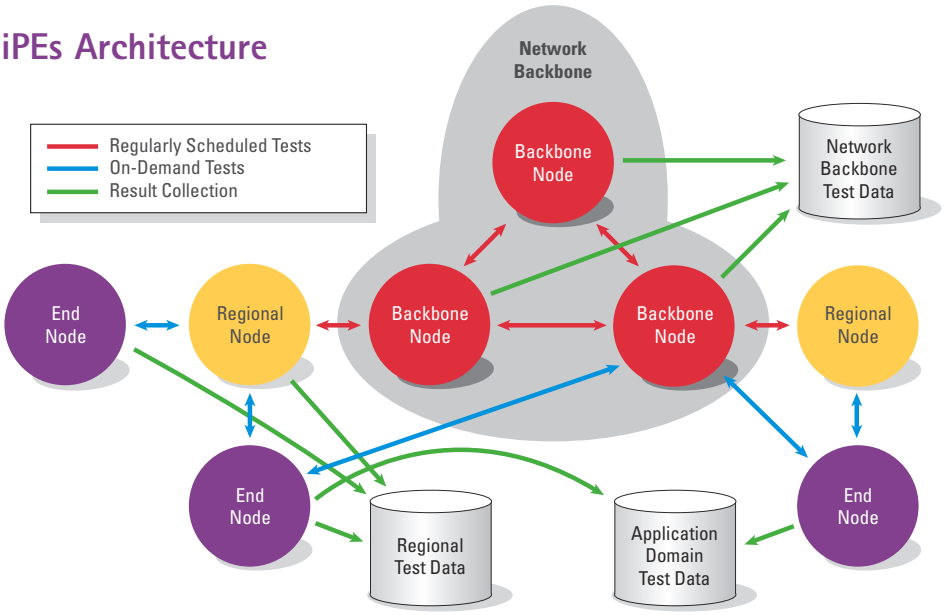
End-to-End Performance Initiative (E2Epi)

www.internet2.edu

For high-speed computing to become a reality, performance needs to be addressed. Users of state-of-the-art, 10 gigE backbone networks currently encounter many of the same problems faced by dial-up users. Internet2's E2Epi is creating a framework (E2E piPEs) for identifying the source of problems; developing measurement and troubleshooting tools; collaborating with researchers on related projects to avoid duplication of effort; and fostering communication between researchers, network operators, and end-users.

E2E piPEs Architecture



"In the ideal world, network users would have a tool that could tell a user where a problem is, what type of problem it is, and the person to contact for the resolution of the problem."

JAMES D. BRUCE
"Beyond Bandwidth," *EDUCAUSE Review*, vol. 38, no. 1 (January/February 2003): 30

E2E piPEs

e2epi.internet2.edu/ E2EpiPEs/

With Internet2's E2E piPEs, the average user will have such a tool. In its final form, the E2E piPEs can determine the performance characteristics of the complete path by aggregating information about the segments that make up the path; problematic segments can be identified and reported, with supporting data, to the appropriate network administrator. The aim of this system is to reduce the "signal-to-noise ratio."

E2E piPEs is a framework that employs various tools, such as traceroute and Iperf, to run tests to provide information on loss, jitter, flow data, one-way latency, and throughput. Data collected from regularly scheduled tests is used by the Abilene Observatory to provide weekly reports on the status of the Abilene network.

