.

Telecommunication Infrastructure

40. The current information technology is closely linked with communication networks. It is meaningless to discuss development of ICT without such networks. Networks between companies and between regions should be opened up to the private sector.

41. The installation of telecommunication networks in rural areas requires a huge amount of funds. An effective means should be selected by taking into account the prevailing technological trends. Efficient networks should be created combining fibre optic technology, communication satellites, and wireless networks, etc.

Image Building

42. If a good image for Myanmar products and the quality of Myanmar ICT engineers could be established in Japan in conjunction with a close cooperative relationship between the two nations, the effects would spread to other countries.

Conclusion

43. The advantages of Myanmar in developing an ICT Industry, particularly a software industry, are the availability of knowledgeable manpower and the comparatively low labour costs. Infrastructure and availability of financial resources are the factors restraining the growth of the ICT industry.

44. ICT human resource development, infrastructure building and implementation of national-level projects are identified as areas in which cooperation and assistance from Japan would be beneficial to both Myanmar and Japan.

9. Appendices

Appendix 1.　Membership Status to Several ICT-related Multilateral Conventions & Institutions

Appendix 2.　Major ICT Indicators of Asian Countries, 2001

Appendix 3.　Abstract from the ICT Master Plan (2001-2010)

Appendix 4.　Institutionalisation for ICT Development

Appendix 1. Membership Status to Several ICT-related Multilateral Conventions & Institutions

Multilateral Conventions and Institutes / Country	UN United Nations	GATT General Agreement on Tariffs and Trade (replaced by WTO)	WTO World Trade Organisation	ITU International Telecommunication Union	UPU Universal Postal Union	Paris Paris Convention for the Protection of Industrial Property (Patent)	Berne Berne Convention for the Protection of Literary and Artistic Work (Copyright)	Metre Metre Convention	ISO International Organisation for Standardisation	SWIFT Society for Worldwide Inter-bank Financial Communication (Number of banks connected)	EAN Int'l Article Number Authority (Year national body created)
As of	2000/9/26	1994/12/31	2000/9/8	2000/10/4	2000/4/27	2000/4/15	2000/5/4	2000/9/5	1999	2001/12/31	2001/12/31
Brunei	1984	1993	1995	1984	1985	--	--	--	--	1	--
Cambodia	1955	--	observer	1952	1951	1998	--	--	--	3	--
China	1945	--	2001	1920	1914	1985	1992	1982	1978	23	1991
DPKR	1948	--	--	1975	1974	1980	--	1982	1963		1999
Hong Kong	--	1986	1995	--	--	--	--	--	--		1989
India	1945	1948	1995	1869	1876	1998	1928	1957	1947	47	1995
Indonesia	1950	1950	1995	1949	1877	1950	1997	1960	1954	29	1993
Japan	1956	1955	1995	1879	1877	1899	1899	1885	1952	125	1978
ROK	1948	1967	1995	1952	1900	1980	1996	1959	1963		1988
Laos	1955	--	observer	1952	1952	1998	--	--	--	1	--
Malaysia	1957	1957	1995	1958	1958	1989	1990	--	1969	13	1988
Mongolia	1961	--	1997	1964	1963	1985	1998	--	1979		--
Myanmar	1948	1948	1995	1937	1949	--	--	--	--	0	--
Philippines	1945	1979	1995	1912	1922	1965	1951	--	1968	19	1993
Singapore	1965	1973	1995	1965	1966	1995	1998	1994	1966	9	1987
Thailand	1946	1982	1995	1883	1885	--	1931	1912	1966	13	1988
Vietnam	1977	1979	observer	1951	1951	1949	--	--	1977	8	1995

Source: UN, WTO, ITU, UPU, WIPO, BIPM, ISO, SWIFT, EAN International, etc.

Appendix 2. Major ICT Indicators of Asian Countries, 2001

Indicator / country	Main telephone lines per 100 inhabitants = Tele-density	Digital main lines	Cellular mobile telephone subscribers per 100 inhabitants	Number of personal computers	Number of Internet hosts	Number of Internet users (estimated)
Unit	%	%	%	X 1,000	X 1	X 1,000
Brunei	NA	100.0	NA	25	8,707	35
Cambodia	0.25	100.0	1.66	20	623	10
China	13.81	99.9	11.17	25,000	89,357	33,700
DPRK	4.50	NA	0.00	NA	NA	NA
Hong Kong	58.08	100.0	84.35	2,600	387,670	3,100
India	3.38	99.8	0.56	6,000	82,979	7,000
Indonesia	3.70	100.0	2.47	2,300	45,660	4,000
Japan	59.69	100.0	57.17	44,400	7,118,300	57,900
Korea	47.60	100.0	60.84	12,000	439,860	24,380
Laos	0.93	99.5	0.52	16	165	10
Malaysia	19.91	100.0	29.95	3,000	74,007	5,700
Mongolia	4.81	NA	7.62	35	151	40
Myanmar	0.58	64.2	0.03	55	2	10
Philippines	4.02	99.0	13.70	1,700	30,851	2,000
Singapore	47.17	100.0	69.20	2,100	197,960	1,500
Thai	9.39	100.0	11.87	1,700	71,995	3,536
Vietnam	3.76	100.0	1.54	800	487	400

Source: International Telecommunication Union, Yearbook of Statistics.

Appendix 3. Abstract from the ICT Master Plan (2001-2010)

Mission

Based on the national political, economic and social objectives and present status and future trend of ICT in Myanmar and internationally, the ICT Master Plan may have the following broad mission elements.

(a) Widespread application of ICT in state management with the intention of providing better services to the public, improving efficiency and reducing costs.

(b) Widespread application of ICT in business organisations to improve productivity and render better services.

