

## Annex L

### PTCL Network and Infrastructure Report

The following report discusses PTCL's network and infrastructure. It was prepared by PTCL in late 2003. The report is provided for the information of Applicants. The Authority is not responsible for the contents of the report and assumes no responsibility or liability for any inaccuracies or omissions. Applicants should address any questions or requests for clarification to PTCL.

#### Introduction

Over the past few years PTCL has managed to rapidly modernize its network, while at the same time increasing teledensity, quality of service and other telecom infrastructure. PTCL's current network consists of 99.6% digital switching system, optical fiber cable backbone, subsidiary routes, long distance media, digital radio systems, submarine communication, satellite communication and alternate arrangements. PTCL is also the provider of infrastructure connectivity for ISPs, data network operators, software exporters, educational institutions, corporate and other users. Network capacity has grown rapidly in the last five years ending June 2003 by 1.5 million additional ALI with a digitalization rate of over 99.6%. The number of exchanges has increased to the current level of 2,826. PTCL has also been one of the few telcos in the region to deploy DWDM technology on its optical fiber system. Although the network is largely automatic, there are few manual exchanges is a limited manual network, primarily serving remote communities, which is connected to the rest of the network through LEs.

The key elements of PTCL's network and infrastructure are as follows:

- **Local Loop network** – principally copper wire based lines connecting the LEs to the subscriber's premises (also known as the "access network")
- **Junction network** – comprises of transmission facilities linking LEs and providing links to transit exchanges either directly or through tandem exchanges (also known as the "Tandem Network")
- **Switching network** – comprises local, tandem and transit exchanges. Current total number is 2826.
- **Trunk network** – comprising of the transmission facilities linking the Digital Transit Exchanges ("DTEs") and the IGEs. The Digital Transit Exchange is not always a dedicated trunk switch and may also support direct customer connections, in which case it is known as a combined exchange
- **International network** – comprising of the IGEs and the transmission facilities at the satellite earth stations and submarine cables
- **Intelligent network** – Comprises of service control and service switching systems utilizing the PSTN to deliver VAS services to its subscribers

PTCL also provides network related services, particularly leased-lines to all cellular, data, ISP and payphone licensees. With a high-speed fiber backbone in place and additional access rings operational in major cities, such as Karachi, Lahore and Islamabad. PTCL is ideally positioned to cope with future service expansion and the growing demand in both voice and data traffic.

#### Domestic network

PTCL's domestic network consisting of the local loop, junction network and the trunk network are interconnected by an integrated transmission system. PTCL has continuously expanded its domestic network to provide comprehensive high quality coverage to its subscribers. As of June 2003, PTCL had a total ALI of 4.94 million and ALIS of 3.98 million lines with digitalization rate of over 99.6% in both ALI

and ALIS. PTCL has been successful in rapidly expanding its ALI, while continuously improving digitalization levels and maintaining a satisfactory level of utilization over the last five years.

PTCL has also continued to expand its switching capability along with the increase in the number of ALI. As at June 2003 the total number of exchanges stood at 2,826 comprising of 2,574 digital exchanges (4.923 Million lines) and 252 manual exchanges (17K lines). Manual exchanges are utilized primarily in rural areas.

### Local loop network

The subscriber is connected by a polyethylene insulated, aluminum shielded, pair type copper wire to the LE.. The LEs in single exchange areas are directly linked to the DTEs, through long distance media while in multi-exchange areas (LE's are linked to the DTE via the tandem exchanges.

Each subscriber has an associated meter in the LE. In the digital exchanges the meter is housed within the software. Meters are automatically activated by the initiator of the call being connected to the dialed call. The LE determines the destination of the call from the dialed digits.. The action of lifting the receiver alerts the operator to a call initiation.

Local exchanges				
	2000	2001	2002	2003
Digital	1,639	1,833	2,122	2,574
Manual	735	618	456	252
Analogue	299	250	41	0
Digitalization	61.3%	67.8%	81.0%	91.0%

Source: PTCL

PTCL plans to rollout new technology to expand coverage and lower installation costs. The expected launch of the wireless local loop ("WLL") network this year, is part of this strategy.

### Wireless Local Loop

As part of its strategy to harness new cost effective technology and provide nationwide coverage, PTCL is planning to implement a WLL network. WLL is a superior solution to provide service to the remote areas of Pakistan given the country's scattered population, limited demand, large average access distance, poor infrastructure, low affordability, and ease of operations and maintenance. The current WLL project once fully implemented is expected to have a subscriber base of 195,000. PTCL hopes to rollout a WLL network based on CDMA2000 1x technology, utilizing the PSTN switching, tariff and numbering plans.

