



# PAKISTAN EDUCATION & RESEARCH NETWORK (PERN2) OPERATIONS

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# AGENDA

- ◉ PERN2 Network Overview and key objectives
- ◉ Interconnectivity between PERN2 and other NREN`s
- ◉ PERN2 NOC
- ◉ Operational Challenges
- ◉ PERN Research Activities
- ◉ Future Plans



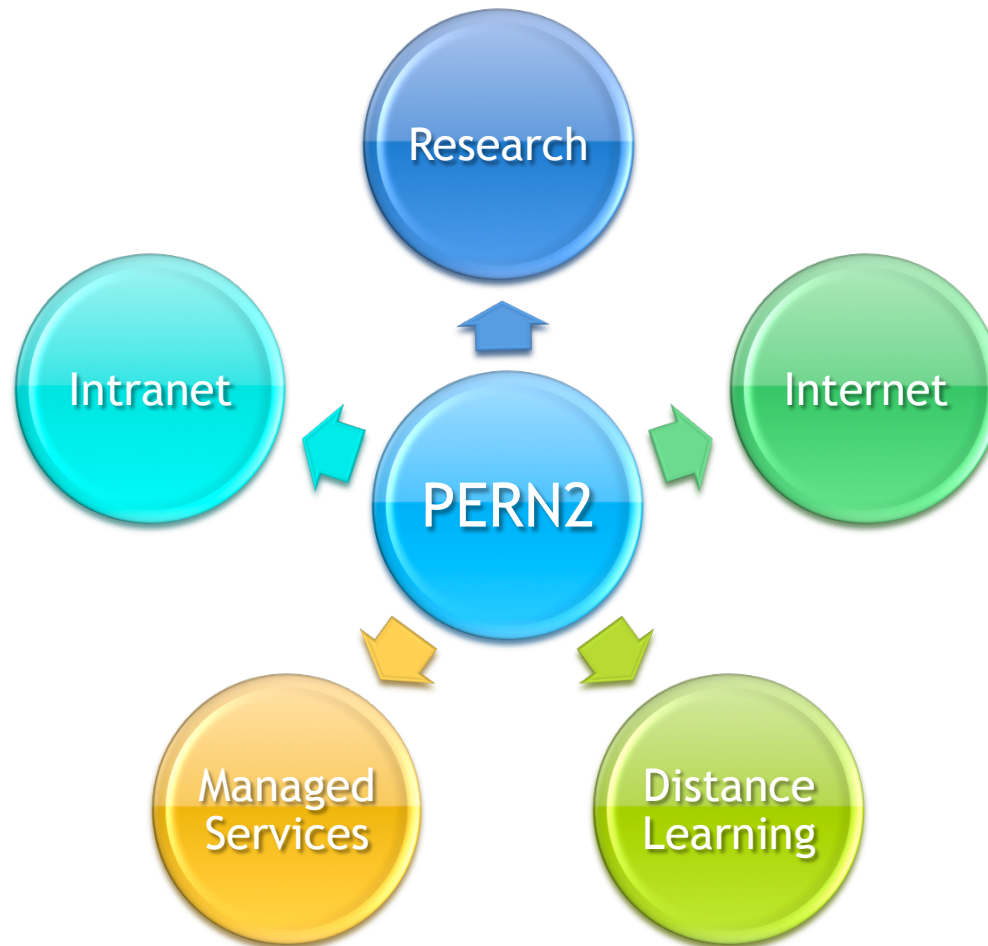
# PERN2 OVERVIEW

- ◉ Pakistan's National Education & Research Network.
- ◉ A Digital Dedicated Communication Network interlinking 154 Public & Private Sector Universities in Pakistan.
- ◉ A vision to enhance the Education & Research capabilities among the students of Pakistan.
- ◉ Provide integration of data banks, collaboration for research and development activities and up-gradation of teaching and learning skills.
- ◉ Connected to other Education & Research Networks World wide for fruitful R&D.



# PERN2 OVERVIEW (CONTD..)

- PERN2 Motive

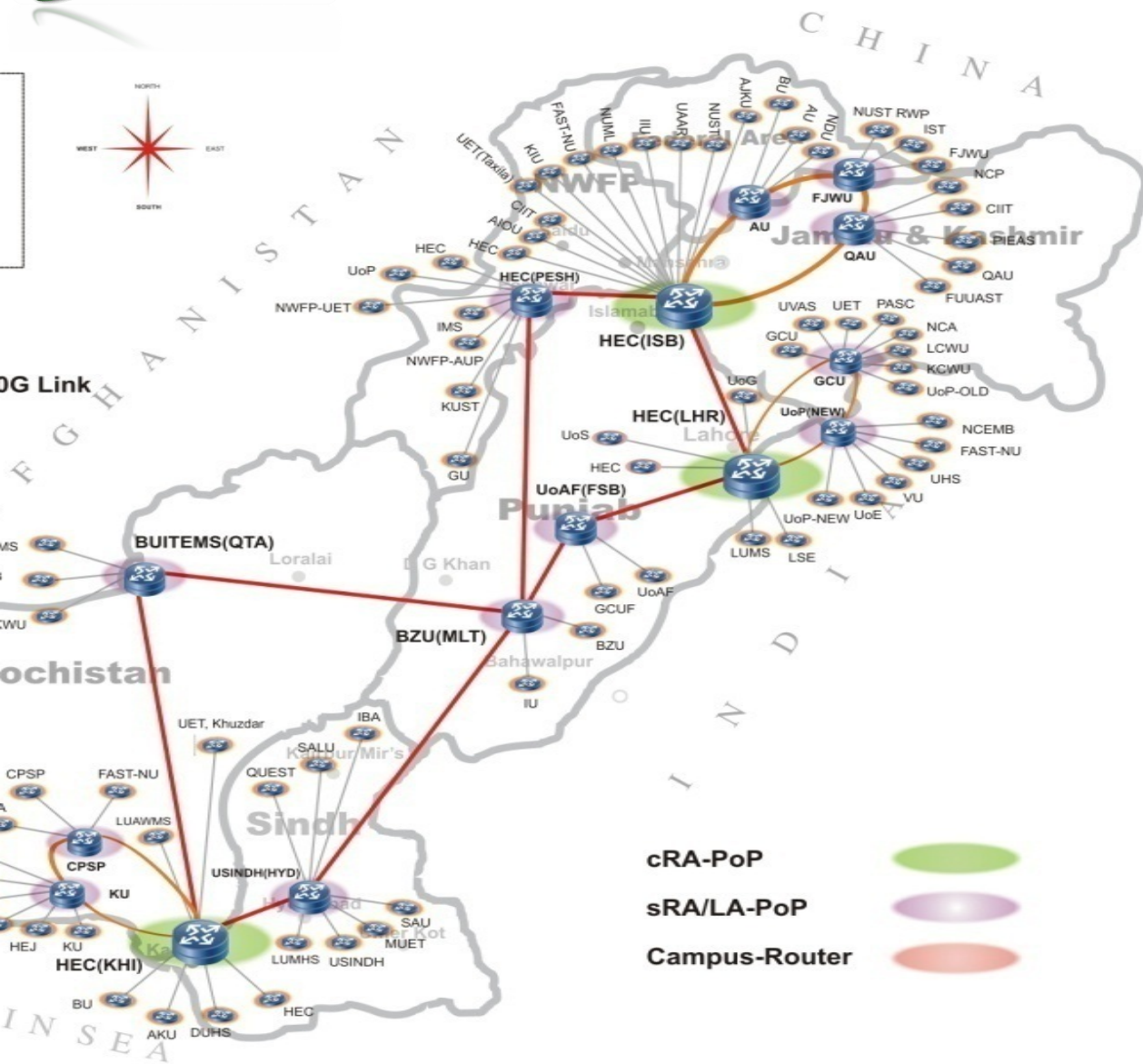






## PERN2 OVERVIEW (CONTD..)

- ◉ PERN2 Network Overview & Transmission Services Overview
  - ◉ Network up-gradation through
    - Three (3) Regional Access PoPs
    - Twelve (12) Local Access PoPs in major cities
  - ◉ 10Gbps metro rings in Karachi, Lahore & Islamabad
  - ◉ 10 Gbps Commodity Internet bandwidth
  - ◉ 1Gbps (40 times faster) connectivity to all the Universities/institutes connected to PERN2
  - ◉ 155Mbps Link with TEIN3



