Internet2 End-to-End Performance Monitoring Initiative Update

Eric L. Boyd, Internet2

May 21, 2003

Agenda

- Motivation
- piPEs / AMI Overview
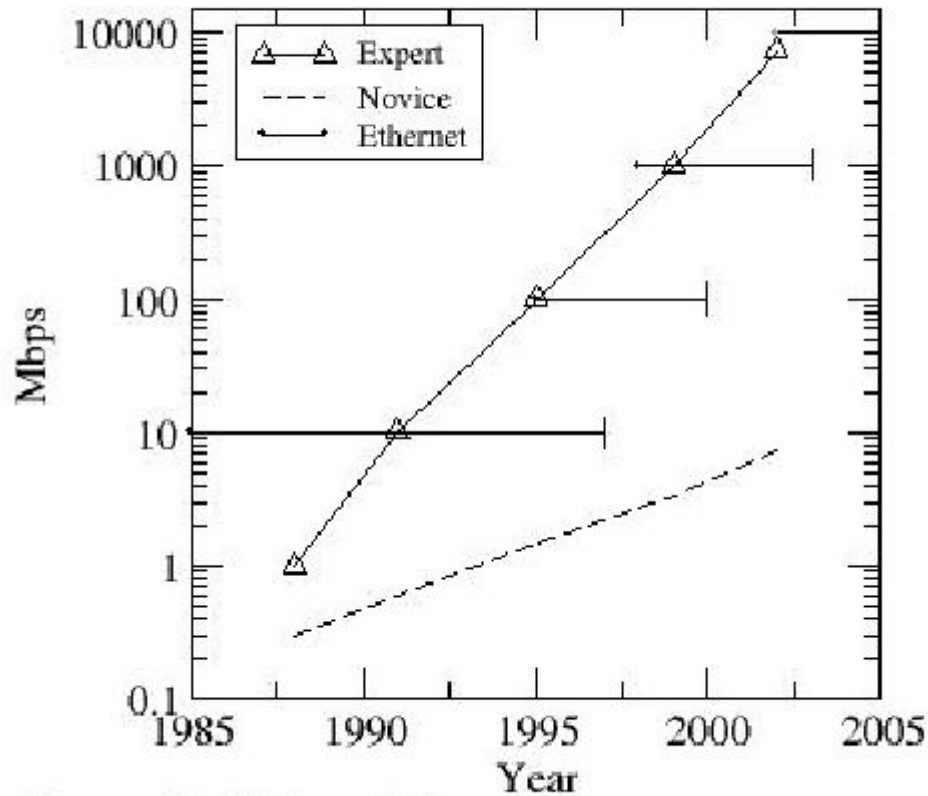- piPEs / AMI Deployment Plan
- OWAMP Release
- Demo

Even with high bandwidth network links, the Internet2 community often does not see expected performance.

Courtesy Matt Mathis, mathis@psc.edu
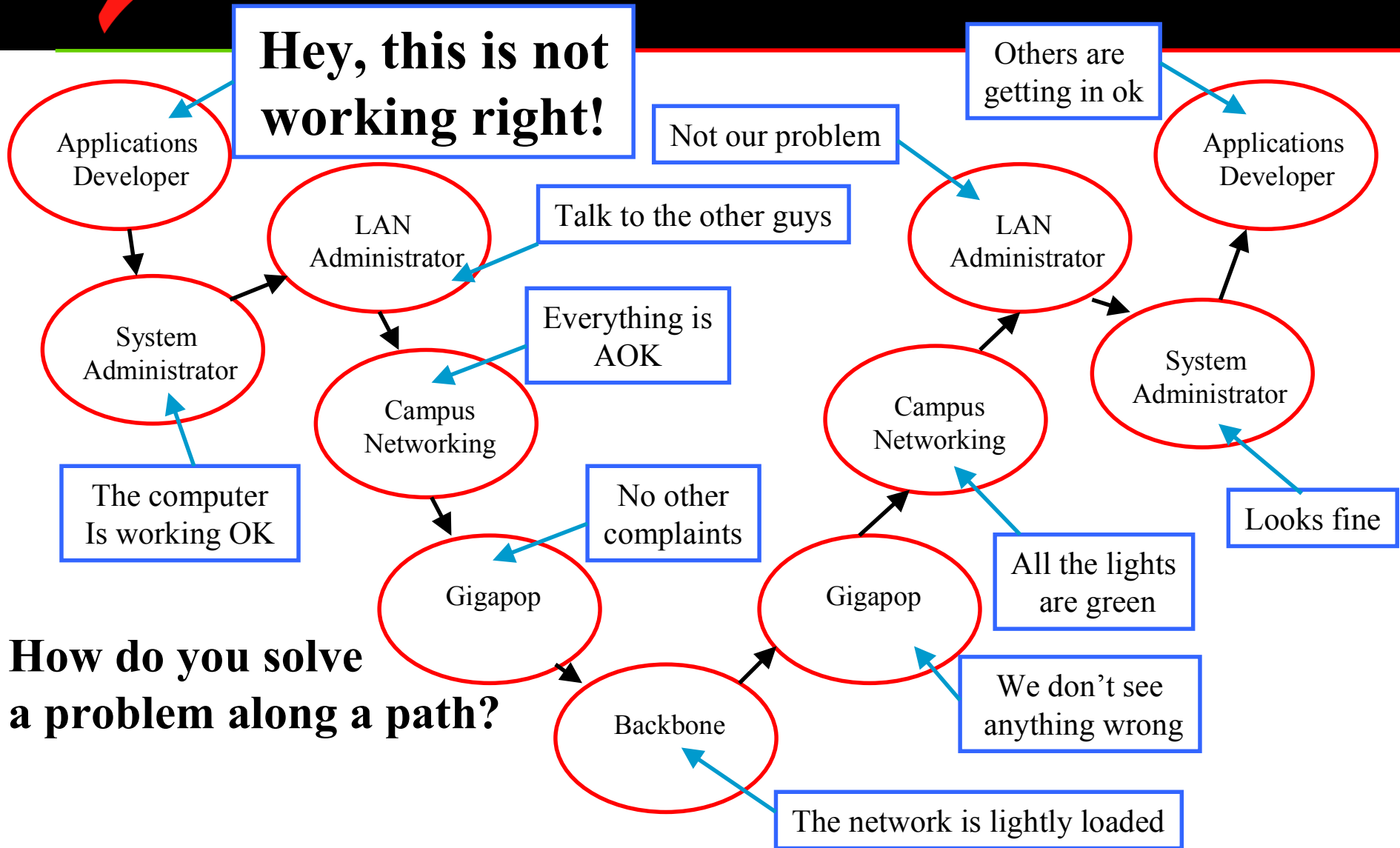
A Problem