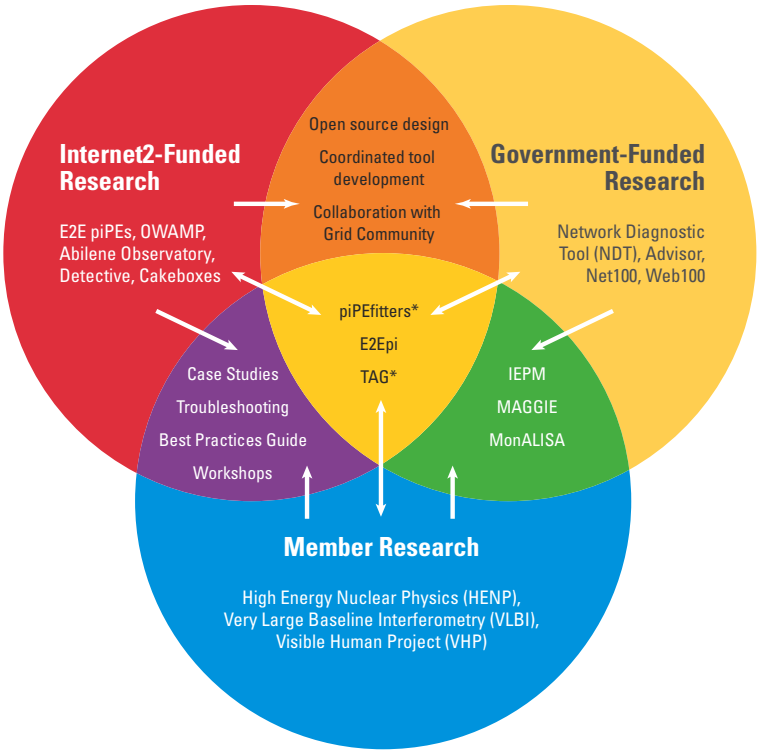
Tool Development

owamp.internet2.edu
bwctl.internet2.edu
www.itecohio.org/beacon/

The E2Epi has supported development of three tools: OWAMP (One-Way Active Measurement Protocol), BWCTL (Bandwidth Control), and the H.323 Beacon, that provide users with methods to determine the location of common end-to-end performance problems. OWAMP helps a user determine whether latency is experienced on the inbound or outbound path. The BWCTL allows the scheduling of regular and on-demand authorized throughput tests in the presence of scarce resources. These tools are used by E2E piPEs and are part of Abilene quality control.

The H.323 Beacon tool measures and monitors videoconference sessions, qualifies sessions, and can be used as a debugging tool to troubleshoot problems. This tool is used by the Internet2 Commons videoconferencing service (commons.internet2.edu).

E2Epi Collaboration



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piPEfitters: Volunteers working on specific pieces of the E2E piPEs architecture.
TAG (Technical Advisory Group): Experts who provide biweekly input on E2Epi projects.

Collaboration

Such projects as E2E piPEs and NLANR's Advisor are combining results of different measurement tools into a richer, broader, and leveraged collection of solutions for the growing knowledge base. The E2Epi has established working relationships with specific application communities (i.e., videoconferencing and multicast) and disciplines (such as high-energy and nuclear physics, radio astronomy, and health care) to help solve performance problems encountered by users. The Initiative continues to work on other Internet2-focused advanced applications, including distributed computation, digital libraries, distributed learning, digital video, tele-immersion and virtual laboratories. The E2Epi also works with such Internet2 corporate members as Apparent Networks to develop products for the Internet2 community that are appropriately tuned and provide high-performance capabilities.

Communication

Performance problems can be identified and solved more efficiently through communication—integrated and shared within an established knowledge base, using successful measurement performance stories derived from research and engineering communities. The E2Epi collects and disseminates brief case studies of problems encountered and their solutions.

The E2Epi uses their website to: disseminate these case studies; solicit member input in developing/collecting "best practices" for campus networking infrastructure and troubleshooting techniques; provide links to related documents and websites; and foster an open discussion of end-to-end performance tools, techniques, and issues (e2epi.internet2.edu).

The E2Epi has hosted several workshops on end-to-end issues, bringing together researchers, network engineers, and end-users to discuss the problems encountered and methods by which a user could be more informed. In December 2003, for example, with funding from an NSF grant, the E2Epi brought together a number of topical experts to create a "road map" of the research currently in progress and how each piece links with the others. This ensures that all the necessary measurement and performance tools are being developed and that the tools will be interoperable.

At several meetings each year, the E2Epi sponsors tutorial sessions (focusing on using the latest measurement/troubleshooting tools) and update sessions (where researchers provide status reports on related projects). The E2Epi also provides ongoing support for the Peer-to-Peer Working Group (p2p.internet2.edu) and the Measurement Special Interest Group (measurement.internet2.edu).

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