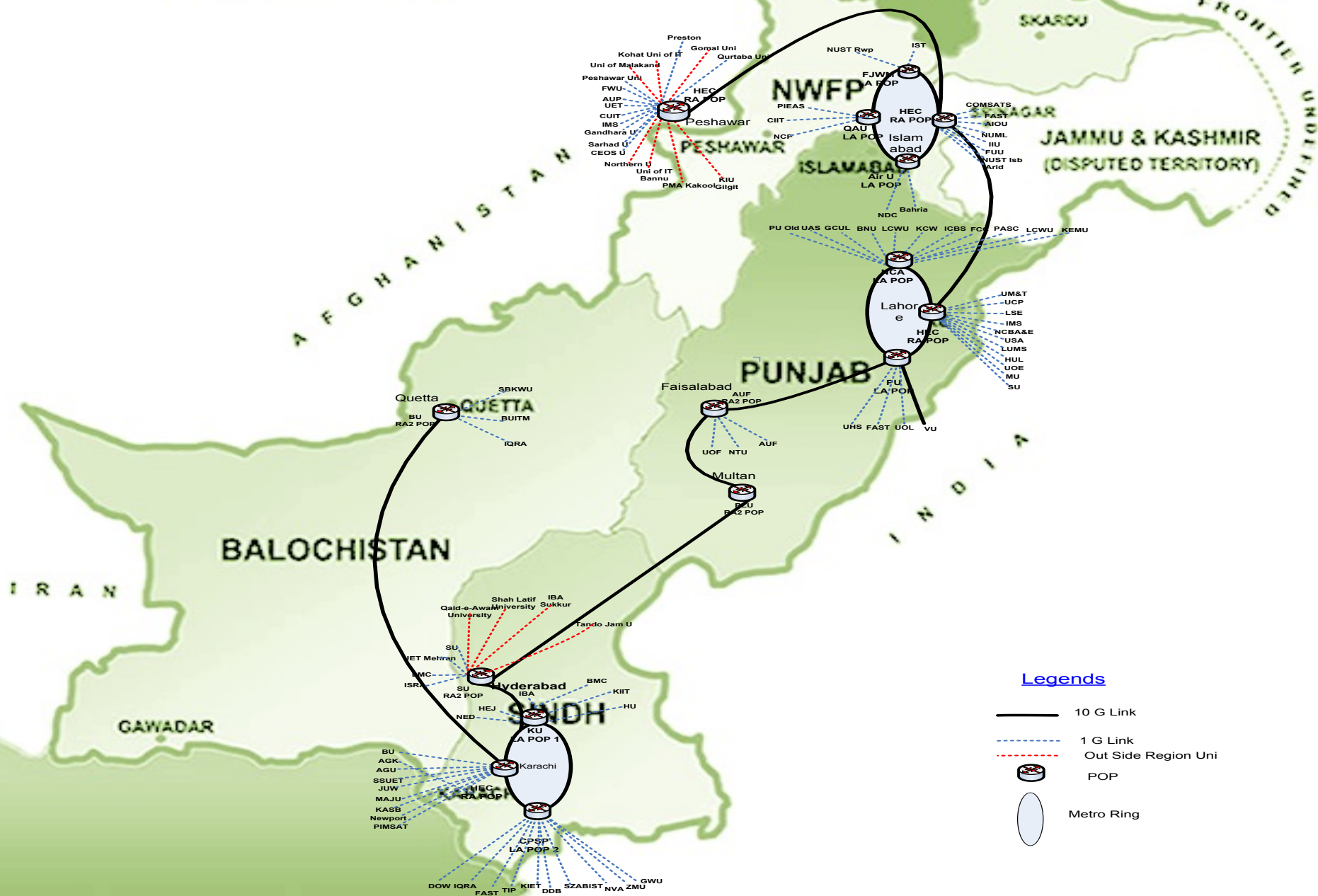
cRA-PoP

sRA/LA-PoP

Campus-Router

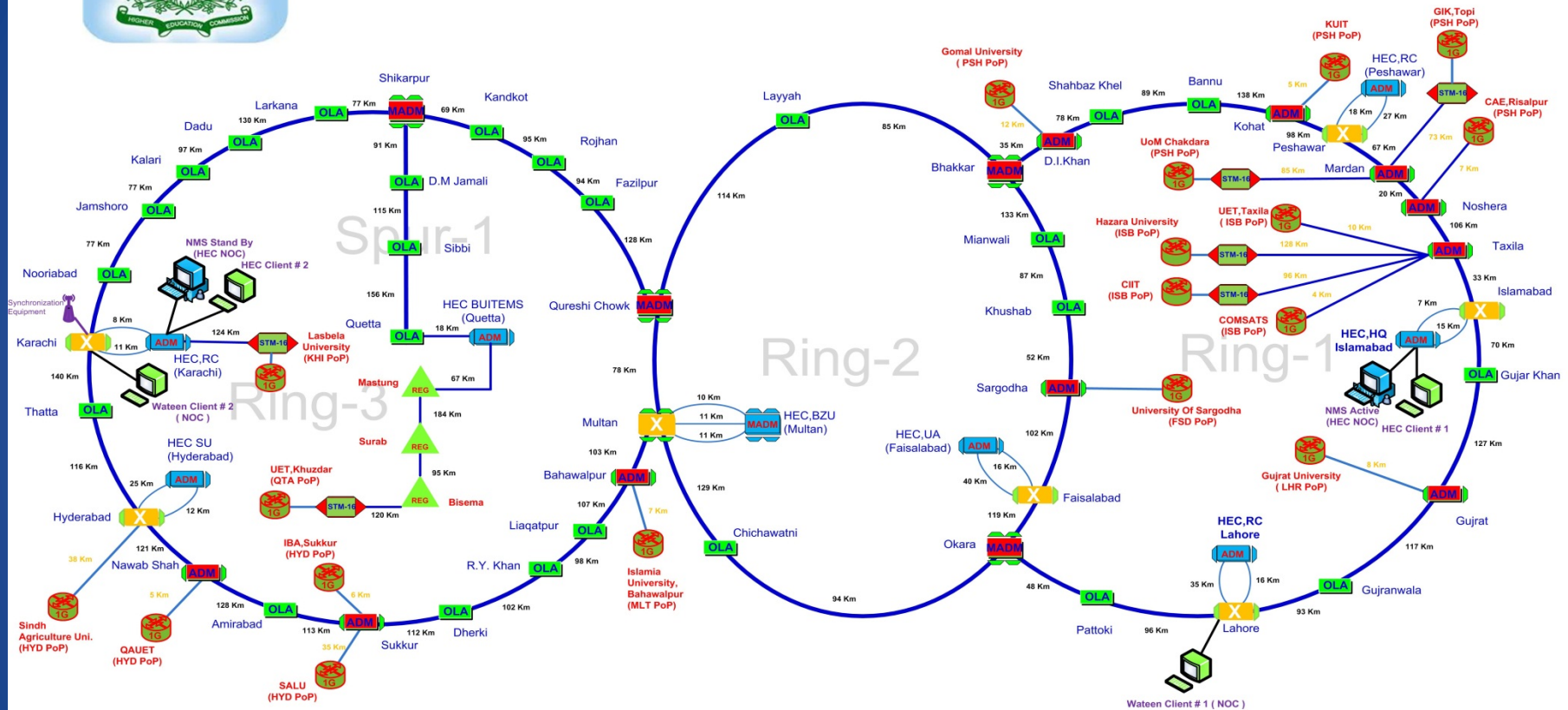


# PAKISTAN





# HEC PERN-II NETWORK TOPOLOGY

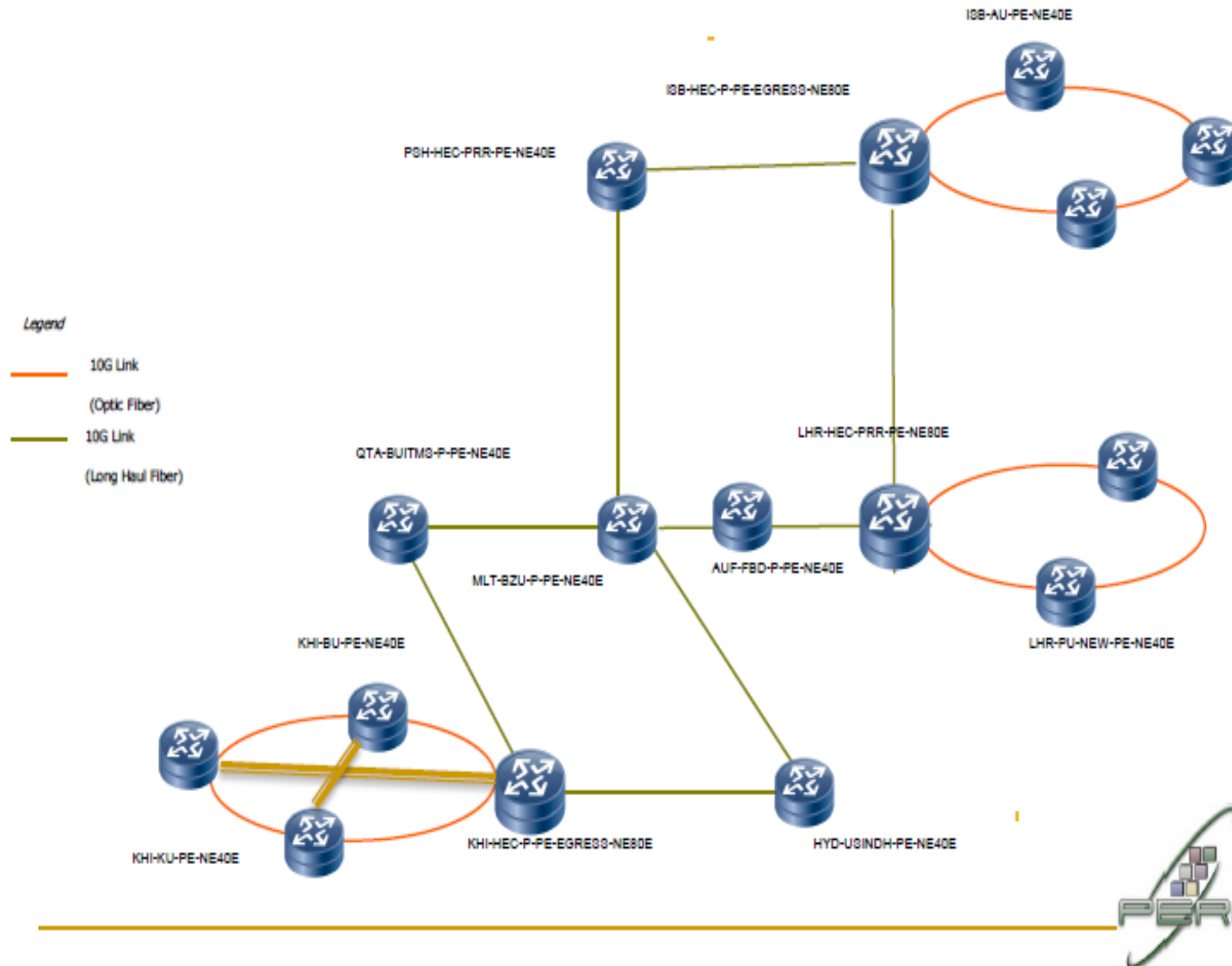


Wateen Telecom

Wireline Networks Planning



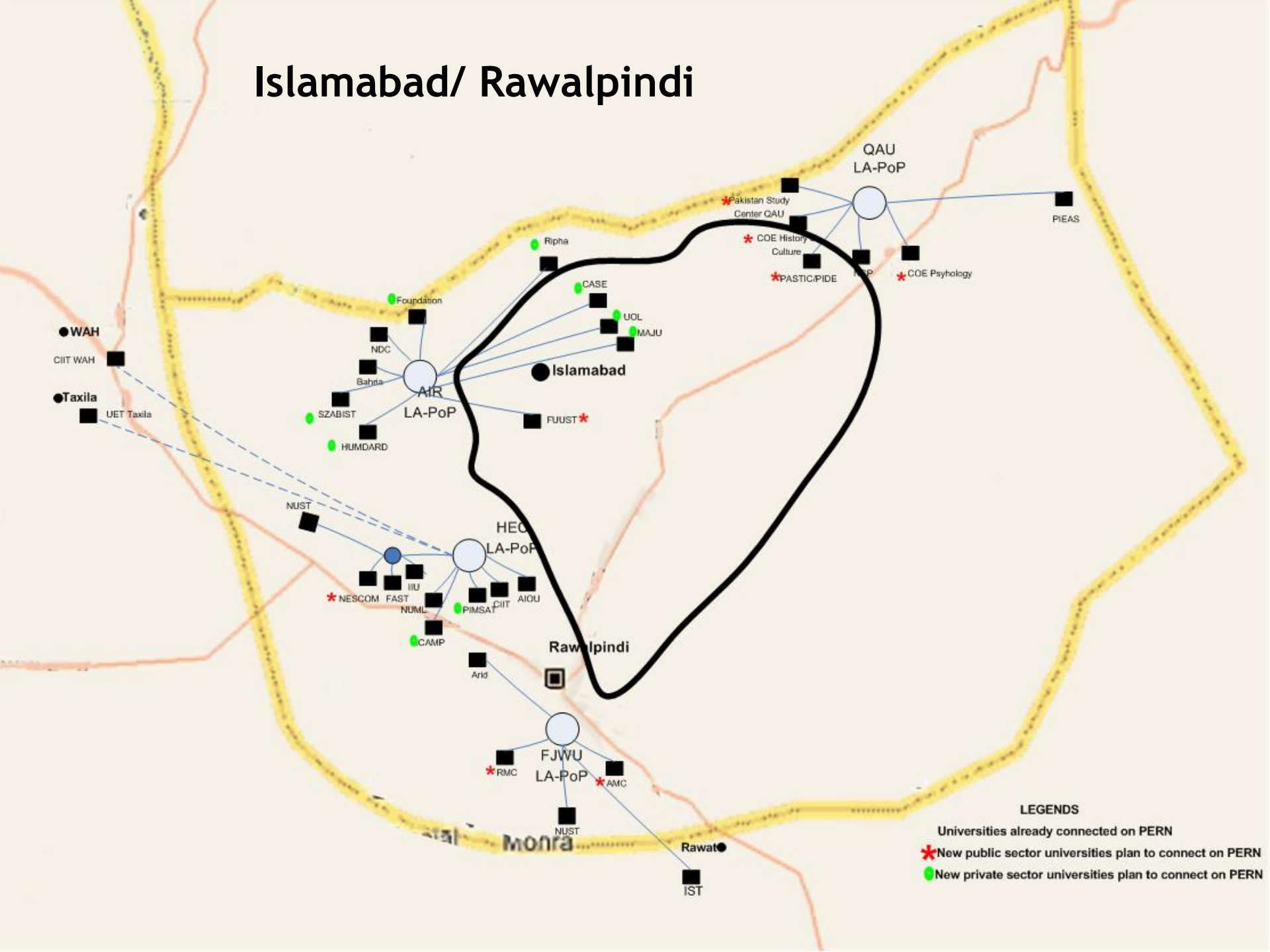
# Low Level Design (Router Topology)



# Islamabad/ Rawalpindi

**LEGENDS**

- Universities already connected on PERN
- \* New public sector universities plan to connect on PERN
- New private sector universities plan to connect on PERN



Universities already connected on PERN

