

PingER in Pakistan

Presented By:

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PingER Project-Pakistan



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Presentation Purpose

- To Share the Real World experiences while setting up PingER Monitoring Hosts in Pakistan

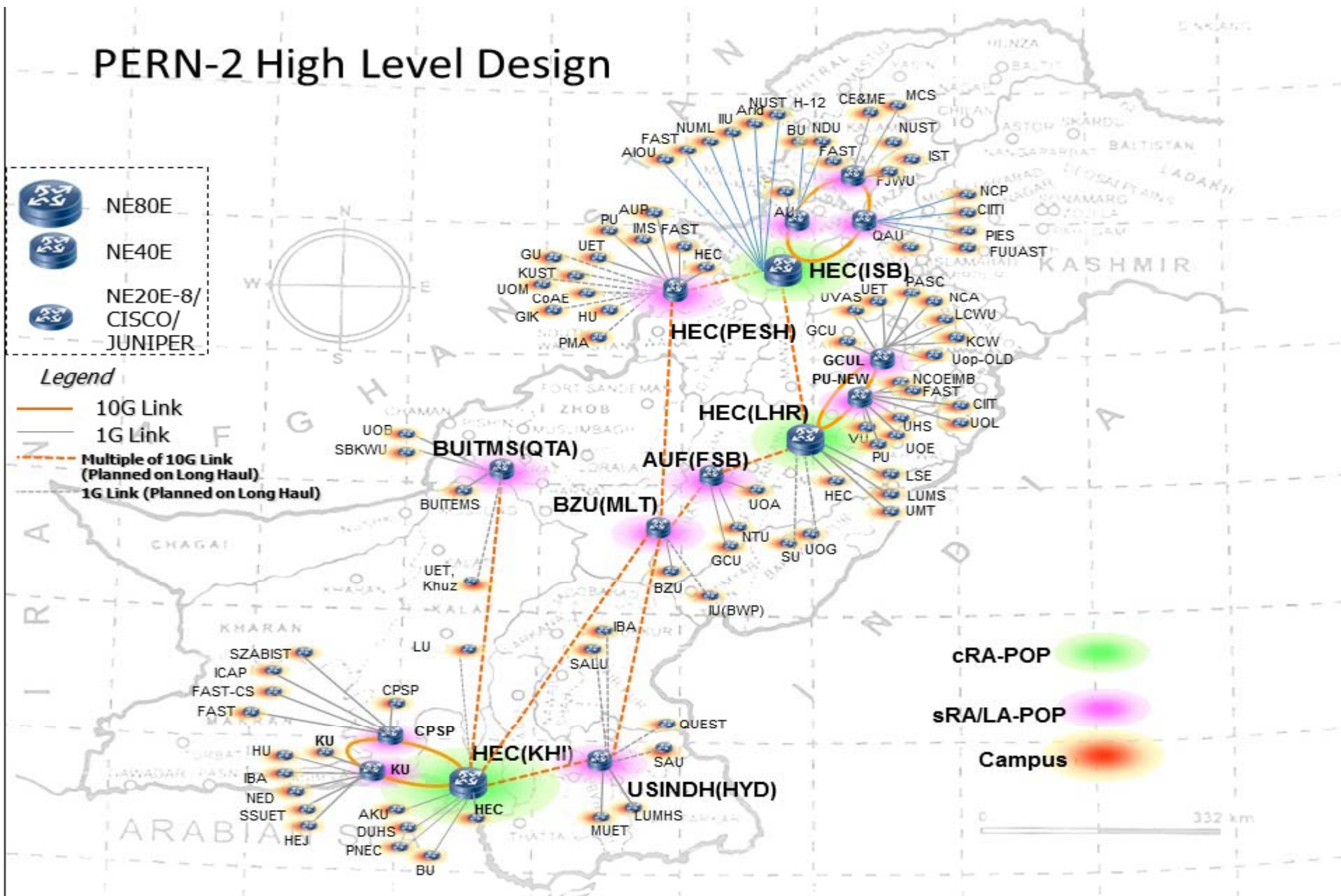
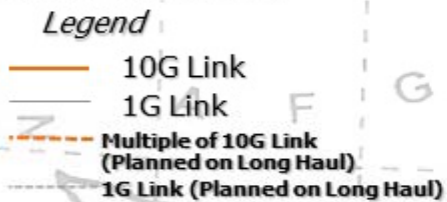
Presentation Outline

- Introduction
 - PERN Network
 - PingER Project
- PingER Metrics
- Monitoring Host
 - Types of installations
 - Requirements
- Problems
 - Technical
 - Administrative and Social

Introduction-PERN Network

- PERN - Pakistan Education and Research Network
 - ~103 Universities of Pakistan
 - 15 PoP/Regional sites
- Connects:
 - Premiere educational and research institutions of country.
 - People through the use of Intranet and Internet resources.
 - Part of the world-wide ERN deployment
 - E.g. JANET of UK, CERNET of China, MYREN of Malaysia.....
- Focuses on:
 - Collaborative research
 - Knowledge sharing
 - Resource sharing
 - Distance learning

PERN-2 High Level Design



PERN Network-Pakistan

Src: <http://www.pern.edu.pk/>

Introduction-PingER Project

- In Pakistan, PingER for PERN, Project started in 2008
- HEC funded project in collaboration with NUST-SEECS and SLAC
- Purpose:
 - End-to-end performance measurement infrastructure deployment for PERN and capacity building
- Objectives:
 - Deployment of Archive servers
 - Deployment of network monitoring nodes at participating universities
 - HR Training through workshops and visits