### Optical Fiber Access Network

PTCL also hopes to implement an Optical Fiber Access Network ("OFAN") to enhance capacity in the densely populated cities of Karachi, Lahore and Islamabad. OFAN once fully implemented will provide better quality of service, provision of broad band service, longer reach exchanges, protection of ring topology and fault management. At present the contract for the OFAN system has already been awarded and implementation is expected to be completed in FY2004.

### Junction network

The junction network connects LEs through tandem exchanges to each other as well as to the trunk network of DTEs (also known as the "Tandem Network"). Tandem exchanges are located in all major cities in Pakistan to provide connections between LEs and DTEs, which are not directly linked. The main elements of the junction network are transmission and switching. PTCL has achieved a 100% digital junction network.

## Trunk network

The Trunk network consists of 36 DTEs, all of which are directly or indirectly interconnected. While all 36 exchanges are digital the transmission medium while being predominantly digital includes a limited analogue links connecting 3 DTEs in the remote areas of Balochistan.

## Fiber network

PTCL has continuously expanded its optical fiber network to achieve a total length of 6,880 km of optic fiber connecting 405 cities and spanning both banks of the Indus River. This translates into total E-1 length of [1.72] million km. In the last five years, PTCL added 3,237 km to its optical fiber network and plans to add a further 1000km in FY2004.

The graph below represents the current strength of PTCL's fiber optic infrastructure.

Optical fiber links km			
	2001	2002	2003
Main Optical Fiber	3,910	4,591	4,591
Spur links	763	1,557	2,205
Short haul links	0	70	84

PTCL manages its optical fiber cable system by division to five different regions of Islamabad, Lahore, Multan, Hyderabad and Quetta. The total system capacity is 136,680 channels and utilizes multiple technologies of Alcatel; NEC; Fujitsu; Ericsson and Siemens/CTI. The current load factor is about 62% with 10,780 of the total 17,366 E-1s used.

Long distance system capacity		
System	Capacity	Channel Capacity
DWDM	3x2.5GB	90,720
PDH	5x565 Mbit/s	38,400
SDH	1x622 Mbit/s	7,560

Source: PTCL

As part of the ongoing development and modernization of the network, PTCL has installed 3x 2.5GB Dense Wave Division Multiplexing ("DWDM") Backbone high capacity Fiber Access Rings, as well as 10GB DWDM equipment. The deployment of the DWDM technology is an upgrade of the 622-megabit Synchronous Digital Hierarchy ("SDH") network deployed previously. In tandem with the continuous improvement of technology, PTCL has also managed to progressively reduce the number and duration of cable breakdowns.

The expansion and further upgrading of the domestic network coupled with the launch of new WLL and OFAN technology will provide higher capacity bandwidth for both voice and data communication. While facilitating the expansion of its subscriber base this also complements PTCL's plan to retain high-margin customers by providing them with efficient and high quality service.

### Domestic satellite network

Domestic satellite stations for communication are being used for accessing remote areas of Pakistan such as Gilgit, Skardu and Gwadar. PTCL uses a satellite connectivity agreement with INTELSAT at 64 degrees to provide this service. This satellite connectivity currently has a capacity of 12 Mbps. The inaccessibility of these areas makes satellite telecommunication the required method of connectivity.

These satellites are linked to the earth station at Malacch for onward connectivity with the national network.

#### Radio network

More remote rural areas are connected by the use of Digital Radio Systems ("DRS") to the optical fiber backbone. NTC-owned, high capacity microwave links are used by PTCL for restoration fallback and connectivity to remote areas of Pakistan.

Currently, the terrestrial trunk network includes high capacity microwave systems covering major cities in Pakistan. In addition, there is a wide-band analogue coaxial cable (which is owned by NTC and used by PTCL) under inter-connect arrangements.

### International network

PTCL has developed an extended international network that currently provides direct connections with 43 countries and indirect connections with all countries of the world. At present over 90% of the international traffic is with countries that have direct connectivity. As at June 2003, PTCL has 13,489 bilateral voice circuits with 53 International carriers. Another 2100 voice circuits with five VoIP carriers are established at Digital Transit exchanges for International incoming voice traffic only. The key components of PTCL's international network are:

- 2.8 Million MIU KMs capacity in South East Asia - Middle East- Western Europe ("SMW -3") optical fiber submarine cable system with 2.93% voting rights.
- Three INTELSAT standard 'A' earth stations, situated at Malacch (Islamabad), Dehmandro and Karachi.
- 1,177 kms long 1200 channel analogue submarine coaxial cable between Karachi and Fujaira in the U.A.E. (jointly owned by PTCL and the Etisalat UAE).
- Four operating International Gateway Exchanges ("IGE") two each at Karachi and Islamabad
- 136 voice channels Analogue microwave links to Iran,
- 8Mb Digital radio links to Afghanistan,

PTCL intends to further expand the capability of its international connectivity and with this intention have signed a memorandum of understanding to jointly plan and construct a new submarine cable system called South East Asia - Middle East - Western Europe ("SMW -4") from Singapore to France. In addition, PTCL is also considering investment in the Trans Asia-Europe Optic Cable System project linking Germany and China via a number of countries including Iran, Turkey and Afghanistan.