\*New public sector universities plan to connect on PERN

● New private sector universities plan to connect on PERN

## LEGENDS



PERN connected Public Uni = 05



PERN Not connected Public Uni = 02



PERN connected Private Uni = 05



PERN Not connected Private Uni = 16

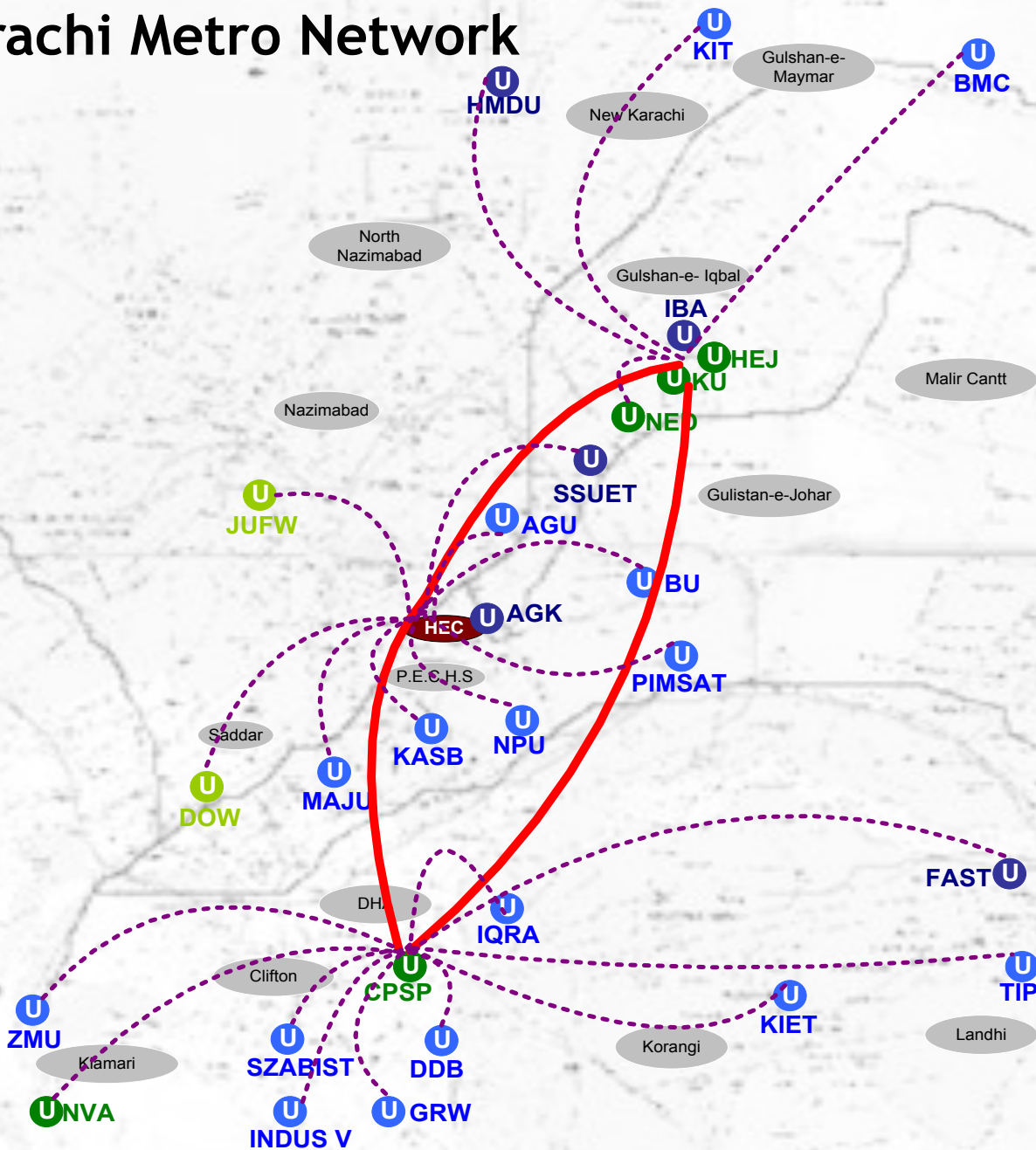


10 Gbps Metro Ring







1 Gbps Link

# Karachi Metro Network

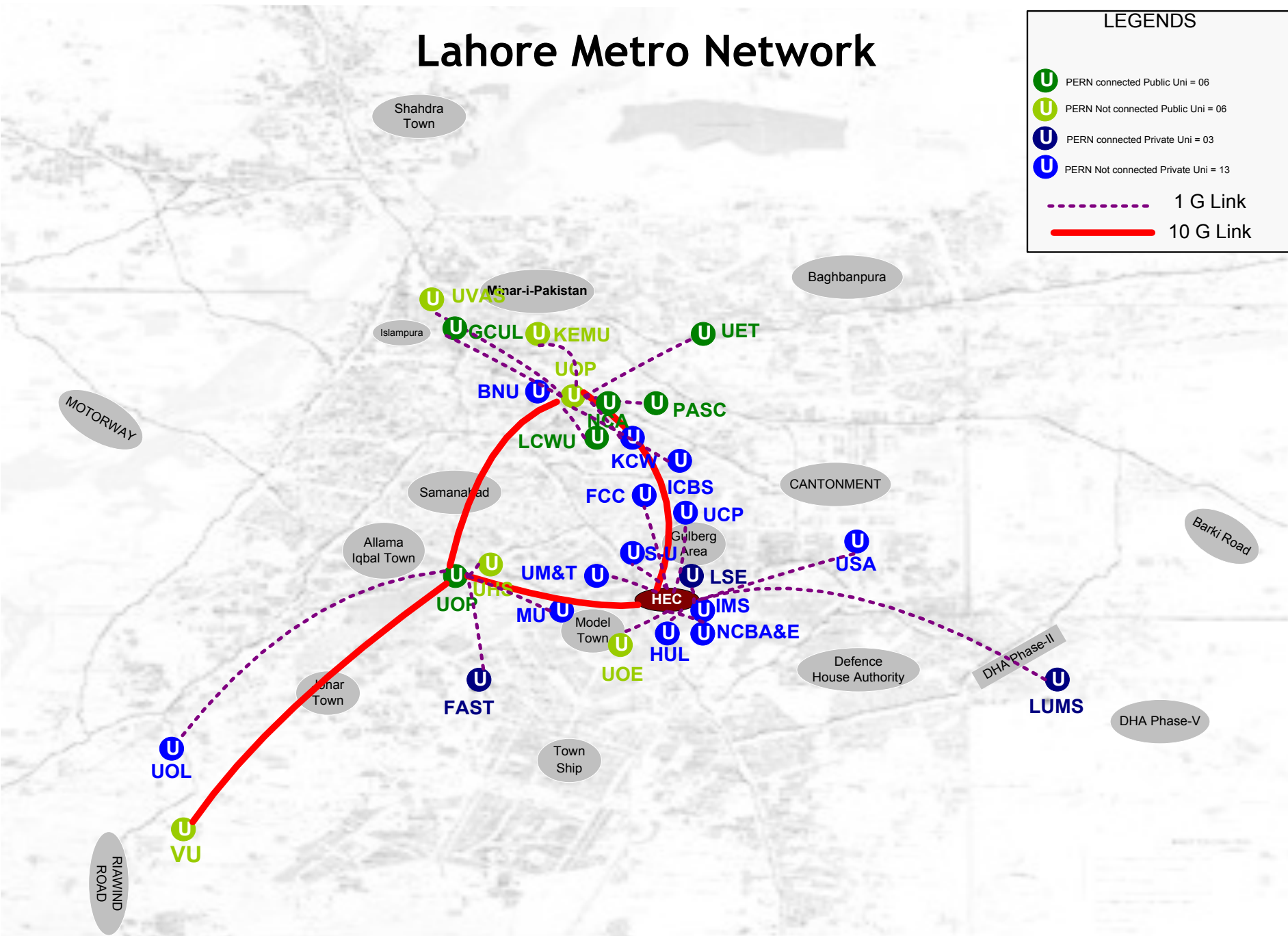


# Lahore Metro Network

## LEGENDS

-  PERN connected Public Uni = 06
-  PERN Not connected Public Uni = 06
-  PERN connected Private Uni = 03
-  PERN Not connected Private Uni = 13