Current Project Status

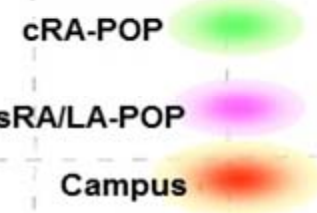
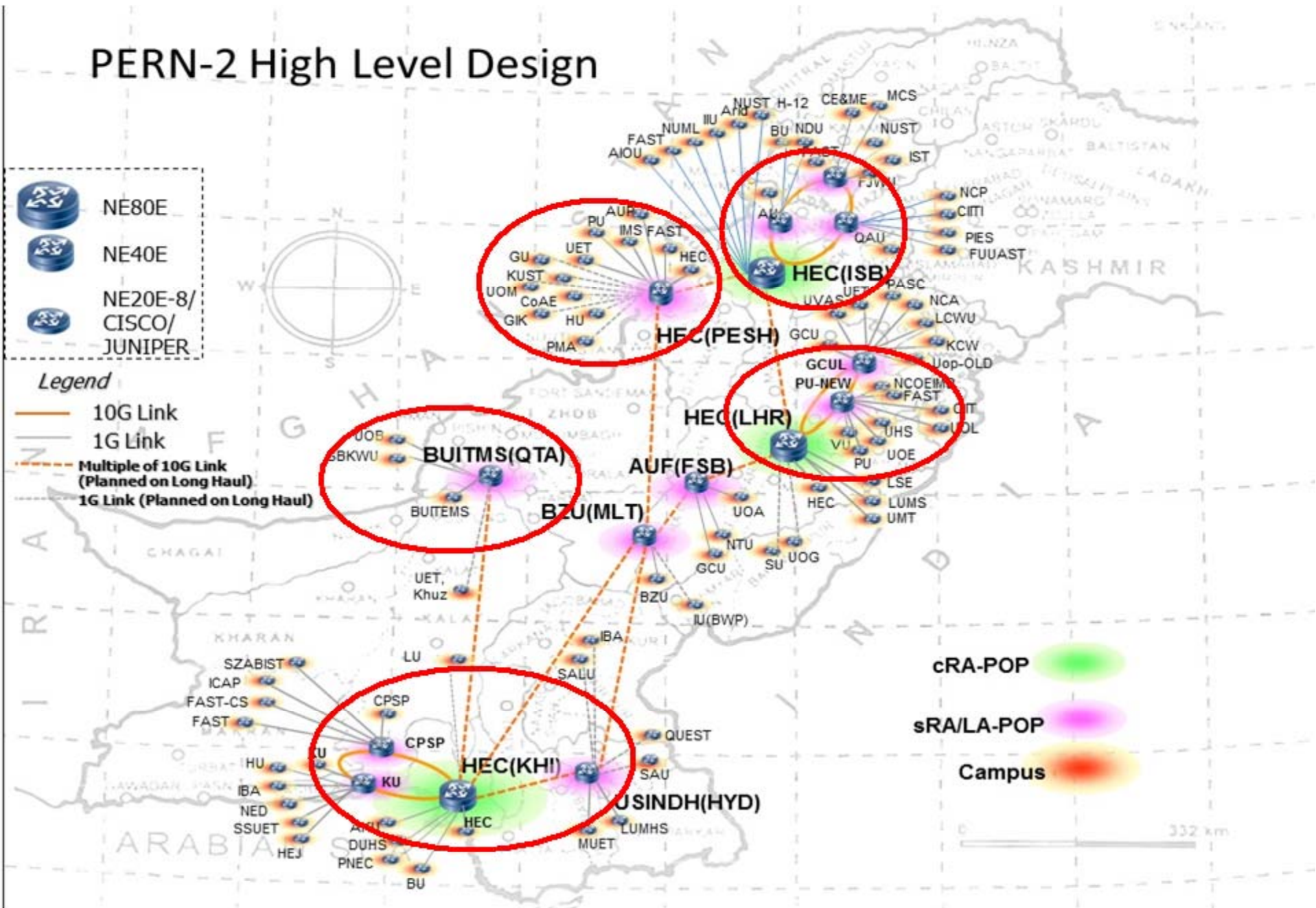
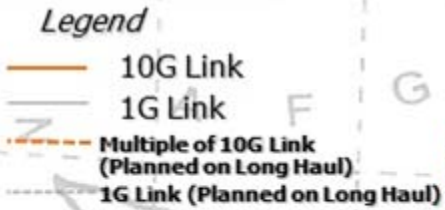
- Daily monitoring of ~50 Pakistani nodes
- Maintenance of archive server
- Preparing monthly performance analysis reports
- Preparing case studies(if required)
- Maintenance/Deployment of monitoring nodes
 - Updating
 - Re installation
 - Trouble shooting
 - Technical
 - Administrative

Analysis Scenarios

- We divide Pakistani Monitoring Nodes in Five Regions on Geographical location basis:
 - Peshawar (North) 06 Nodes
 - Islamabad(Central) 16 Nodes
 - Lahore (West) 12 Nodes
 - Karachi(South) 12 Nodes
 - Quetta(East) 03 Nodes

- Node Analysis
 - Intra Region
 - Inter Region

PERN-2 High Level Design



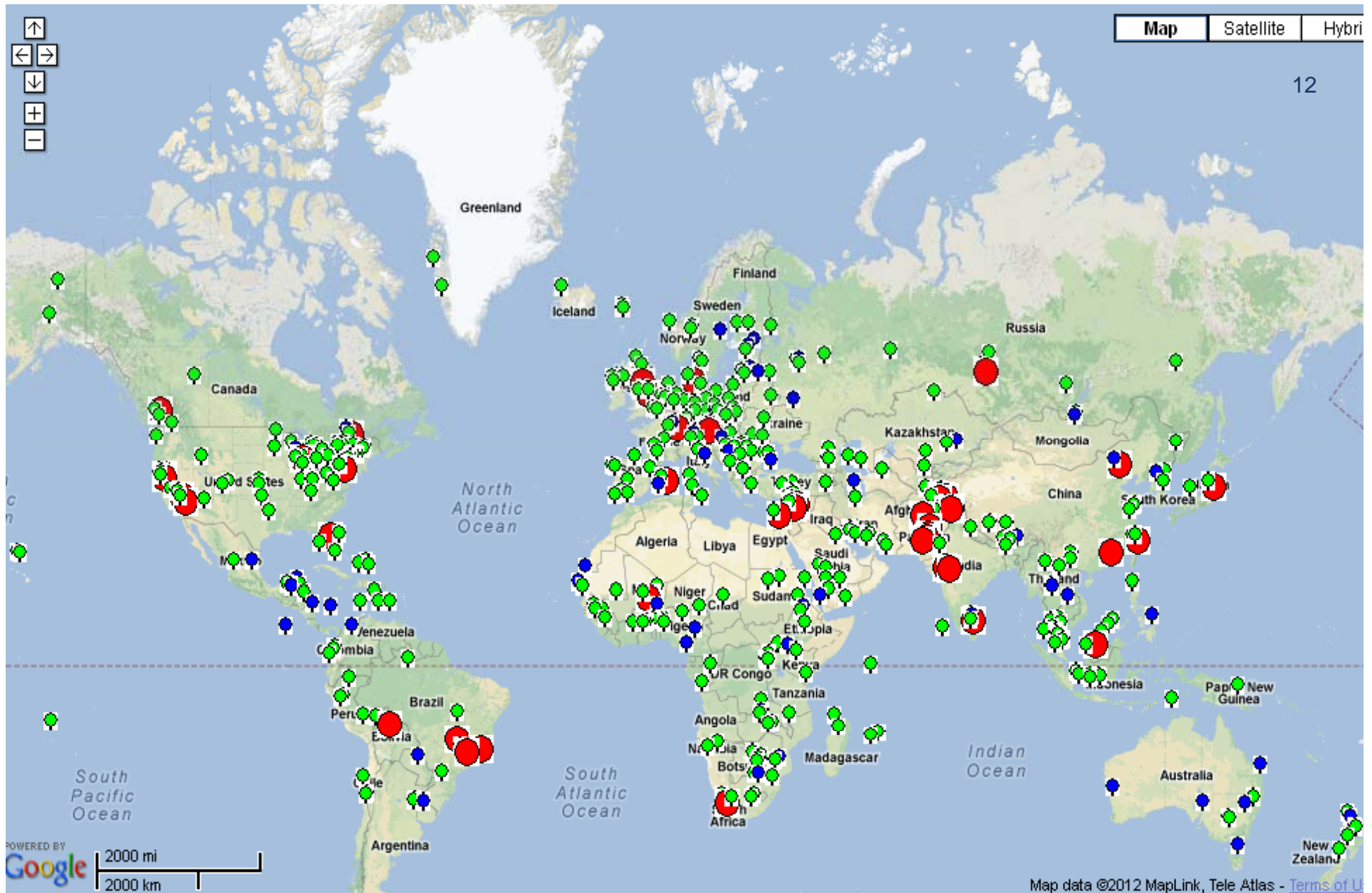
PingER-Pakistan Deployment

Project Benefits

- Collaboration between NUST and SLAC-Stanford
 - Students visits SLAC and get training
 - Improves their skill set for network analysis
 - Development of new tools for better analysis
- We organized series of workshops and as a result ~50 universities are collaborating with us
- Use of PingER data
 - Technical
 - Economical
- We are continuously guiding HEC through:
 - Monthly network analysis reports
 - Highlight exceptions through Case studies