#### Submarine connectivity

The primary media for PTCL's international connectivity is via two submarine cable systems. PTCL has access to a total of 8,102 channels comprising of 7,054 channels via the main SMW-3 submarine cable and another 1,048 channels via the Pakistan-U.A.E. submarine cable.

Available channels through submarine connectivity				
	International Gateway exchange			
	Islamabad		Karachi	
	IGE -II	IGE -III	IGE -I	IGE -II
SMW-3	2865	532	348	3330
PTCL/ETISALAT cable	390	179	30	614
<b>Total</b>	<b>3255</b>	<b>711</b>	<b>378</b>	<b>3944</b>

Source: PTCL

Note: 620 circuits are for rVoIP connectivity through DTEs with 3 VoIP carriers on SMW-3 Media

The bulk of the international communication requirement for data and voice are at present provided via connectivity to SMW-3. SMW-3 launched in 1999 has now developed into a highly successful optical cable system with a present membership of 92 countries and 34 landing stations. PTCL has a total capacity of 2.8 million minimum investment unit ("MIU") kms on SMW-3 providing direct access to 30 countries. PTCL has activated 3397 and 3678 voice channels to IGEs at Islamabad and Karachi respectively.

PTCL jointly owns an analogue submarine cable with ETISALAT of the UAE. The cable links Karachi and the UAE with a total current capacity 1,048 channels (510 and 538 channels to IGEs at Islamabad and Karachi respectively) to handle international traffic onwards to the UAE. This was the first submarine cable installed by Pakistan and is still in use for international traffic in the region.

In order to meet future international connectivity requirements, PTCL and 13 other international carriers signed an MOU in Indonesia on September 4, 2002 to jointly plan and construct a new submarine cable linking South East Asia, Middle East and Europe called Sea Me We4(SMW4). SMW-4 is expected to connect 12 countries including Pakistan. Once implemented, SMW-4 is expected to meet strategic restoration needs as well as enhance PTCL's ability to offer bandwidth services on International Fiber optic system at competitive prices.

PTCL has indicated to invest US\$ 40-45 Million in SMW4 system in exchange for capacity.

#### Satellite connectivity

PTCL is a signatory to the INTELSAT and INMARSAT satellite consortia that allows it to use their capacity to establish direct connections with telecommunication carriers around the world. As of June 30, 2003, PTCL has access to a total capacity of 5201 channels connected to the IGEs.

The Company has three-satellite antennas one directed to, 359 degrees, over looking the Atlantic (USA) and the remaining two at 60 and 62 degrees over looking the rest of the earth.

#### Available channels through satellite connectivity

	International Gateway Exchange			
	Islamabad		Karachi	
	IGE -II	IGE -III	IGE -I	IGE -II
359 Degrees East	580	300	173	811
62 Degrees East	1,169	76	14	252
60 Degrees East	458	175	30	1163
	<b>2207</b>	<b>551</b>	<b>217</b>	<b>2226</b>

Source: PTCL

Note: 480 Circuits on DTE's are for one VoIP operator on Satellite Media

#### Terrestrial microwave

PTCL continues to utilize the terrestrial microwave link originally established in 1958 to connect Pakistan, Iran and Turkey, for communication between Pakistan and Iran. PTCL has access to 136 voice circuits to Iran channels through this media. However given the poor quality of the connectivity, PTCL hopes to discontinue with this media in the near future.

PTCL has recently re-established digital radio links between Peshawar in Pakistan and Kabul capital of Afghanistan. The radio link has a total capacity of 8Mb.

#### International gateway exchanges

The international submarine, satellite and microwave media are connected to the local network via the IGEs. There are currently four IGEs in operation, two each in Karachi and Islamabad with a total 13,460 operating international channels. The details of the exchanges are as listed below:

- **IGE-I at Islamabad** — Currently decommissioned
- **IGE-II at Islamabad** — Is a NEC NEAX 61E exchange, which has a capacity of 392 E-1's of International and National channels. The gateway was commissioned in 1995
- **IGE-III at Islamabad** — Is a Huawei (C&C08) exchange, which has a capacity of 450 E-1's International channels and National channels. This more advanced gateway was commissioned in August 2002. This exchange handles international traffic for Punjab and NWFP and overflow traffic from IGE-II at Karachi
- **IGE-I at Karachi** — Is a Huawei (C&C08) exchange, which has a capacity of 450 E-1's of International channels and National channels. This gateway was also commissioned in August 2002
- **IGE-II at Karachi** — Is an Ericsson TG-III exchange, which has a capacity of 408 E-1's of International channels and National channels. The gateway was commissioned in 1999