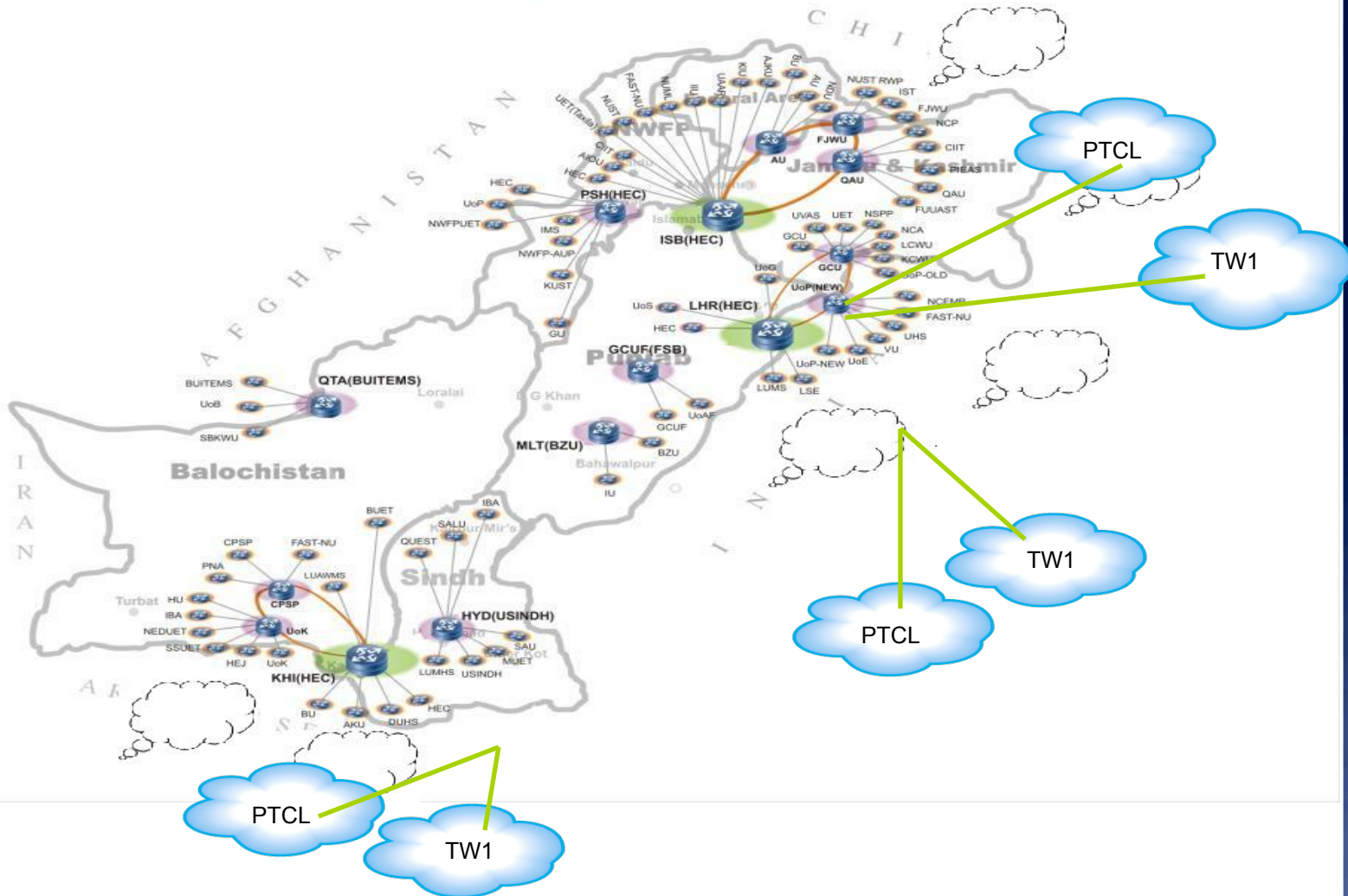
-  1 G Link
-  10 G Link





## REDUNDANT INTERNET CONNECTIVITY ON EACH METRO CITY

### PERN2 High Level Design





# PERN2 OVERVIEW (CONTD..)

## • PERN2 Offered Services

### • Ordinary Services

- Internet – Min 8MB Bandwidth  
(PERN connected to multiple service providers for redundancy)
- IPv4
- Network Monitoring Services (NMS)
- Digital Library Access
- Video Conferencing
- VOIP



# PERN2 OVERVIEW (CONTD..)

- Special Services
  - IPv6
  - Up to 1Gig Intranet connectivity
  - MPLS L3 VPN
  - MPLS L2 VPN
  - IPv4 Multicast (local and foreign universities)
  - IPv6 Multicast (local and foreign universities)
  - Dedicated R&D link (PERN directly connected to NREN through TEIN3 SG-PoP)



# INTERCONNECTIVITY BETWEEN PERN2 AND OTHER NREN's

- ◉ Partners Role in PERN2
- ◉ PERN2 Linkage to other NREN`s & current status
- ◉ Applications & Research Project



# INTERCONNECTIVITY BETWEEN PERN2 AND OTHER NREN'S (CONTD..)

## ◉ Partners

### ◉ Asia-Pacific Advance Network

- ◉ Primary Member of APAN of Asia and Australia

### ◉ Pak-EC Joint Commission on Science & Technology

- ◉ DANTE: Collaborating partner representing GEANT2 of Europe and TEIN2/3 of ASEM (Asia-Europe Meeting)

### ◉ Pak-US Joint Commission on Science & Technology

- ◉ NSF/IU: Collaborating partner representing Internet2 of USA

### ◉ Pakistan-UAE Partnership on NRENs (in progress)

- ◉ Ankabut: Collaborative partner representing NREN of UAE

# ISESCO INITIATIVE OF PIREN

- ◉ Pan-Islamic Research & Education Network
  - A project being initiated by Islamic Educational, Scientific and Culture Organization
- ◉ Concept Paper approved by ISESCO
- ◉ Third meeting is being scheduled for 28-29 august 2014 Pakistan
  - Participation is requested from
    - Algeria, Egypt, Kazakhstan, Malaysia, Pakistan, Saudi Arabia, Turkey, Uganda
  - Project proposal, guidelines, and organization formation of PIREN Foundation has been prepared.



# INTERCONNECTIVITY BETWEEN PERN2 AND OTHER NREN'S (CONTD..)

## ◉ Importance

- ◉ To provide direct connection between the two regions to support current & potential co-operative research between different regions.
- ◉ High capacity broadband infrastructure
- ◉ Acquisition of International Private Leased Circuit (IPLC) is of fundamental importance in providing high capacity connectivity between PERN and other NRENs to further collaborate on research and education across continents.
- ◉ Regular IP traffic between PERN & Other NRENs