Examples to use PingER

- Identifying sites to upgrade
- Identifying Last Mile Problems
- Choosing an ISP for home connectivity
- Setting expectations for a collaboration
- Setting expectations for VOIP & Video Conferencing
- Choosing routes
- Evaluating the impact of major cable cuts
- Quantifying the impact of changes
- Quantifying the Digital Divide



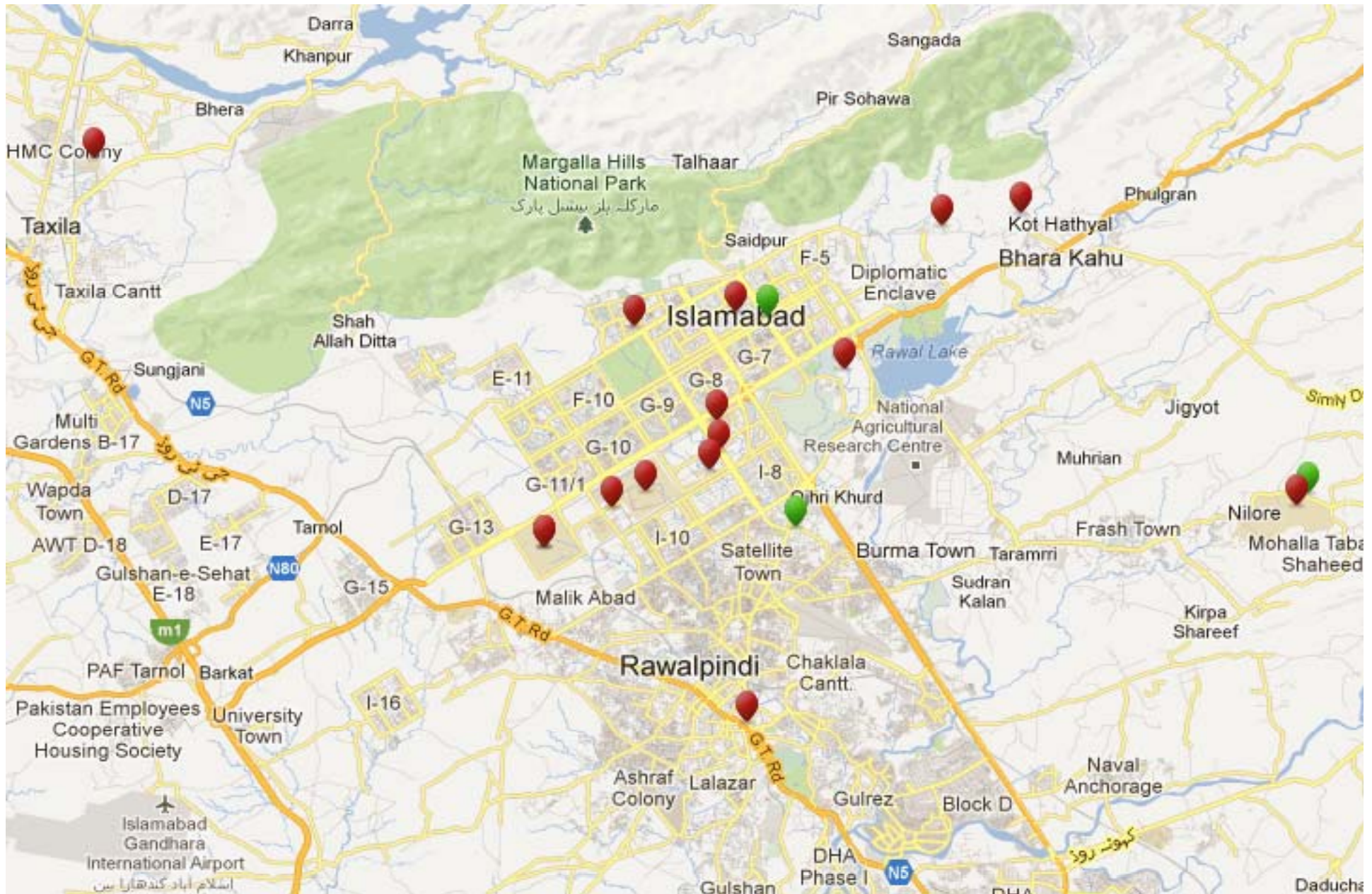
PingER-Worldwide Deployment

Src: <http://www-wanmon.slac.stanford.edu>



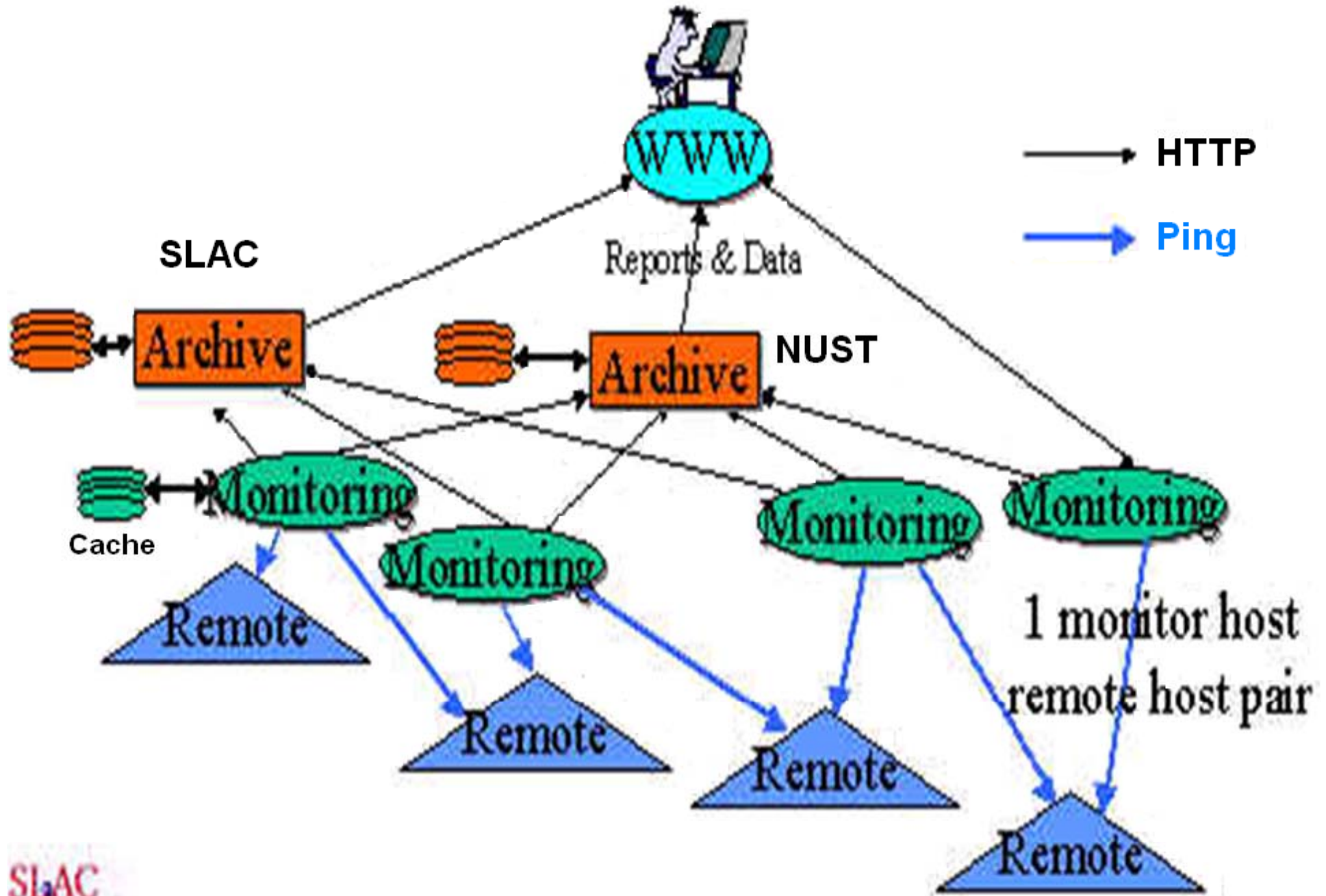
PingER-Pakistan Deployment

Src: <http://www-wanmon.slac.stanford.edu>



PingER-Islamabad Region Deployment

Src: <http://www-wanmon.slac.stanford.edu>

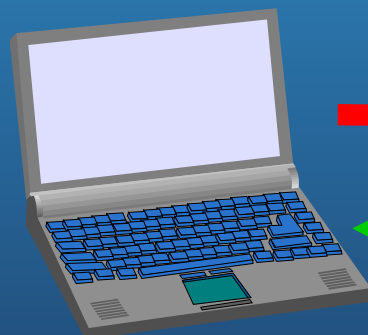


SLAC

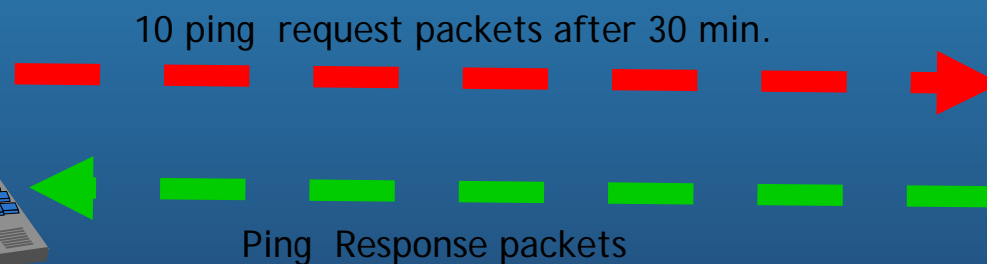
PingER-Architecture

Ping Mechanism

- ICMP Echo Message (Ping Facility)
- Modest in its network bandwidth requirements
 - ~ 100 bits per second per monitoring-remote-host-pair
- Ping measure the response time (round trip time in milli-seconds (ms))



Monitoring Host



Remote Host

What PingER measure

- Use ubiquitous Internet ping facility (ICMP Echo) to measure
 - Short and long term Response Time
 - Packet Loss percentage
 - Jitter
 - Un-Reachability
 - Throughput

Metrics Standard Values

Degradation category	Unreachability (%age)	RTT (ms)	Packet Loss (%age)	Throughput (Kbps)	Jitter
Excellent	<1.0	<62.5	<0.1	>1000	<10
Good	≥ 1.0 & < 3.0	62.5 - 125	≥ 0.1 & < 1	1000 - 500	10 - 70
Acceptable	≥ 3.0 & < 5.0	125 - 250	≥ 1 & < 2.5	500 - 100	70 - 150
Poor	≥ 5.0 & < 10	250 - 500	≥ 2.5 & < 5 Very Poor: ≥ 5 & < 12	100 - 50	150 - 500
Bad	≥ 10	≥ 500	≥ 12	< 50	≥ 500

Packet Loss

- Packet loss is a good measure of the *quality* of the link
- At Losses greater than 10% TCP connection fails
- We can analyze
 - The nodes causing congestions
 - The network which is delivering an imperfect copy of the packet (caused by bit errors in the links or in network devices)

Degradation category	Packet Loss (%age)
Excellent	<0.1
Good	≥ 0.1 & < 1
Acceptable	≥ 1 & < 2.5
Poor	≥ 2.5 & < 5
Very Poor	≥ 5 & < 12
Bad	≥ 12

Round Trip Time (RTT)