#### Gatewaywise status of International media<sup>1</sup>

	International Gateway exchange			
	Islamabad		Karachi	
	IGE -II	IGE -III	IGE -I	IGE -II
SWM-3	2865	532	348	3330
Satellite (359/62/60)	2207	551	217	2,226
Submarine cable	390	149	30	508
Microwave	0	30	0	106
	<b>5462</b>	<b>1262</b>	<b>595</b>	<b>6170</b>

Source: ITCL

PTCL has undertaken a significant amount of expansion and modernization over the last five years to upgrade these exchanges. During 2002-03 1,654 new circuits were added to the network. Expansion of capacity in these exchanges has now been completed and C7 signaling has been implemented for national and international circuits.

Capacity of International Gateway Exchanges E-1 (240's Ports)

S. No		Capacity	NAT	Int.	Spare
1	IGE-I Karachi	450	169	22	259
2	IGE-II Karachi	408	111	218	79
3	IGE-II IBA	392	195	192	5
4	IGE-III IBA	450	159	45	246
	Total	1700	634	477	589

#### Intelligent network

The intelligent network ("IN") has over a short period of time achieved tremendous success particularly in the area of pre-paid calling cards. Users dial an access number to enter the IN via a local exchange or international gateway. The call is then forwarded to a Service Control Point ("SCP") via a Service Switching Point ("SSP") for verification. The Due to the extensive demand the capacity of the IN platform is also being enhanced.

## Other infrastructure

PTCL is also the provider of infrastructure connectivity for ISPs, data network operators, software exporters, educational institutions and other users. As part of expanding internet infrastructure three high speed internet exchanges were established at Karachi, Lahore and Islamabad while the number of towns/cities/villages having internet access have been increased to 1,708.

Other initiatives include improved fault management and complaint systems with the introduction of Computerized Fault Management Systems ("CFMS") and Customer Complaint Centers. Complying with its Service Quality Obligations, the Company has vastly improved fault management, reducing response times and increasing overall reliability.

## Capital Expenditure Plan ("Capex Plan")

PTCL has a well-defined build-out strategy, with geographic coverage and quality of service improvement as priorities. Special emphasis has been given to expansion of the existing network and expansion of data communication services.

The Company has earmarked Rs.17.1 billion for capital expenditure in FY2004. The plan envisages expansion and modernization of the voice and data networks, introduction of more VAS for a wider customer base and improved service quality. Almost 90% of the funds required for the capital expenditure will be met through internal generation with the balance being debt financed.

As part of its Universal Service Obligation ("USO"), PTCL has focused much of its line build out in the rural areas. The USO requires 83,000 lines to be built in rural areas.. However, demand for line subscription is fairly high in urban areas, allowing for efficient line utilization in the more populated areas of Pakistan.

PTCL Capex budget is prepared on a 'bottom-up' basis. The data for the preparation of the Capex budget is primarily supplied by the regions that entertain the actual applications for new telephone connections, bandwidth and other services. In addition public representatives also provide their inputs into the PTCL expansion plans.

The Capex Plan focuses on the following areas:

- Expansion and enhancement of the trunk network and introduction of new technology into the access network
- Launch of new various value-added services including E-commerce applications, credit limit on pre-paid cards and Data network backbone development
- Improved customer services via modernization and development of billing systems, service centers and training of staff

Key items of the FY2003-04 Capex Plan with the estimated cost are presented in the table below:

Key items of capital expenditure budget 2003 -04	
Development Scheme	Description
Local Network	1. Commission 500,000 new switch lines, 50,000 WLL lines and 43,600 OFAN lines
Long Distance Network	1. Provision of new optical fiber links and upgrading and redeployment of existing optical fiber systems 2. Provision DR3 links 3. Provision of 10GB /S DWDM 4. Expansion of Digital Transit Exchanges
International Communications	1. DCME, New TWC, Higher order DX and teleports earth station 2. New gateway exchanges 3. Submarine optical fiber cable system

Development Scheme	Description
	4. Replacement of old equipment of existing earth station
Value Added Services	1. Expansion of IN 2. Multimedia and cable TV 3. Establishment of co-location centers 4. Video conferencing network 5. Operational research
Customer Care and Billing Systems	1. Establishment of call centers and customer care centers 2. Billing in tranet and packages 3. Replacement and upgrading of technology and equipment
I.T. & Data Communication	1. Expansion of RE network 2. Expansion of DXX network
Modernization of 17 & 18 (CDAs)	1. Upgrading and replacement of CDAs for major cities 2. Establishment of CFWS in major cities and CDAs 3. Provision of ACDs and virus protection software for CFWS
Miscellaneous/ Unforeseen	
<b>Total</b>	

Source: ITCL