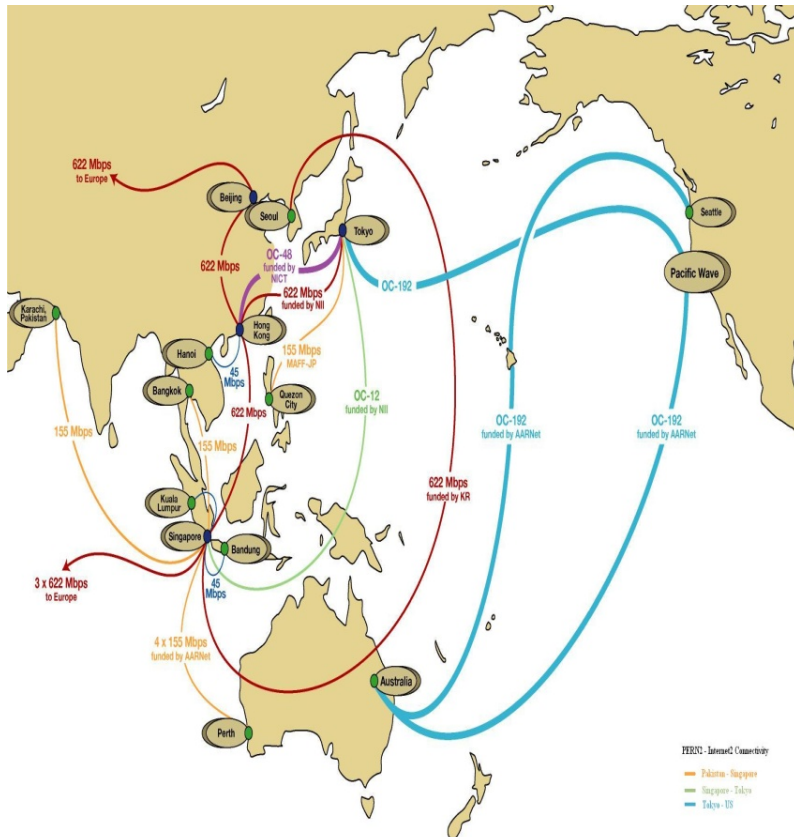


# INTERCONNECTIVITY BETWEEN PERN2 AND OTHER NREN'S (CONTD..)

## International NREN`s Connectivity

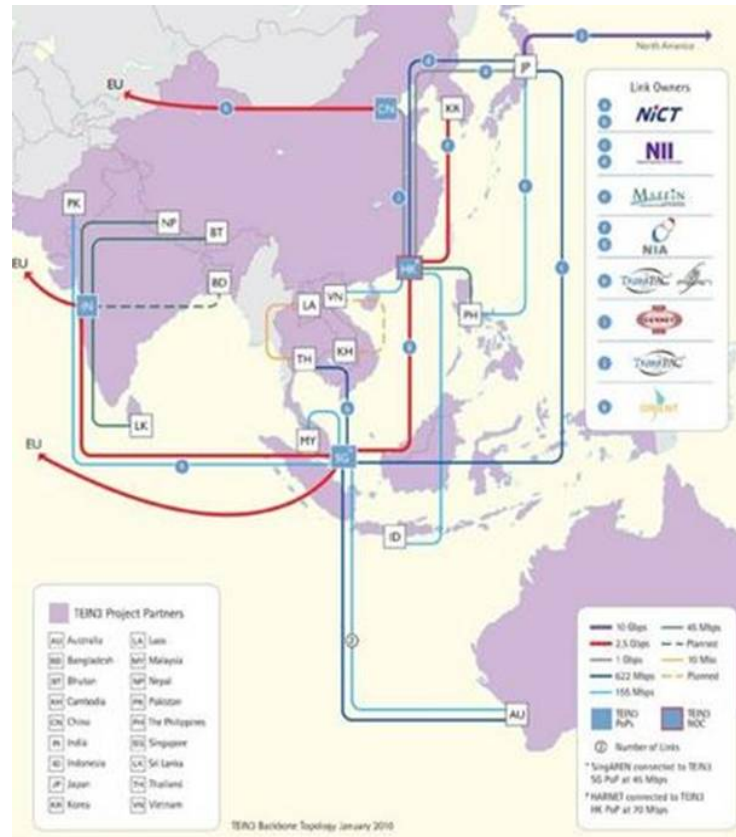
# PERN2-Internet2

PERN2-APAN



# PERN2-GIEANT

# PERN2-TEIN3

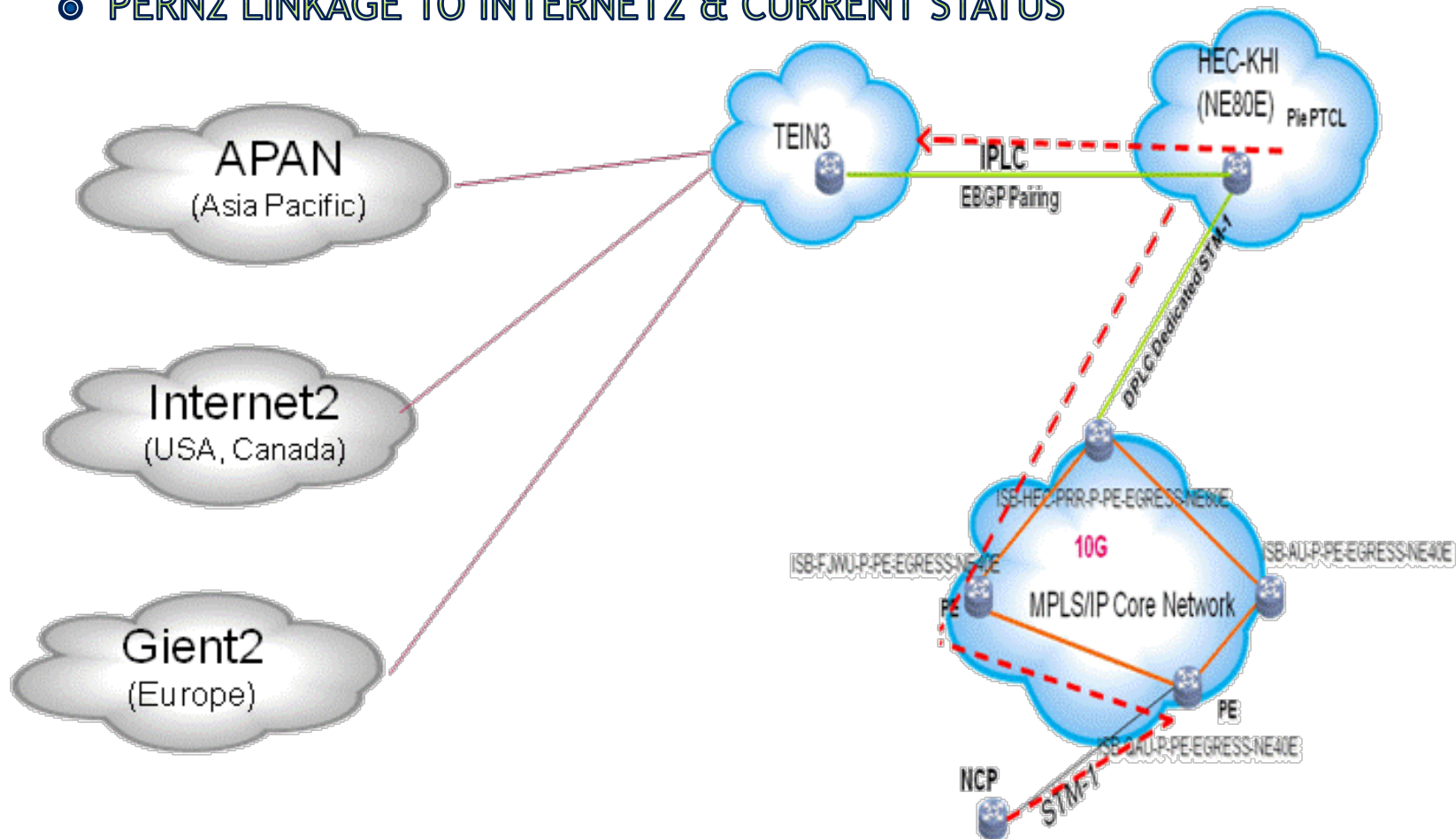






# INTERCONNECTIVITY BETWEEN PERN2 AND OTHER NREN'S (CONTD..)

- PERN2 LINKAGE TO INTERNET2 & CURRENT STATUS





# PERN2 NETWORK OPERATIONS

- ◉ Network Operation Center
- ◉ Network Management System
- ◉ Customer Relationship Management (CRM)
- ◉ Information Store & Web portal
- ◉ Security portal



# PERN2 NETWORK OPERATIONS (CONTD..)

- Network Operation Center
  - Central NOC at HEC national TEIR2 level  
DATACENTER in Islamabad
  - NOC Team has been Deputed 24X7X365
  - Engineers are deputed on each PERN2 POP site  
(Karachi , Lahore, Peshawar, Quetta & Multan)



# PERN2 NETWORK OPERATIONS

(CONTD..)

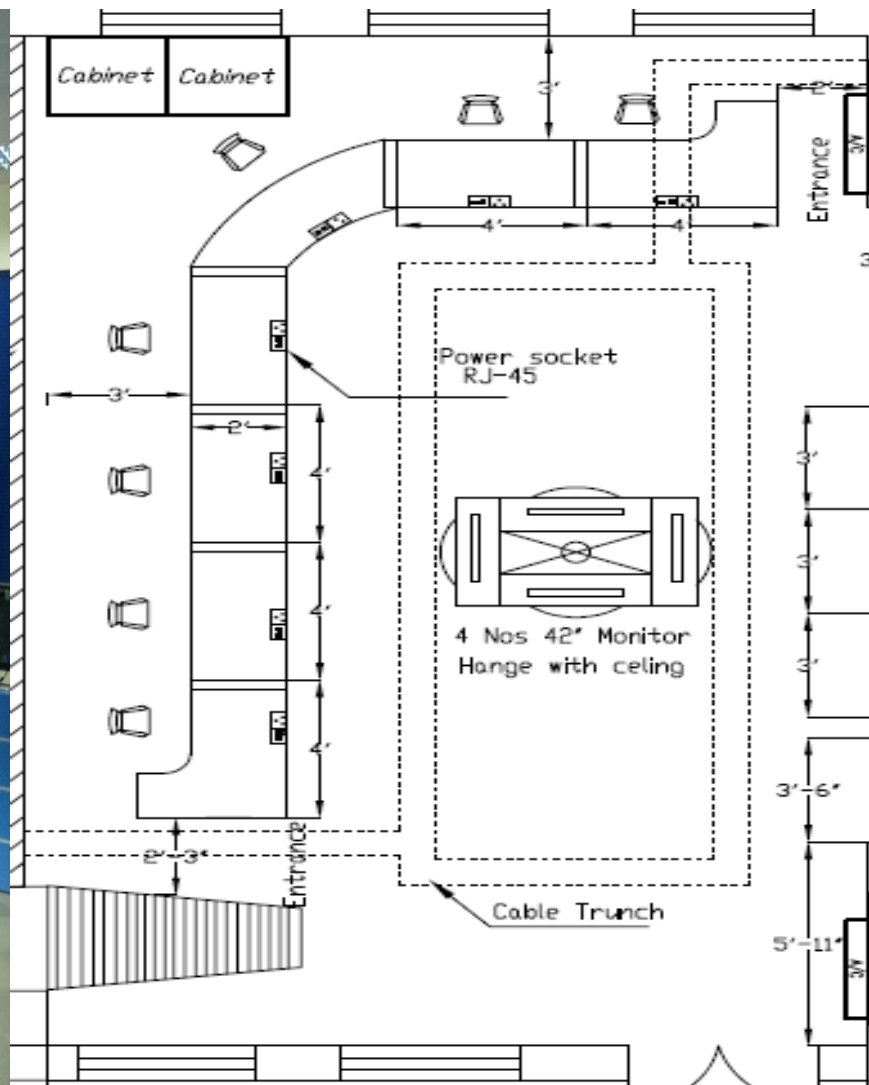
- View of PERN2 Central NOC







# PERN2 NETWORK OPERATIONS (CONTD..)



2009

# HEC NATIONAL DATA CENTER ISLAMABAD

99.99%  
Uptime Guarantee



Till 2007



Today

24/7  
SERVICE

Tier II Uptime  
Institute





# PERN2 NETWORK OPERATIONS (CONTD..)

- ◉ Network Monitoring services

- Primary NMS is Solarwinds
- Secondary NMS is Huawei DMS
- Multisite Monitoring (Islamabad - Karachi) - Redundancy
- Web Access to Universities / Engineers
- 24X7 Monitoring



# PERFSONAR

- ⦿ PerfSONAR server is deployed at four PoP sites
  - ▶ Karachi
  - ▶ Lahore
  - ▶ Islamabad
  - ▶ Quetta
- ⦿ Bandwidth Test Controller (BWCTL)
  - Lookup Service
  - One-Way Ping Service (OWAMP)
  - PingER Measurement Archive and Regular Tester
  - SNMP Measurement Archive
  - Reverse Ping ([http://pern.edu.pk/index.php?option=com\\_content&task=view&id=72&Itemid=96](http://pern.edu.pk/index.php?option=com_content&task=view&id=72&Itemid=96))
  - Reverse Traceroute ([http://pern.edu.pk/index.php?option=com\\_content&task=view&id=72&Itemid=96](http://pern.edu.pk/index.php?option=com_content&task=view&id=72&Itemid=96))