- The RTT is related to the distance between the sites plus the delay at each hop along the path
- RTT also depends on traffic load & congestion
- We can analyze
 - Troubled links which are experiencing network congestion causing packets drop
 - Length of the route and number of hops
 - Speed of routes and change of routes which is possibly taking a longer path.
 - Distribution /usage of bandwidth

Degradation category	RTT (ms)
Excellent	<62.5
Good	62.5 - 125
Acceptable	125 - 250
Poor	250 - 500
Bad	>= 500

Jitter

- Jitter is variability of the response time. Packet delay helps in finding jitter
- Jitter of the packets received is very important for real-time applications and streaming media(voice, video, music)
- We can analyze
 - Links capable or not for real time application services
 - Congestion limitation
 - Bandwidth requirement to handle traffic requirement

Degradation category	Jitter
Excellent	<10
Good	10 - 70
Acceptable	70 - 150
Poor	150 - 500
Bad	>= 500

Un-Reachability

➤ By looking at the ping data to identify 30 minute periods when no ping responses were received from a given host

- We can analyze
- When the host was down
 - How frequent it remained down/up
 - Mean Time Between Failure (MTBF or Mean Time To Failure MTTF)
 - Mean Time To Repair (MTTR)

Degradation category	Unreachability (%age)
Excellent	<1.0
Good	>=1.0 & < 3.0
Acceptable	> =3.0 & < 5.0
Poor	>= 5.0 & < 10
Bad	>= 10

Throughput

- Throughput is important to estimate the network performance.
- It is calculated from RTT and Loss using Mathis formula of throughput.

$$\text{Throughput} \sim (1460B)/(RTT * \text{sqrt}(\text{loss}))$$

- We can analyze
 - Upgrades requirement
 - Provide trouble-shooting information.
 - How much link can be occupied
 - Distribution of bandwidth depending on usage:
 - Time wise
 - Area wise

Degradation category	Throughput (Kbps)
Excellent	>1000
Good	1000 - 500
Acceptable	500 - 100
Poor	100 - 50
Bad	< 50

Types of Installations

- Trace Route Server
 - pinger.seecs.edu.pk/cgi-bin/traceroute.pl
 - Version: 6.0

- Pinger2 Host
 - pinger.seecs.edu.pk/cgi-bin/ping_data.pl
 - Version: 3.93
 - 48 set of pings daily
 - Packet Size
 - 100B
 - 1000B

