# PingER and the Digital Divide

**The Digital Divide: Exemplary Statistics:**

- 41.5% people in Western Europe are internet users
- 2.61% of total Africa's population is online
- Almost a quarter of Korea's population has broadband
- Swaziland, a country of about a million, has total international bandwidth of 256 Kbps, less than many homes in the developed world

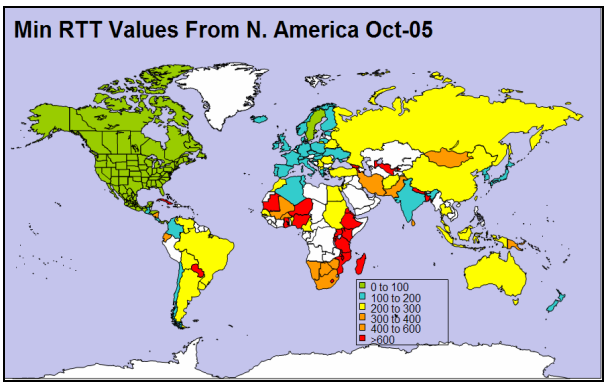



*Fig 1: The countries colored in red have a minimum RTT value greater than 600ms. They are still using satellite links as the only medium of global connectivity.*

**What is PingER?**

The PingER (Ping End-to-end Reporting) project monitors the end-to-end performance of Internet links worldwide. Developed by the IEPM group at the Stanford Linear Accelerator Center (SLAC), PingER has a decade old data repository of network performance measurements from and to sites around the world. Currently, there are around 35 monitoring hosts in 13 countries monitoring over 300 sites in over 115 countries that amongst them contain around 99% of the world's Internet connected population.

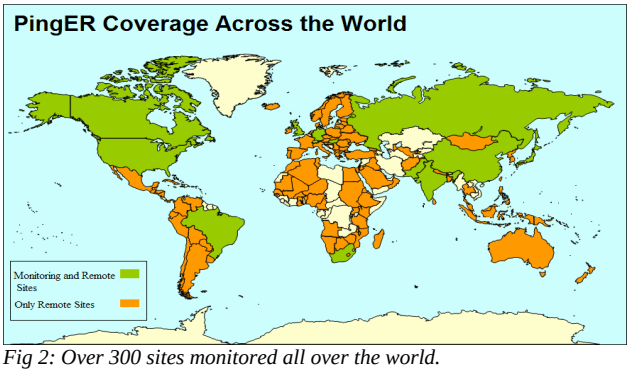
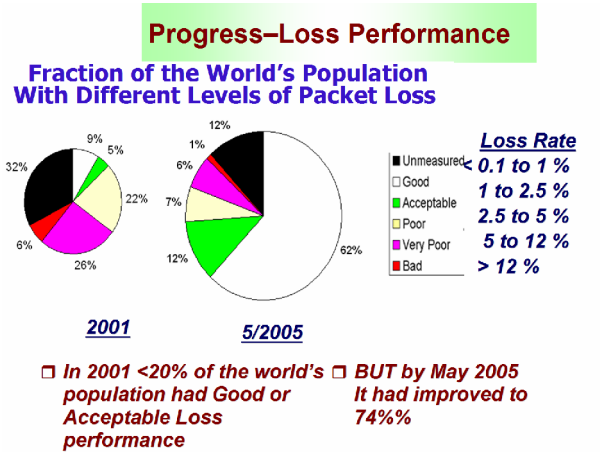



*Fig 2: Over 300 sites monitored all over the world.*

**What we measure**

We use the ubiquitous Internet ***ping*** facility to measure the short and long term Response Time**,** Packet Loss percentages, the variability of the response time (jitter), and the lack of reachability (no response for a succession of pings).




**PingER results**

PingER provides insight into a wide range of network behavior. To summarize the results, it is necessary to aggregate the measurements by country, region, affiliation group (e.g. a High Energy Physics experiment), to divide by metric, and into long-term trends and short-term glitches.

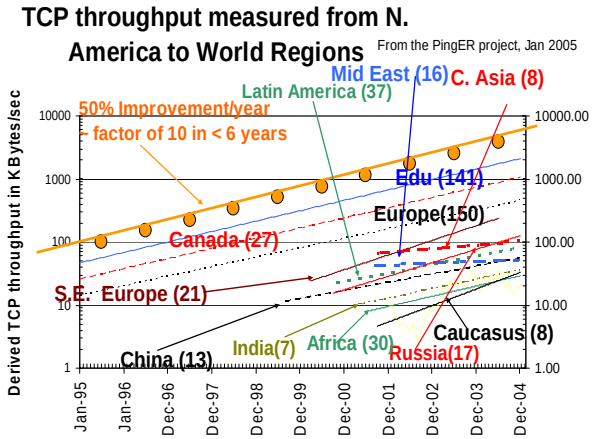
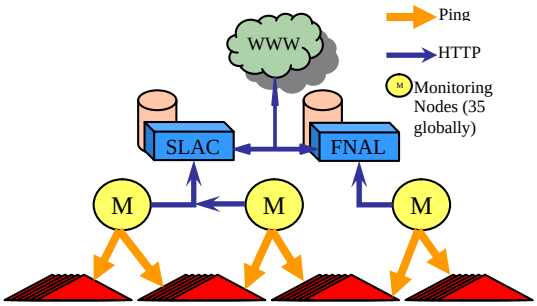