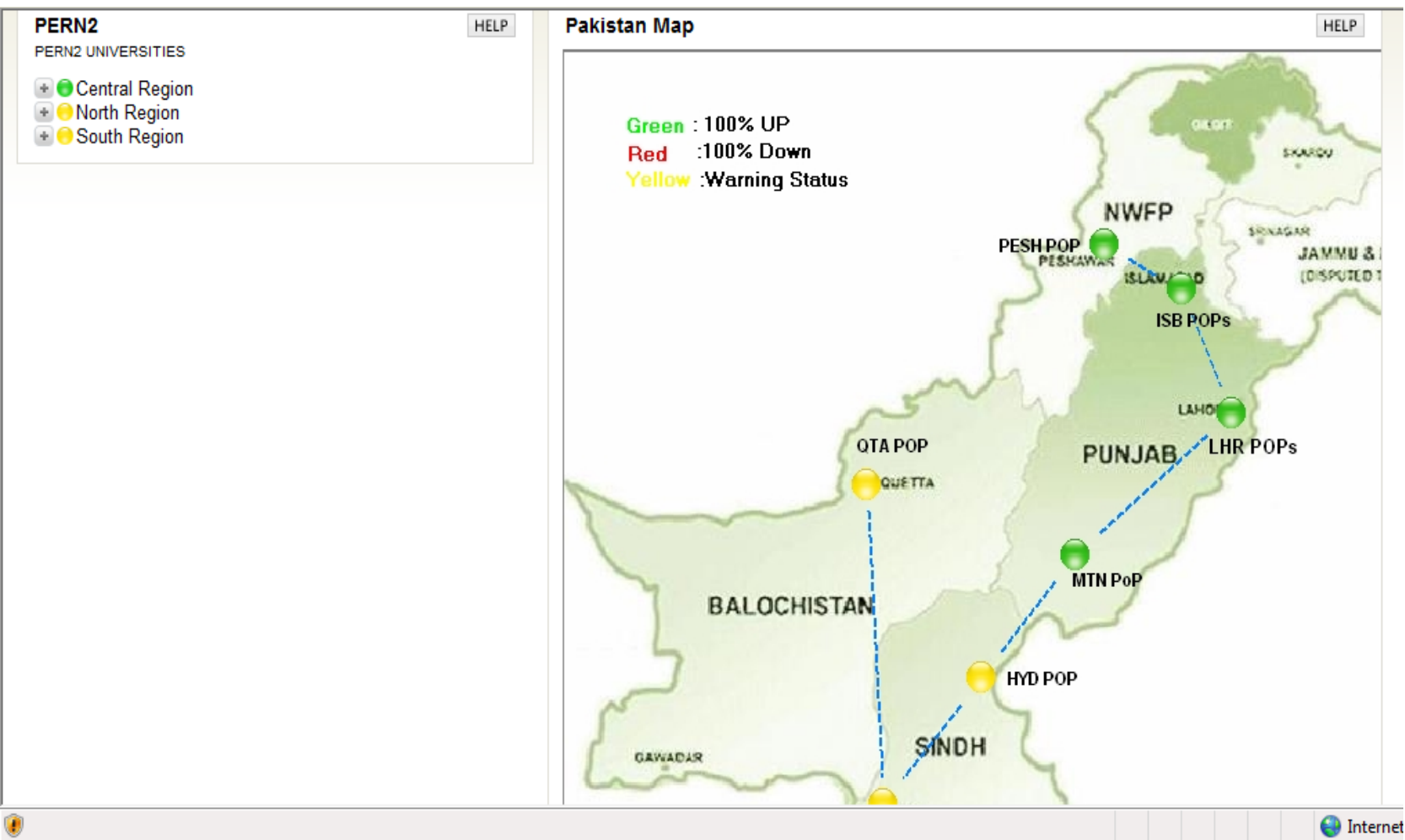




# PERN2 NETWORK OPERATIONS

(CONTD..)

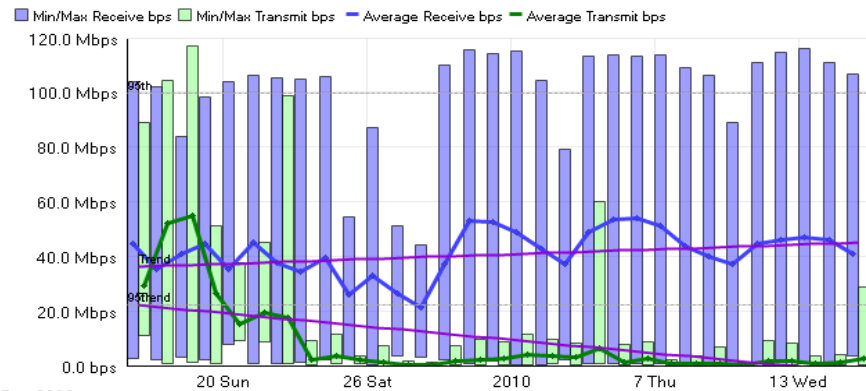
## ● PERN2 NMS



## Last 30 Days Graph of PTCL link at ISB 110-MB Bandwidth

HEC Isb POP-GigabitEthernet2/1/0 - [TO\_PTCL\_EBGP\_LINK\_AS-17557]

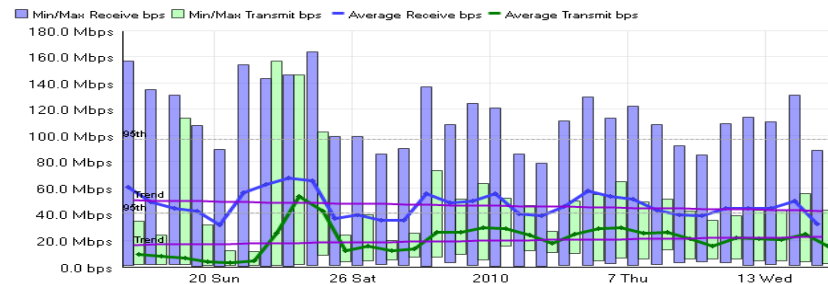
Min/Max/Average bps of Recv 110.0 Mbps Xmit 110.0 Mbps  
LAST 30 DAYS



## Last 30 Days Graph of TW1 link at ISB 200MB Bandwidth

HEC Isb POP-GigabitEthernet1/1/10 - [TO\_TW1\_EBGP\_LINK\_AS-38193]

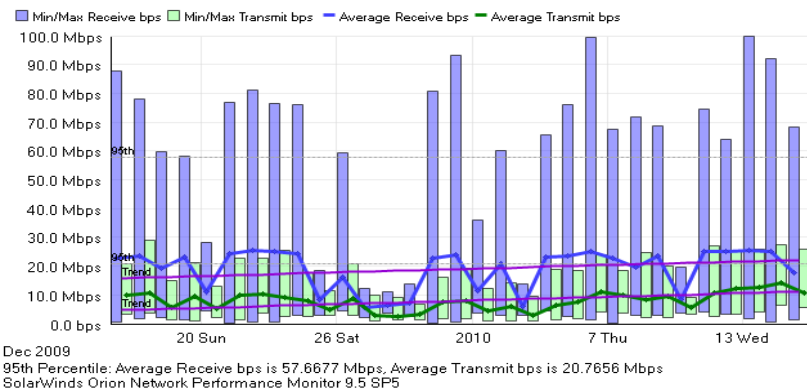
Min/Max/Average bps of Recv 200.0 Mbps Xmit 200.0 Mbps  
LAST 30 DAYS



## Last 30 Days Graph of TWI link at KHI 155MB Bandwidth

HEC RCKhi PoP-GigabitEthernet2/1/1 - to [TW1-LINK]

Min/Max/Average bps of Recv 155.0 Mbps Xmit 155.0 Mbps  
LAST 30 DAYS

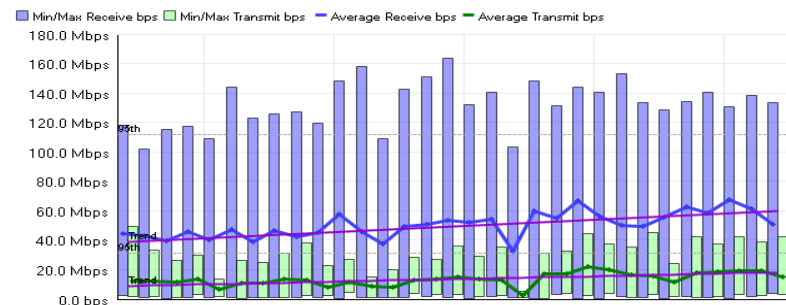


## Last 30 Days Graph of TWI link at LHR 265MB Bandwidth

HEC RCLhr POP-GigabitEthernet2/1/1 -

TW1 Link

Min/Max/Average bps of Recv 1.0 Gbps Xmit 1.0 Gbps  
LAST 30 DAYS





# PERN2 NETWORK OPERATIONS (CONTD..)

## ◉ PERN2 NMS

### ■ Main Interfaces to be monitored

- ◉ .20 interface commodity internet
- ◉ .40 interface intranet
- ◉ .10 interface R&D TEIN3Link

### ◉ Main services to be monitored

- PTCL Internet Link terminating at all Regional Centers
- TW1 link (Redundant Internet B?W Provider) terminating at LHR, ISB & KHI
- International NREN Link



# CUSTOMER RELATIONSHIP MANAGEMENT (CRM)

## ◉ Service Communicator

- Generates Tickets
- <http://sc.hec.gov.pk>
- Account of Every University / Institutes Available.
- They can log their Complain through this portal.
- 24/7 Help Line also Available i.e 111-11PERN & 051-9040PERN
- Complain also can log by email [pern2@hec.gov.pk](mailto:pern2@hec.gov.pk)



# CUSTOMER RELATIONSHIP MANAGEMENT (CRM) (CONTD..)

## ◉ SUPPORT LEVELS

- First Level Support
  - Remote support i. e. on call
- Second Level Support
  - On site support
- Third Level Support
  - Vendor level support (R&D)



# INFORMATION STORE PERN2 WEB PORTAL

## ⦿ PERN Website

- <http://www.pern.edu.pk/>
- Names of Region wise connected universities
- Tariff and different service plans of PERN
- Announcements, trainings, calendars
- Policies, promotions, PERN blog etc.