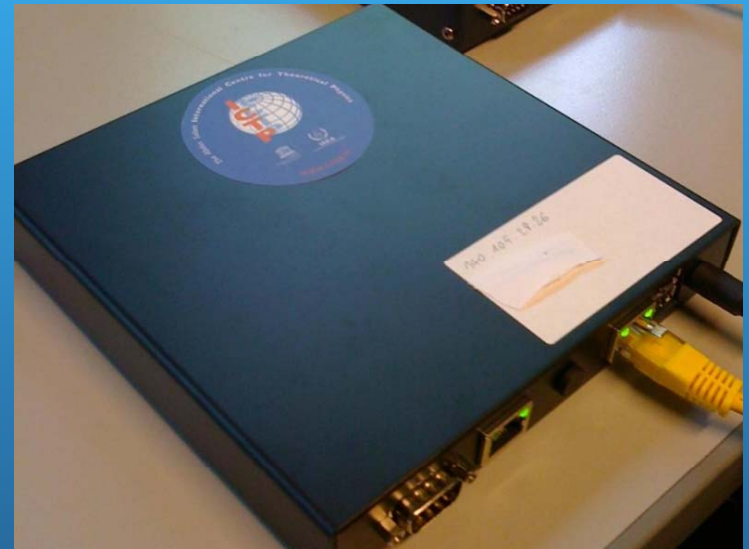
- Data Availability
 - pinger.seecs.edu.pk/cgi-bin/pingtable.pl

Requirement

- Space
 - 2GB of disk space.
- Computer Power
 - A 500MHz or better PC with at least 128MB RAM
 - 10/100Mbps NIC should be quite adequate
- Reliability
 - Reliability is more important
 - UPS or Electricity generators
- Web server
 - The host should run Linux
 - Host registered in the DNS
 - Ping must not be blocked

Minimum Requirement- ePingER

- Project for Zambia
- Initiated by M. Zennaro(ICTP)
- Inexpensive embedded Linux platform
- Draw 5W of 120V DC power(PC=100W)
- Valuable for sites in developing countries where cost and power utilization may be crucial.
- Cost is about \$110/machine
- 256MB RAM, 500MHZ AMD Geode CPU, 128KB L2 cache, 4GB Flash memory
- Dr. Les successfully deployed PingER in **University of Zambia** in June 2009
- For More Information:
<https://confluence.slac.stanford.edu/display/IEPM/ePingER+Project+Zambia>



What at the end Required

- DNS
 - e.g. pingerlhr.pern.edu.pk
- Public IP
 - e.g. 111.68.105.106
- Node Coordinates e.g.
 - Longitude: 74.352967
 - Latitude: 31.510717
- Node Location
 - Complete Postal Address
- Contact Person
 - Name
 - Designation
 - Contact Number
 - E-mail Address

Problems-Technical

- PingER Pre-Installation
- PingER Configuration
- Confusing Areas
- DNS Registration
- Pre-configured vs self-configured host
- Security
- Updating old hosts
- Updating New names and IP
- Identifying network anomalies

Problems-Technical

➤ PingER Pre-Installation Problems

➤ Non Linux OS

➤ Linux not correctly installed

➤ Some packages are missing

➤ Development tools are not installed

➤ E.g. PERL, web server (e.g. Apache) etc..

➤ ICMP echo and reply blocked

➤ It must not be blocked

➤ For detail FAQs

<http://www-iepm.slac.stanford.edu/pinger/faq.html>

Problems-Technical

➤ PingER Configuration

Three ways to configure:

- Download the files and install/configure yourself
 - <http://pinger.seecs.edu.pk/install1.html>
 - Correct version/sequence of PingER file/s not installed
 - The person is not technically sound and unable to configure files e.g. DNS and IP entry
- Inform us to install/configure remotely by giving us the machine access for the installation duration
 - SSH access blocked → It must not be blocked
 - Firewall enabled → Firewall must be disabled
- Allow us to visit and we will install/guide you that how to install and configure the files

Problems-Technical

➤ Confusing Areas

➤ Node working with IP not with DNS

- Some time DNS entry need time to populate itself on internet routers

➤ Data not collected

- Examine pinger directory.
 - The user running the pinger2.pl cron job should have read, write, and execute on directory & pinger2.pl script
 - And read write permission on all other files in directory.
- File paths are not correct
- Beacon List becomes empty

➤ Data not uploaded in the archive server

- When server accessed the host it was down for some time

➤ Not enough space

- Need to extend the space or remove unnecessary files

Problems-Technical

➤ DNS Registration

➤ Two Options

➤ Self DNS entry on their own DNS server

➤ e.g. pingerlhr.pern.edu.pk

➤ **Some universities have no DNS Server**

➤ DNS entry at our DNS server

➤ e.g. nuisb.seecs.edu.pk

Problems-Technical

- Pre-configured vs self-configured host

There are three options for PingER system:

- Interested University use the existing linux based server for PingER installation
 - Any of the installation/updation may effect other
- Interested University arranged a separate machine specifically for PingER
 - Some time they use it for some other purpose
- We visit the university with Pre-configured machine/host
 - We purchased some machines for weaker universities under the project equipment head

Problems-Technical

➤ Security

- Some times a university keeps the node down for network security reasons e.g. ns1.pieas.edu.pk
- They want to install by their own people for extra assurance
- Download the files and install/configure yourself
 - <http://pinger.seecs.edu.pk/install1.html>
- We have well defined security plan & executes on all nodes:
 - The main points are:
 - Create user account other than root:
 - User password must be at least 12 alphanumeric characters
 - Disable root log-in from SSH
 - Enable Firewall
 - Check rootkit Process
 - Identification/Deletion of Irrelevant Processes

Problems-Technical

➤ Security

- We have machine access for about 50% monitoring nodes
 - Implement the security plan remotely
- For rest of the nodes we send an e-mail/phone call and request them to implement it through a guided procedure.
 - <http://pinger.seecs.edu.pk/pinger/Security%20tutorial.doc>
- The contact person at node “ns1.pieas.edu.pk” installed himself using our provided tutorials.
- The node is UP again and working fine

Problems-Technical

- Updating old hosts
 - Developments are continuously going on at SLAC
 - There are two type of hosts:
 - Host with Access
 - We update the hosts with the newer version remotely
 - Host without access
 - It depends upon contact person mode
 - If he is cooperative then its not a big issue
 - If not then it may cause delay
- Some times contact person/administration changed and the new person is not cooperative
 - If we fail to convince then we disable that node from the database and enable later when it get fixed.

Problems-Technical

- Updating New names and IP
 - Some times DNS Server changed/removed and we need to change the DNS with the newer name at:
 - Same organization
 - Our SEECs server
 - Some times IP pools for each university changed due to varying/increasing demand of more live IP
 - Then we need to change:
 - Configuration files
 - DNS entry
 - In Central Database