*Fig 4: As measured by PingER, the throughput factor has certainly improved across the world*

**The PingER Mechanism**

PingER is based on the ubiquitous Internet Control Message Protocol (ICMP) Echo mechanism, also known as the **Ping** facility. This allows sending a packet of a user selected length (we mainly use 100 or 1000 bytes) to a remote node and have it echoed back. Typically twenty measurements are taken every 30 minutes, and gathered data is uploaded from the monitoring hosts to the SLAC and the Fermi National Accelerator Lab (FNAL) central repositories once every day.



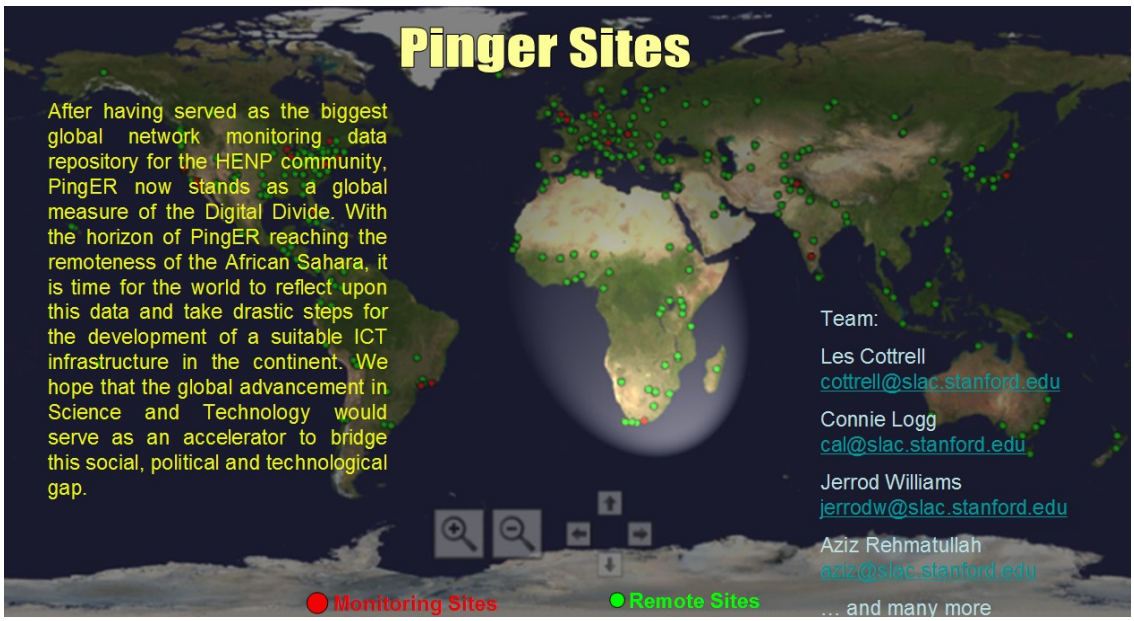

300 Remote nodes distributed in 115 countries

Ping is usually pre-installed on almost all platforms, so there is nothing to install on the clients. The server (i.e. the echo responder) runs at a high priority (e.g. in the kernel on UNIX) and so is more likely to provide a good measure of network performance than a user application.

PingER is very modest in its network bandwidth requirements (~ 100 bps per monitoring-remote-host-pair for the way we use it).

**Uses of the PingER data**

- Technical: PingER data provides a lightweight way of monitoring the throughput, loss and response times, effectively measuring the quality of a particular link with little overhead. This also provides information for setting up and auditing Service Level Agreements
- Economical: Based on the presentation of the PingER findings, a recommendation can be made to the policy/funding people to increase the bandwidth. Furthermore, if one site in a certain region can attain credible connectivity, then other sites in that region should be able to have better connectivity as well. As a troubleshooting tool, PingER can be used to discern if a problem is network related, identify the time the problem started, whether it is still occurring, and provide quantitative analysis.
- Collaboration: In order for scientists to collaborate, a certain level of link quality is required. By using PingER to measure the loss and RTT, you are able to provide expectations for the performance for bulk data transfer and other applications. In case of real-time collaboration, by comparing the results from PingER with various recommendations for loss, RTT and jitter, together with the perceptions of voice quality from the users, you can determine how well VoIP and other interactive applications might work between various pairs of sites.




For more information: http://www-iepm.slac.stanford.edu/pinger/