# OPERATIONAL CHALLENGES

- ◉ **SLA Calculation(Under pining Contracts)**
  - Convectional way of escalation and SLA calculation ( Excel Sheets)
  - NMS escalation to different level with different SLA
- ◉ **Calculation of SLA Factors / Values**
  - With different contracts (Fiber , Bandwidth , Power / Noc Management) has different SLA while Universities are concern for only their end to end connection SLA
- ◉ **Pops / Access Sites Backup Routes Management**
  - Prevising of high speed active source backup is an issue with alternate Media
- ◉ **Automated billings**
  - Using Share point portal for billing planning o implement SAP integrated solution .



## OPERATIONAL CHALLENGES CONT.....

### ◉ Establishment OF Security Operation Center

- Effective SEIM solution deployment for record correlation and Auto Alerts Management
- Composition of CERT team for universities awareness and response from sophisticated attacks
- Requirement of Human resources to deploy more tools for monitoring and security operations
- Appliances Evaluation (UTM vs NGN firewall still a myth )
- Multiple Engineers may acknowledge the Alerts with in their allocated area .

### ◉ Extending Security solution to member institution

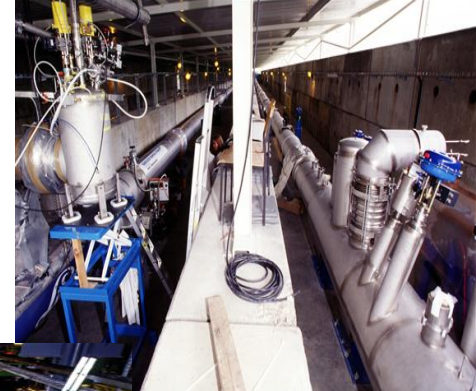
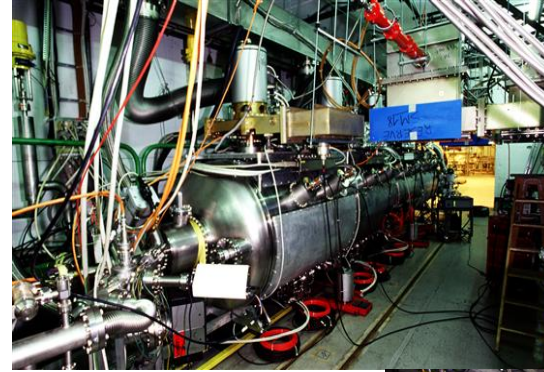
- Security member institution hosted services .
- Provisioning of DDOs mitigation solution of Applications
- Firewall Placement to monitor intra Vlan traffic among Universities (opening MPLS packets add payload )

### ◉ Power and backup power equipment monitoring and consolidating in NMS ( MIBs ) loading issue



# NCP-CERN PROJECT

- NCP is a partner of CERN in this project and it is the only LCG node in Pakistan
- There are stringent requirements for computing at LHC. To exploit the full physics potential of LHC data in comprehensive manner, NCP required Linux based PC farms, data storage capacity in 100s of terabyte and excellent network connectivity starting with minimum of 20MB
- To equip NCP with excellent network connectivity PERN2 has dedicated TEIN3-PK link completely.



# Telemedicine over PERN2

- Promotion of e-health
- Workshops conducted on Upper GI Laparoscopic and Hernia Surgeries as well as Emergency Telemedicine Response
- Lectures on Minimal Invasive Surgeries
- International Surgical Conference 2012 being held in collaboration with Society of Surgeons of Pakistan
- International Surgical Week 2013 being held in collaboration with Society of Surgeons of Pakistan



**PERN & Society of Surgeons**  
*Joining hands for the promotion of  
Telehealth in Pakistan*





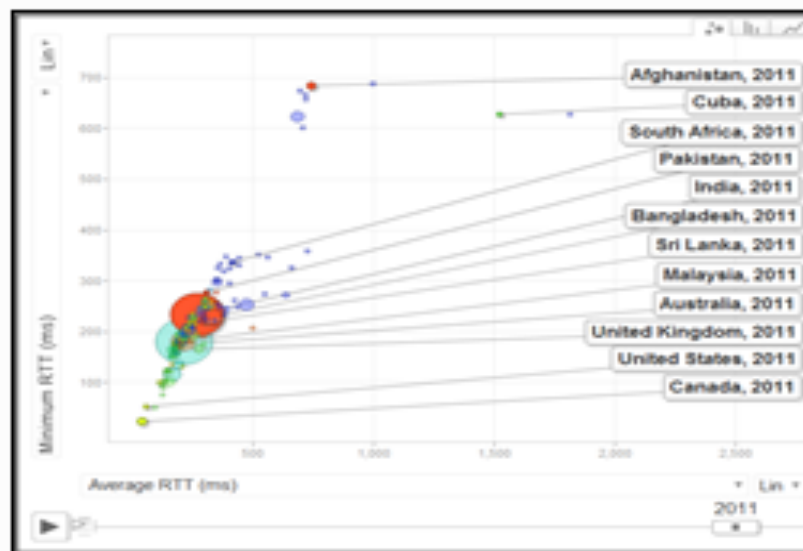
# PingER

Support Project for  
Large Hadron Collider (LHC) Community



## ➤ Salient Features of PingER

- Historical log of raw and sifted data since **1998**
- Chronological view into evolution of network
- Inter-networks and Intra-network comparison
- World wide presence with **~1000** monitored nodes



## Global Development Partners



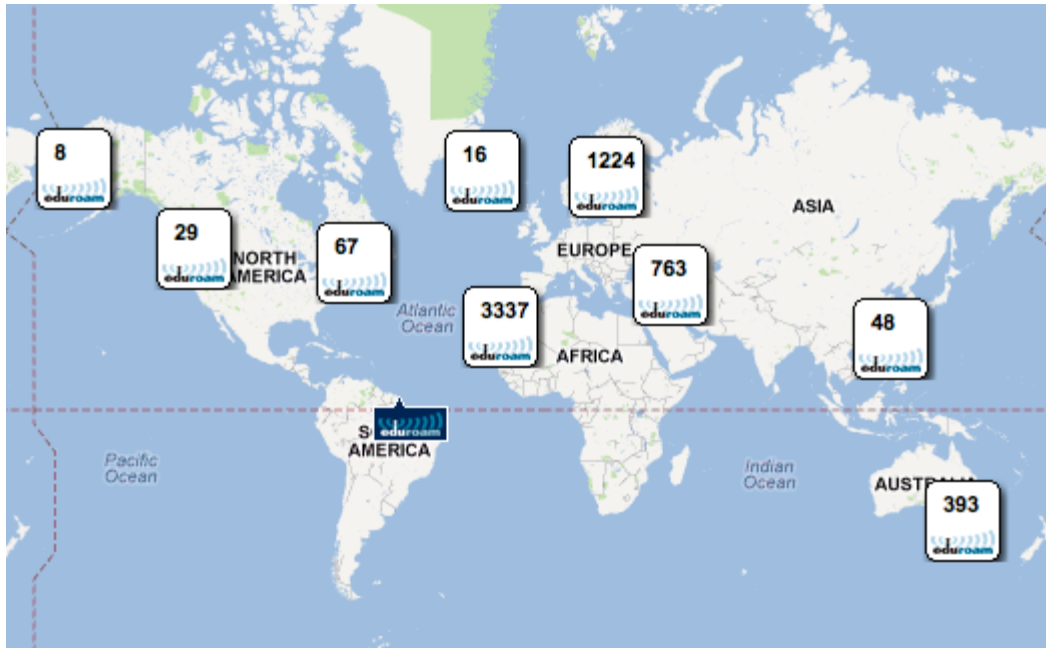
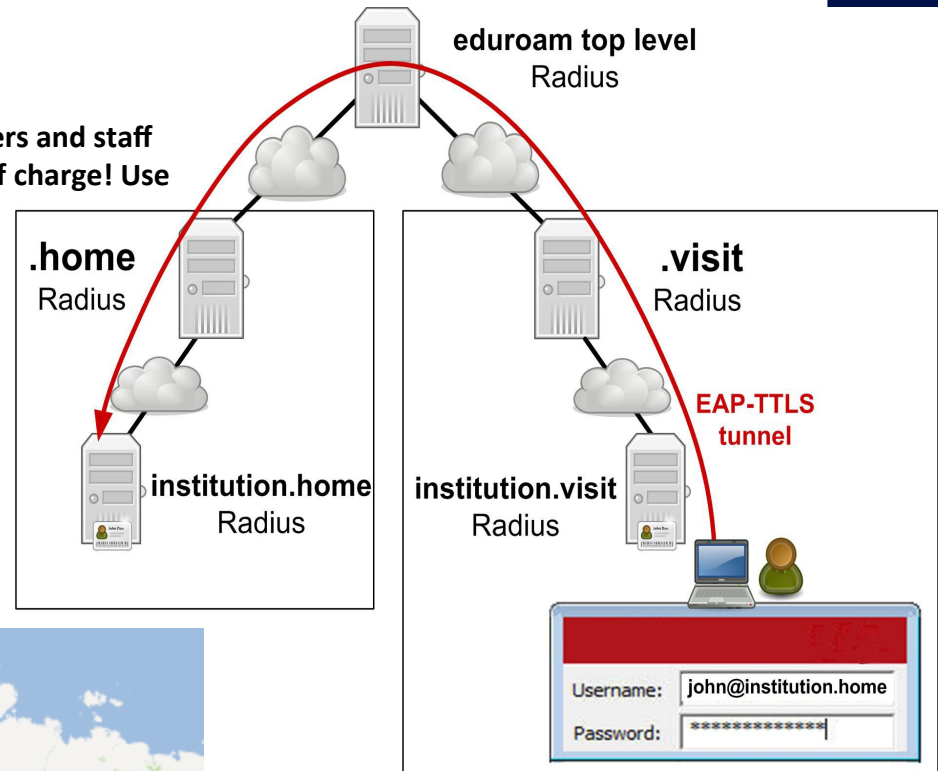
Pakistan Education & Research Network (PERN)  
National University of Sciences & Technology (NUST)  
Stanford Linear Accelerator Center (SLAC)  
European Council for Nuclear Research (CERN)  
California Institute of Technology (CALTECH)  
University of Malaysia Sarawak (UNIMAS)





Simple, secure and fast network access for students, researchers and staff  
Direct Internet access with your laptop or smartphone - free of charge! Use eduroam!