Problems-Technical

➤ Identifying network anomalies

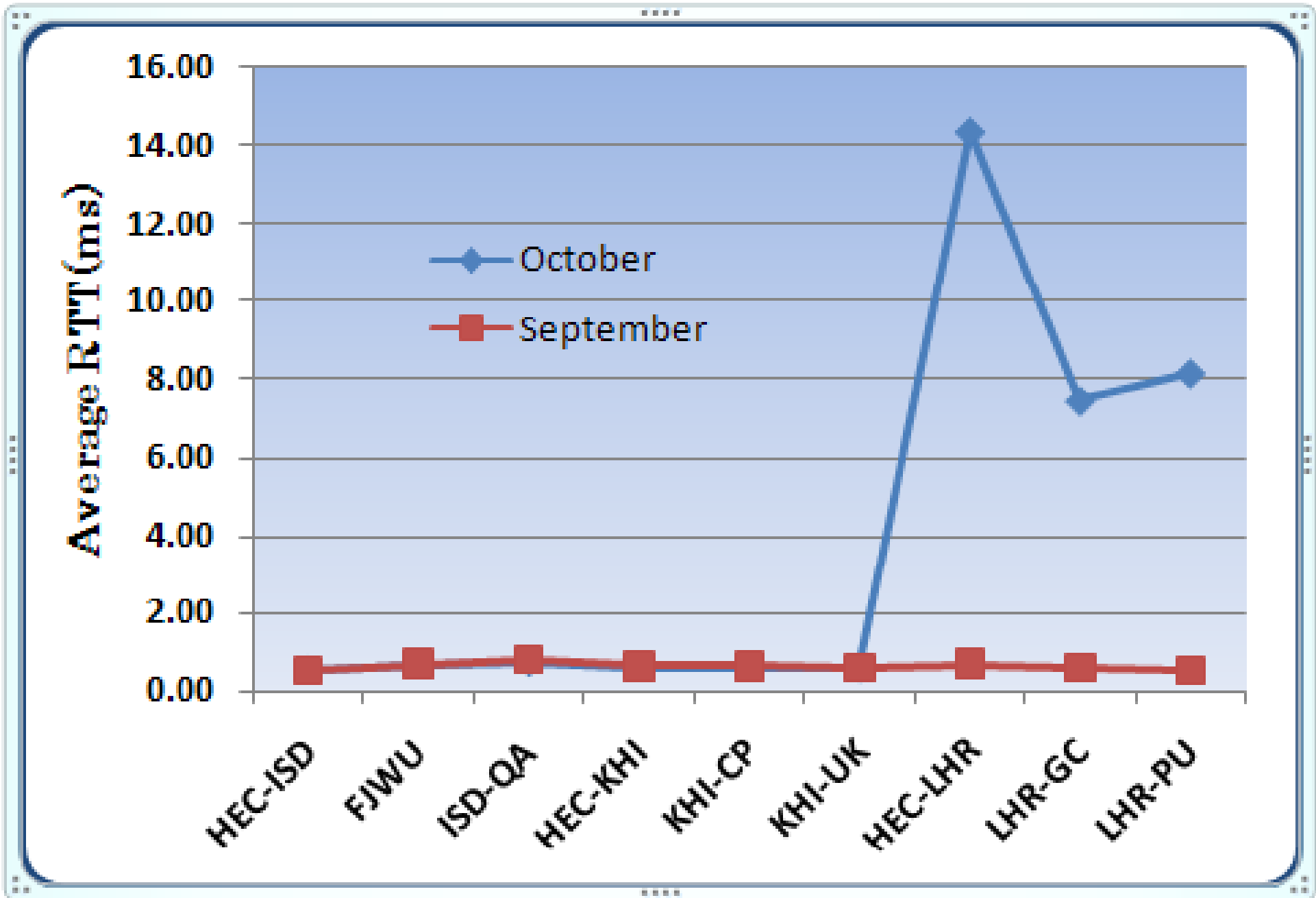
- Longer RTTs
- Higher Packet Loss
- High Un-Reachability
- Longer Routing Paths
- Main link problem
 - Intermediate router/hop fails
 - Intermediate hop longer queues (Congestion)
- Last mile problems
 - Not a fiber optic cable e.g. DSL connection
 - Intra university traffic is very high (Congestion)

Average RTT	HEC- ISD	FSD	HEC- KHI	HEC- LHR	MTN	HEC- Pwr	UoS	FJWU	ISD- QA	KHI- CP	KHI- UK	LHR- GC	LHR- PU	HEC- Qta
HEC-ISD		43.5	24.9	47.5	.	57.7	26.6	0.5	0.6	23.9	24.9	45.0	43.7	38.8
FSD	43.4		21.0	42.6	.	21.9	24.2	46.3	44.6	21.1	21.7	42.8	43.6	38.0
HEC-KHI	24.8	21.0		21.6	.	34.9	3.7	24.1	23.9	0.7	0.6	23.0	23.2	17.1
HEC-LHR	47.6	42.8	21.5		.	56.5	50.0	44.3	45.3	21.7	21.8	14.4	14.3	67.8
MTN	.	.	.	.		.	.	.	.	.	.	.	.	.
HEC-Pwr	51.4	15.5	28.8	51.9	.		29.3	51.8	51.1	30.2	28.0	50.3	48.6	44.4
UoS	26.6	24.3	3.6	41.5	.	33.7		25.8	25.8	3.7	3.7	128.5	128.5	19.7
FJWU	0.5	46.6	24.1	44.3	.	57.9	25.7		0.9	25.3	24.2	47.2	45.9	40.4
ISD-QA	0.6	44.6	24.1	45.3	.	58.2	25.5	0.9		25.3	24.1	43.7	45.4	39.8
KHI-CP	23.9	21.1	0.7	21.6	.	36.6	3.7	25.3	25.0		0.6	23.2	23.4	17.1
KHI-UK	24.9	21.6	0.6	21.7	.	34.6	3.7	24.2	24.0	0.6		21.3	21.6	17.2
LHR-GC	45.1	42.9	23.0	14.4	.	55.5	127.3	47.4	43.8	23.2	21.3		0.5	141.5
LHR-PU	43.7	43.8	23.2	15.8	.	53.6	129.4	45.9	45.4	23.2	21.6	0.5		142.5
HEC-Qta	38.7	38.2	16.9	66.1	.	48.9	19.5	40.4	40.3	17.1	17.1	140.5	140.9	