(c) To use ICT as an infrastructure for the smooth operation of socio-economic organisations by improving communications and reducing costs.

(d) To use ICT as a vehicle for business organisations penetrating into the international market.

(e) Widespread application of ICT to improve the educational level of the entire population.

(f) To develop the ICT Industry as one of the main economic sectors.

(g) To develop human resources so that sufficient ICT professionals are available for both ICT industry and ICT application.

(h) To create an ICT intelligent society.

(i) To facilitate the growth of e-commerce at national, regional and international levels.

(j) To reduce the digital divide.

Strategy

To fulfil the mission, the national ICT strategy should have the following elements:

(a) To develop a scheme so that the public and private sectors can coordinate and cooperate effectively.

(b) As the biggest buyer of ICT products and services, the state should act as the main demand force for domestic ICT application growth.

(c) Demonstration projects to show the benefits of ICT application should be carried out by the state to motivate public and private sectors and the entire population to use extensively.

(d) To provide incentives to business organisations to create better conditions for ICT applications, foreign investment and technology transfer.

(e) Objectives and policies for ICT development should be continuously reviewed and modified according to the changing situation.

(f) Development of the software industry and penetration into the international market should be a high priority task.

(g) To invest concrete efforts in research and development.

(h) To increase international cooperation.

(i) To develop standards for the development of integrated systems.

(j) To make arrangements for local ICT organisations to become involved in major projects that require foreign expertise to provide opportunity for technology transfer.

(k) To provide reliable Internet access to the economic, education, health and social sectors.

(l) To establish an ICT zone that would provide financial incentives, research facilities, adequate ICT infrastructure.

(m) To develop a system for identification, collection, storage and distribution of ICT at both the national and international level.

(n) Efforts on effective application of ICT in education should be given high priority.

(o) To familiarise the entire population with ICT.

(p) To promote and facilitate liberalisation in investment, production and distribution of ICT products and services.

(q) To develop regulatory and legislative frameworks to facilitate the growth of e-Commerce.

Appendix 4. Institutionalisation for ICT Development

Organisation charged with ICT Development (Public)

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┌─────────────────────────────────────────────────────┐
│                 E-ASEAN Framework                    │
└─────────────────────────┬───────────────────────────┘
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┌─────────────────────────┴───────────────────────────┐
│                 e-National Task Force                │
└─────────────────────────┬───────────────────────────┘
                          │
┌──────────────────────┐  │  ┌──────────────────────┐
│ e-Application        │──┤  │ ICT Infrastructure   │
│ Committee            │  │  │ Committee            │
└──────────────────────┘  │  └──────────────────────┘
                          │
┌──────────────────────┐  │  ┌──────────────────────┐
│ ICT Legal            │──┤  │ ICT Liberalisation   │
│ Infrastructure       │  │  │ Committee            │
│ Committee            │  │  └──────────────────────┘
└──────────────────────┘  │
                          │
┌──────────────────────┐  │  ┌──────────────────────┐
│ e-Education          │──┘  │ ICT Standardisation  │
│ Committee            │     │ Committee            │
└──────────────────────┘     └──────────────────────┘
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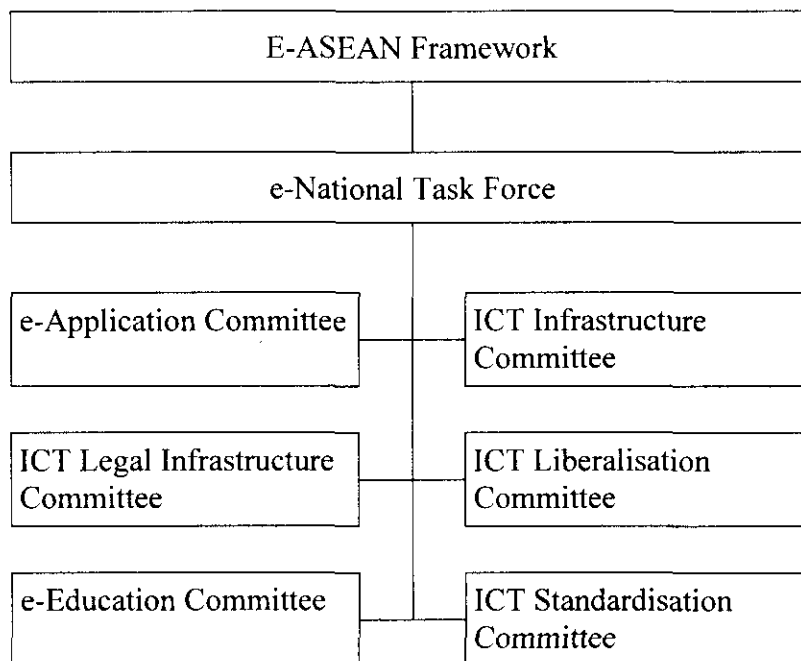
Organisation charged with ICT Development (Private)

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┌─────────────────────────────────────────────────────┐
│   Myanmar Computer Science Development Law 1996       │
└─────────────────────────┬───────────────────────────┘
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┌─────────────────────────┴───────────────────────────┐
│  Myanmar Computer Science Development Council 1996    │
└─────────────────────────┬───────────────────────────┘
                          │
┌─────────────────────────┴───────────────────────────┐
│        Myanmar Computer Federation 1998              │
└─────────────────────────┬───────────────────────────┘
           ┌──────────────┼──────────────┐
┌──────────────────┐ ┌──────────────────┐ ┌──────────────────┐
│ Myanmar Computer │ │ Myanmar Computer │ │ Myanmar Computer │
│ Scientist        │ │ Industry         │ │ Enthusiasts      │
│ Association      │ │ Association      │ │ Association      │
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