The eduroam service is coordinated within Pakistan by **Pakistan Education & Research Network [PERN]** and across Europe by a team from the GÉANT project, which is funded by the European Commission.



Andorra, Armenia, Australia, Austria, Azerbaijan, Belarus, Belgium, Brazil, Bulgaria, Montenegro, Morocco, The Netherlands, New Zealand, Norway, Peru, Poland, Portugal, Pakistan, Romania, Russia, Serbia, Singapore, Slovenia, Slovakia, South Africa, Spain, States of America

# VIDEO CONFERENCING FACILITY

Launched in Dec 2006		2006	2007	2008	Total
Universities Equipped		4	14	10	28
Events organized		14	532	122	668
Savings	Cost in Rs. million	5.344	98.960	13.264	117.568
	Time in man-hours	2120	51044	7916	61080



Events		Lectures / Presentations	Conferences	Technical Discussion	Meetings	Interviews	Total Events
2006	December	3	3	8	Nil	Nil	14
	Jan - Mar	22	Nil	49	14	Nil	85
2007	Apr - Jun	48	2	80	21	1	152
	Jul - Sep	39	2	89	16	19	165
	Oct - Dec	42	3	73	12	Nil	130
2008	Jan - Mar	38	Nil	73	9	2	122





# FUTURE ACTIVITIES

## ◎ Back Bone Upgrade

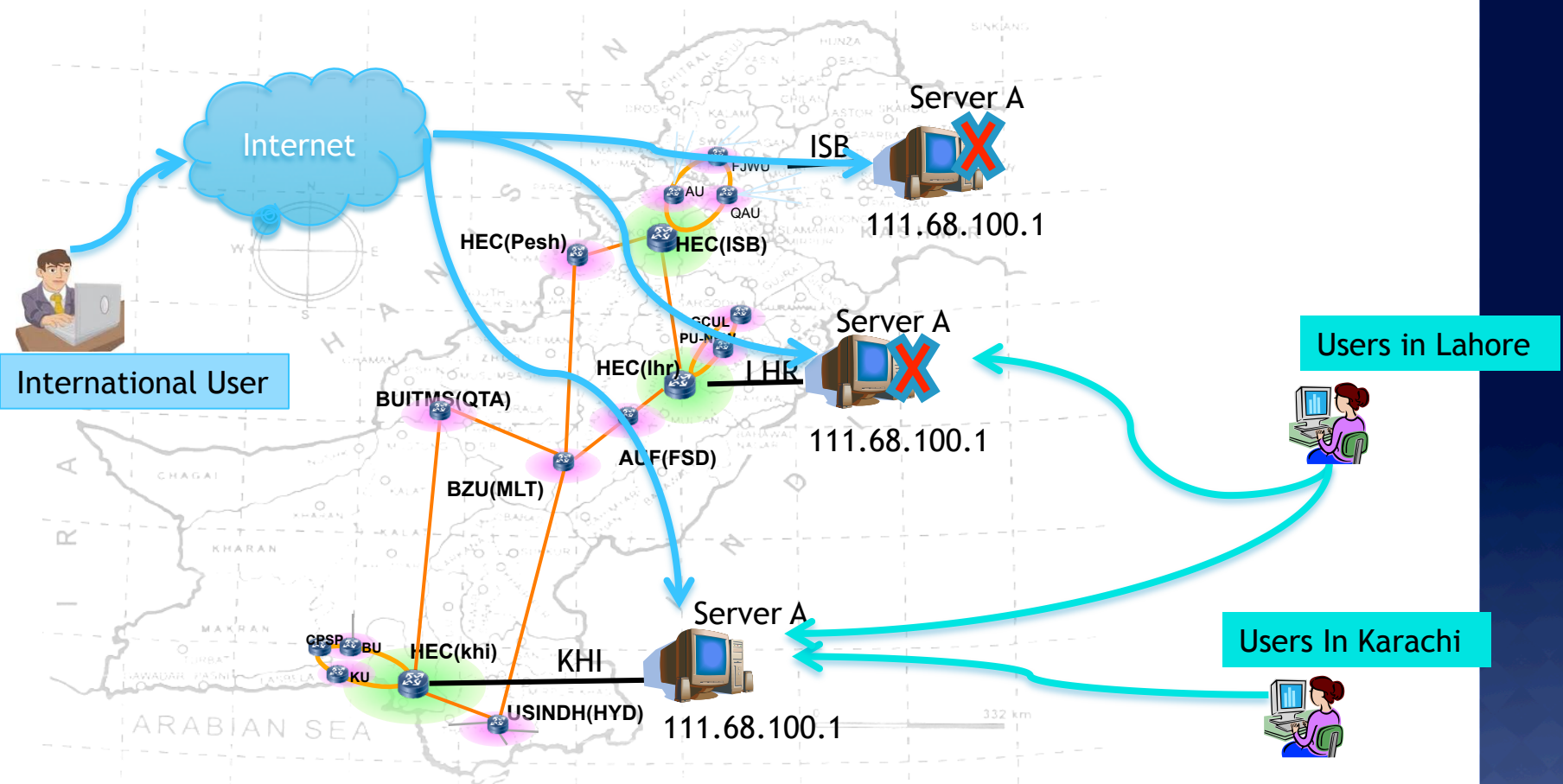
- DWDM backbone up grade 10 Gbps to 100 Gbps
- Protection in South region Ring
- Up gradation of TEIN link to STM-4
- Bandwidth Ratio From 70 :30 to 50:50 % with bandwidth upstream bandwidth provider

## ◎ Security Operation Center

- Deployment of ITIL Compliance CRM Kayako for auto escalation , SLA management, Contractors Management and customer CRM .(Open Source Software Procured Customization underway)
- Deployment of SEIM solution evaluation and finalization of product ( major intention is to outsource )
- Deployment of TLD DNS servers ( tender is prepared for acquisition of services)

## ◎ Research Activities

# PERN NETWORK LAYER FAILOVER FOR UNIVERSITIES SERVERS ( ANYCAST OVER IBGP)



# R&D ORGANIZATION , HOSPITALS , IIRDA DIES INTERCONNECT

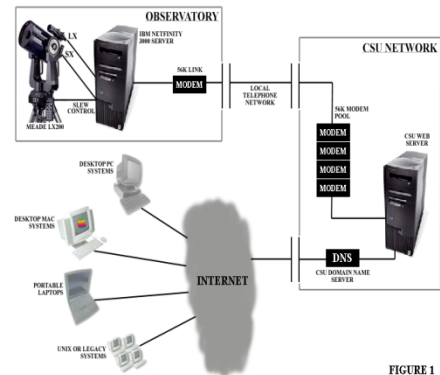
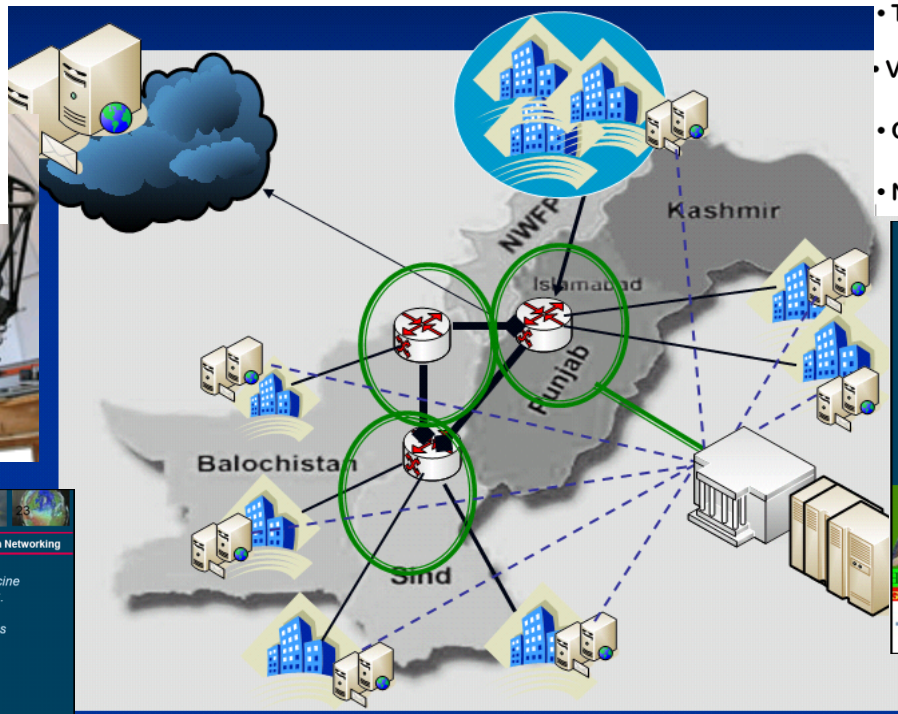
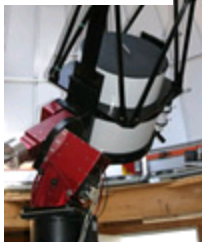
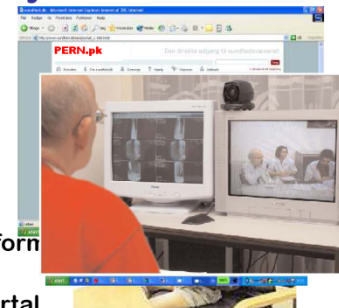


FIGURE 1



## Internet project: Services

- Web access
- Teleconsultation
- Videoconference
- Collaboration Platform
- National Health Portal



## Societal Benefit - Orthodontics

- Dr Mike Snow, an orthodontist from Melbourne, comes to Vietnam three times each year to treat Vietnamese children with cleft lip and cleft palate deformities.
- He has developed a broadband-enabled dental assessment chair that will allow him to examine Vietnamese children while he is still in Melbourne
- Two broadband-enabled orthodontal examination chairs are now in Vietnam



Helping Children with Cleft Lip and Palate in Vietnam  
TOP DO THƯƠNG KINH HỖ MÔI & LỖI KHỎI Ở VIỆT NAM



13

## Telemedicine APAN Manila, January 2007

During the APAN meeting in Manila, January 2007, demo'd live telemedicine (including live surgery) between all TEIN2 partners plus India and the US. Involved 12 countries and ~100 people  
- DVTS and Ipv6 multicast now deployed across all TEIN2 member NOCs

- Beneficiary partners
  - Indonesia
  - Malaysia
  - Philippines
  - Thailand
  - Vietnam
  - China
- Non-beneficiary partners
  - Korea
  - Singapore
  - Japan
  - Australia
- Others
  - India
  - US





THANKS