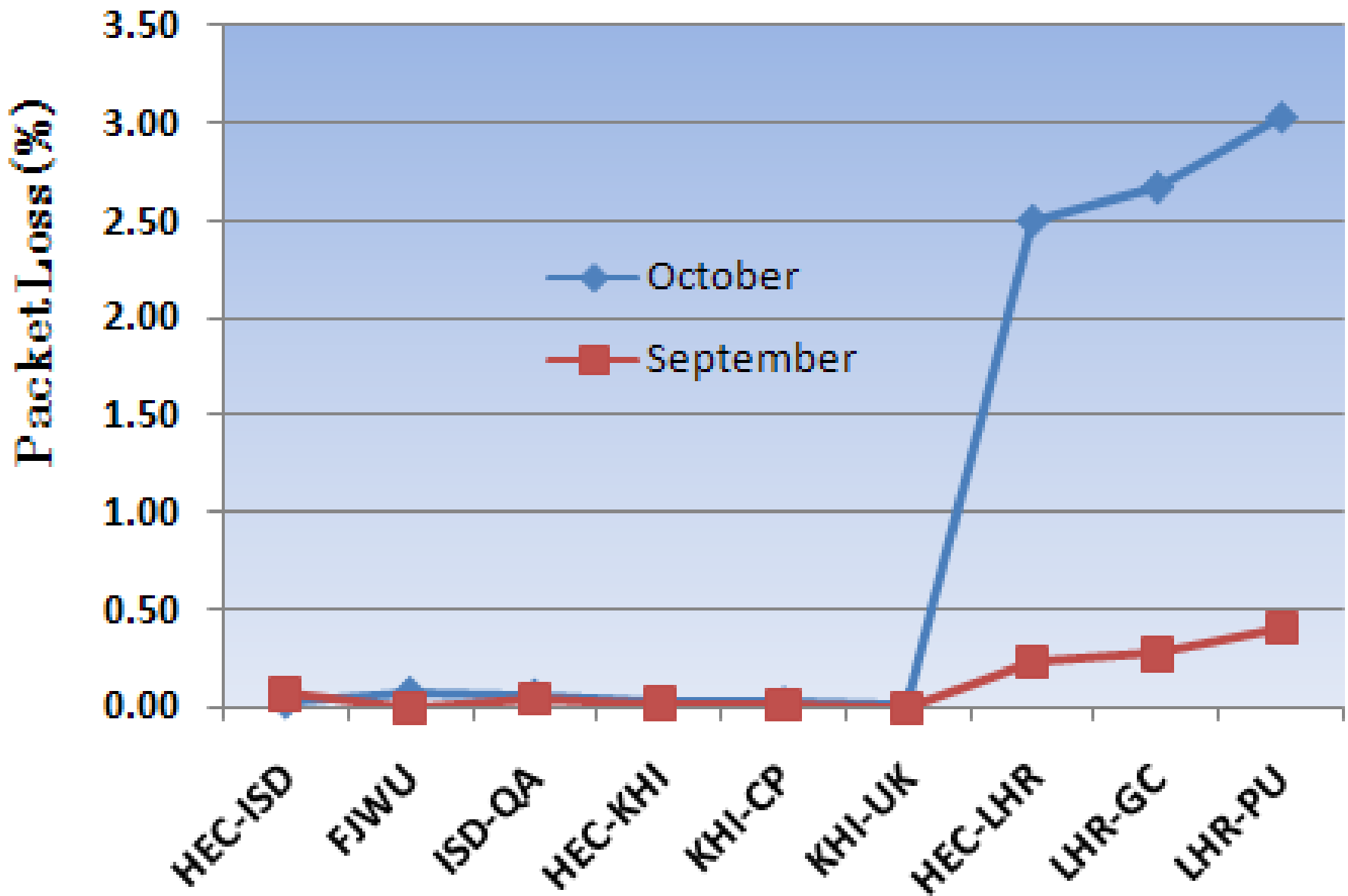
Average RTT Anomalies

Packet Loss	HEC- ISD	FSD	HEC- KHI	HEC- LHR	MTN	HEC- Pwr	UoS	FJWU	ISD- QA	KHI- CP	KHI- UK	LHR- GC	LHR- PU	HEC- Qta
HEC-ISD		0.06	0.00	0.62	.	0.26	0.25	0.04	0.00	0.06	0.06	0.12	4.62	0.00
FSD	0.01		0.03	0.26	.	0.24	0.38	0.22	0.00	0.02	0.00	0.20	5.13	0.50
HEC-KHI	0.00	0.12		0.39	.	0.87	0.25	0.05	0.05	0.00	0.04	0.06	4.64	0.01
HEC-LHR	1.06	0.54	0.14		.	0.59	0.57	0.85	1.13	0.31	0.88	0.63	4.38	0.22
MTN	.	.	.	.		.	.	.	.	.	.	.	.	.
HEC-Pwr	0.70	0.13	0.87	1.07	.		0.29	0.42	0.21	0.16	0.79	0.38	1.67	0.17
UoS	0.00	0.04	0.01	0.35	.	0.03		0.00	0.01	0.00	0.20	0.12	1.04	0.14
FJWU	0.00	0.30	0.00	0.49	.	0.16	0.03		0.14	0.04	0.02	0.05	3.87	0.16
ISD-QA	0.00	0.00	0.00	0.67	.	0.10	0.14	0.13		0.12	0.00	0.01	6.70	0.12
KHI-CP	0.01	0.03	0.01	0.62	.	0.86	0.23	0.06	0.00		0.04	0.19	4.18	0.17
KHI-UK	0.01	0.16	0.00	1.17	.	0.17	0.60	0.10	0.06	0.02		0.15	4.39	0.23
LHR-GC	0.05	0.56	0.06	0.79	.	0.37	0.16	0.19	0.02	0.14	0.02		4.56	0.42
LHR-PU	2.27	2.62	2.62	3.19	.	3.46	2.33	2.87	3.55	2.34	2.78	2.87		2.84
HEC-Qta	0.00	0.41	0.01	0.10	.	0.14	0.36	0.14	0.22	0.04	0.15	0.16	5.16	

Packet Loss Anomalies



Average RTT Comparison



Packet Loss Comparison

Case Study: Longer RTT

➤ In September 2012 through PingER tables we found

➤ Longer RTT between two PoP nodes

➤ pingerlhr.pern.edu.pk (111.68.105.97)

➤ pingerqta.pern.edu.pk (121.52.157.157)

➤ [12Sep14](#) [12Sep15](#) [12Sep16](#) [12Sep17](#) [12Sep18](#) [12Sep19](#) [12Sep20](#)

37.615 **110.156** 144.940 154.369 154.459 159.469 157.108

➤ The quick answer was “highly congested link”

➤ But when we checked the nearby nodes on the same link, they were fine with ~50ms RTT.

Traceroute From HEC-Lahore to 121.52.157.157 (HEC-Qta)

Hop	City/Country	RTT
1 lhr-hec.gov.pk (111.68.105.97)	Lahore	0.650 ms
2 172.31.252.145 (172.31.252.145)	Private	0.591 ms
3 tw21-static61.tw1.com (117.20.21.61)	Transworld Lahore	6.892 ms
4 tw255-static101.tw1.com (110.93.255.101)	Transworld Pak	24.875 ms
5 tw255-static6.tw1.com (110.93.255.6)	Transworld Pak	35.380 ms
6 212.73.253.73 (212.73.253.73)	France	129.257 ms
7 ae-4-5.bar1.Marseille1.Level3.net (4.69.151.9)		130.805 ms
8 ae-3-4.edge2.Marseille1.Level3.net (4.69.143.254)		129.935 ms
9 213.242.115.6 (213.242.115.6)		129.890 ms
10 static-10GE-KHI494-P01-KHI494-SWB.pie.net.pk (202.125.128.157)	Pak	133.642 ms
11 rwp44.pie.net.pk (221.120.251.42)	Islamabad	144.168 ms
12 rwp44.pie.net.pk (221.120.251.45)	Islamabad	143.565 ms
13 khi77.pie.net.pk (221.120.205.194)	Karachi	144.608 ms
14 sbkwu.edu.pk (121.52.157.157)	Quetta	144.561 ms

Router
Configuration
Problem Not
Congestion

Case Study: Longer RTT

➤ Actual Problem:

- No International eXchange Point in Pakistan.
- This can lead to the peering being abroad when traversing from one ISP to another.
- Normally the people at suffering end feels that there is a congestion or we have low capacity links
- But that is not always true

Case Study: Longer RTT

➤ Solution:

- HEC Changed the route from secondary link to primary link
- Case study Link:

<https://confluence.slac.stanford.edu/display/IEPM/PingER+Case+Studies>

Traceroute From HEC-Lahore to 121.52.157.157 (HEC-Qta)			
Hop		City/Country	RTT
1	lhr-hec.gov.pk (111.68.105.97)	Lahore	0.6 ms
2	172.31.252.145 (172.31.252.145)	Private	1ms
3	221.120.197.21	PERN Primary Link	24ms
4	221.120.251.1	PERN Primary Link	31ms
5	221.120.251.154	PERN Primary Link	34ms
6	221.120.205.194	PERN Primary Link	35ms
7	121.52.157.157	Quetta	36ms

Problems-Administrative & Social

- Social Issues
- Need for contact person
- Requirement of contact person
- Long term issues
- Spotting failing hosts
- Host may not recover form outages

Problems-Administrative & Social

➤ Social Issues

- Some times University administration is **not willing** based on the following questions:
 - Its very common question that, what is the benefit to our university(Particularly if the university is already enjoying good Bandwidth) ?
 - its more than individual thinking
 - It is for our national interest
 - Its extra burden on us to maintain ?
 - You need not to do anything unless there is some problem
 - Are you monitoring our people?
 - We are monitoring links not people

Problems-Administrative & Social

➤ Social Issues(cont....)

- Some time university is willing but the contact person is not willing based on the following questions:
 - Its extra load on me to maintain?
 - After installation its very rare that node goes down
 - If it happens once in a month then it is not a big issue
 - Just inform us and we are available to help you
 - What is my personal benefit for doing this?
 - You are part of a monitoring system which is deployed worldwide
 - Its learning for you about network monitoring
 - If funding is not a big issue then we can grant some stipend to the contact person to keep the node up.
 - It can helps us to get complete data for better analysis.

Problems-Administrative & Social

- Need for contact person
 - Some times a contact person is not available/left/changed for some time
 - It may cause the node down for many days unnecessarily
 - The possible reasons are:
 - System goes **DOWN** and need to press the power button
 - System **Crashed** and no one is there to reinstall or inform us
 - **Power supply** of the system failed and need to replace it
 - **Network Cable** is unplugged due to some reason
 - We are monitoring on daily basis and identify immediately that node is down
 - We notify the contact that node is down(for a week or so)
 - If no response then Re-Notifies ~fortnightly
 - If again no response then Re-Notifies after ~1 month

Problems-Administrative & Social

- Requirement of contact person
 - We prefer that Contact person should be Network Administrator (NA) or equivalent
 - About ~90 % we have NA/SA/Manager IT
 - ~10% are support engineers, lecturers etc.
 - If contact person is not network aware then:
 - at least should be cooperative
 - Accessible through contact number
 - Inform us that what is the problem
 - Can follow the trouble shooting instructions given to him

Problems-Administrative & Social

➤ Long term issues

➤ Contact person changed

- We send the PingER detail information through e-mail
- We send an official letter to university to keep the node UP
- But we can't do anything thing except wait

➤ Machine is out of order (financial constraint)

- We have some backup machines and send through courier/visit
- Some times we allow to purchase and pay online

➤ No machine access and delay in visit plan

- Some times we are busy in other things like workshop, exams etc.
- Some times we need approval to visit from both ends
- So we prefer to get machine access to save travelling and time

Problems-Administrative & Social

- Long term issues(cont.....)
 - **University on strike**
 - One of our node remained down for about 2 months
 - Again we can't do anything thing except wait
 - **Public IP shortage**
 - Some time a university face live/public IP shortage
 - They start using PingER IP to other high priority server
 - We try to convince them to run PingER on another running server
 - We write to HEC to assign more IP's to the university.
 - **Shifting of server room/data center**
 - Some time it takes months for a university to shift the equipment to a new place.
 - **Summer vacations**
 - Some time a university keeps the network OFF to save resources.

Problems-Administrative & Social

- Spotting failing hosts
 - Automated continuous monitoring 24/7
 - <http://pinger.seecs.edu.pk/checkdata/>
 - Manual monitoring daily
 - 10:00am morning
 - 4:00pm evening
 - Daily reports at <http://pinger.seecs.edu.pk/daily-report/>
- We identify failing hosts immediately and try to resolve by:
 - Phone call
 - Remote access (if have)
 - Send customized trouble shooting steps via e-mail (if no access)
- **In morning ~4-5 and in evening ~1-2 nodes remain down**



PingER Monitoring Site Data Collection Status for Dec 2012

- [IEPM Home Page](#)
- [IEPM Site Map](#)
- [Network Monitoring](#)
- [PingER](#)
- [IEPM Papers and Presentations](#)
- [Monitoring Sites](#)
- [PingER Meta Database](#)

Host	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31		
airuniversity.seecs.edu.pk (1)	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	ping to ping from avg rtt pkt loss get data 0
aup.seecs.edu.pk (2)	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	ping to ping from avg rtt pkt loss get data 0
brunsvigia.tenet.ac.za (3)	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	ping to ping from avg rtt pkt loss get data 0
buitms.seecs.edu.pk (4)	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	ping to ping from avg rtt pkt loss get data 0
cae.seecs.edu.pk (5)	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	ping to ping from avg rtt pkt loss get data 2
cc.if.ufrj.br (6)	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	ping to ping from avg rtt pkt loss get data 4
duhs.seecs.edu.pk (7)	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	ping to ping from avg rtt pkt loss get data 0
ford.cefet-rj.br (8)	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	ping to ping from avg rtt pkt loss get data 0
hepnrc.hep.net (9)	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	ping to ping from avg rtt pkt loss get data 0
hunna.learn.ac.lk (10)	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	ping to ping from avg rtt pkt loss get data 4
icfamom.dl.ac.uk (11)	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	ping to ping from avg rtt pkt loss get data 0
icfamom.rl.ac.uk (12)	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	ping to ping from avg rtt pkt loss get data 0
juarez-med.core.cudi.edu.mx (13)	Disabled in Guthrie NODEDETAILS database, no longer monitoring																																
kinnaird.seecs.edu.pk (14)	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	ping to ping from avg rtt pkt loss get data 0
maggie1.seecs.edu.pk (15)	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	ping to ping from avg rtt pkt loss get data 0

Data Collection Status

Problems-Administrative & Social

- Host may not recover form outages
 - **Very serious problem in Pakistan**
 - Some universities have no power backup devices like UPS or power generators
 - Remain Down
 - 50% of the time in office hours
 - 100% in other timings and week ends
 - **Our software's are good enough to handle missing data**
 - But we prefer that we have complete real data for accurate analysis.

Useful Links:

- PERN-Pakistan Education and Research Network

- <http://pern.edu.pk>

- SEecs-NUST University

- <http://seecs.nust.edu.pk>

- Pinger project at SEecs-NUST

- <http://pinger.seecs.edu.pk>

- <http://pinger.seecs.edu.pk/install1.html>

- <http://pinger.seecs.edu.pk/cgi-bin/traceroute.pl>

- http://pinger.seecs.edu.pk/cgi-bin/ping_data.pl

- <http://pinger.seecs.edu.pk/cgi-bin/pingtable.pl>

- <http://pinger.seecs.edu.pk/pinger/Security%20tutorial.doc>

- <http://pinger.seecs.edu.pk/daily-report/>

Useful Links:

- Finding Coordinates of Node
 - <http://itouchmap.com/latlong.html>
- Finding location of IP
 - <http://whatismyipaddress.com>
 - e.g. 49.50.236.98
- Case Studies
 - <https://confluence.slac.stanford.edu/display/IEPM/PingER+Case+Studies>
- FAQs
 - <http://www-iepm.slac.stanford.edu/pinger/faq.html>

Thanks