Hey, this is not working right!

Applications Developer

Others are getting in ok

Applications Developer

Not our problem

LAN Administrator

Talk to the other guys

LAN Administrator

System Administrator

Everything is AOK

System Administrator

Campus Networking

The computer Is working OK

Campus Networking

Looks fine

No other complaints

All the lights are green

Gigapop

Gigapop

How do you solve a problem along a path?

Backbone

We don't see anything wrong

The network is lightly loaded

6/23/2003   5

Many projects and research is underway by others investigating performance on portions of the end-to-end path.

E2Epi seeks to bring these efforts together to look at the end-to-end path as a complete system.

Can You Go Direct to the Problem?

How can you tell where is the problem?

Need a tool to tell you:

- Where the problem is.
- The type of problem
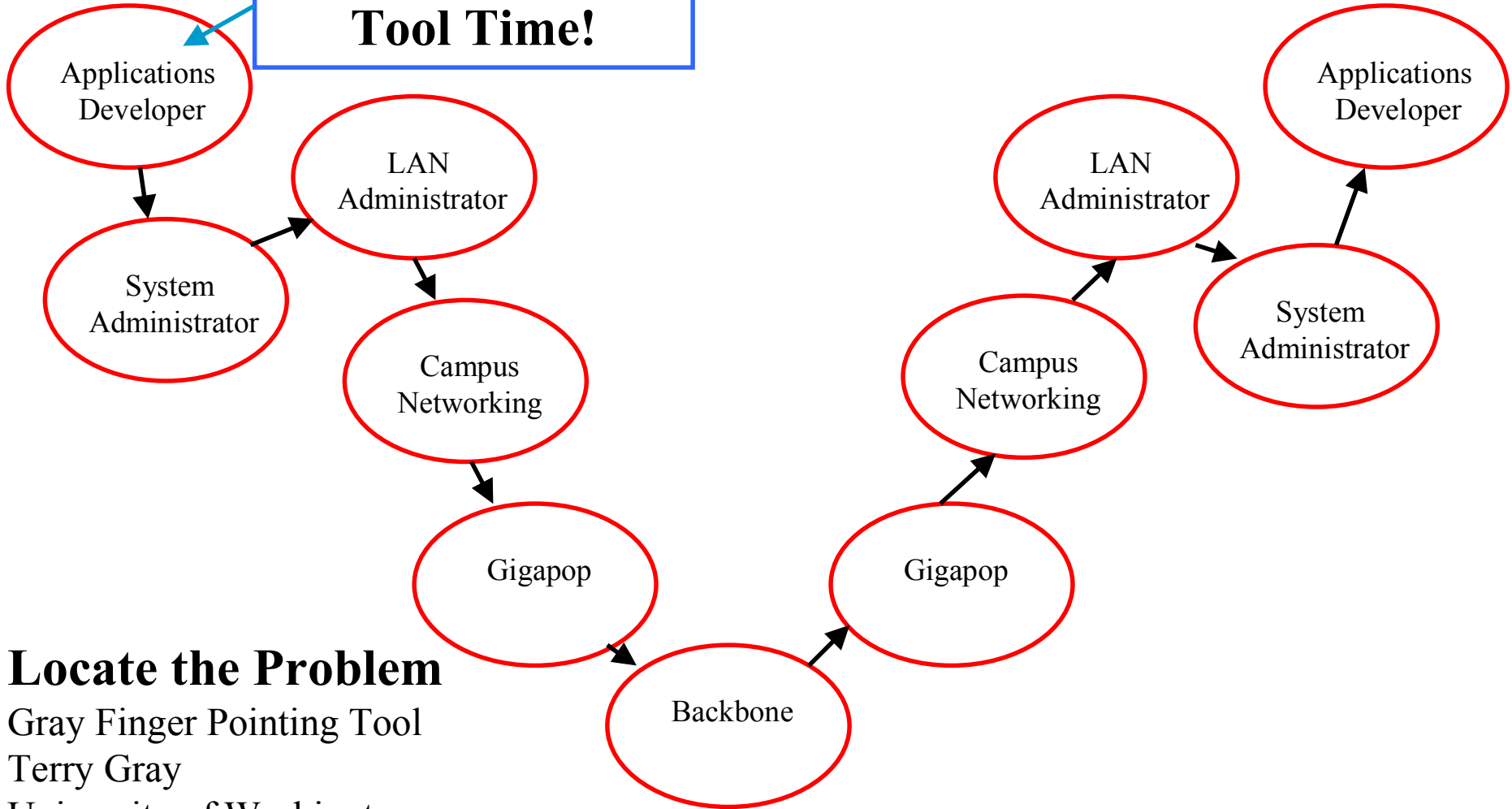- Who to contact to get it fixed

Terry Gray, University of Washington

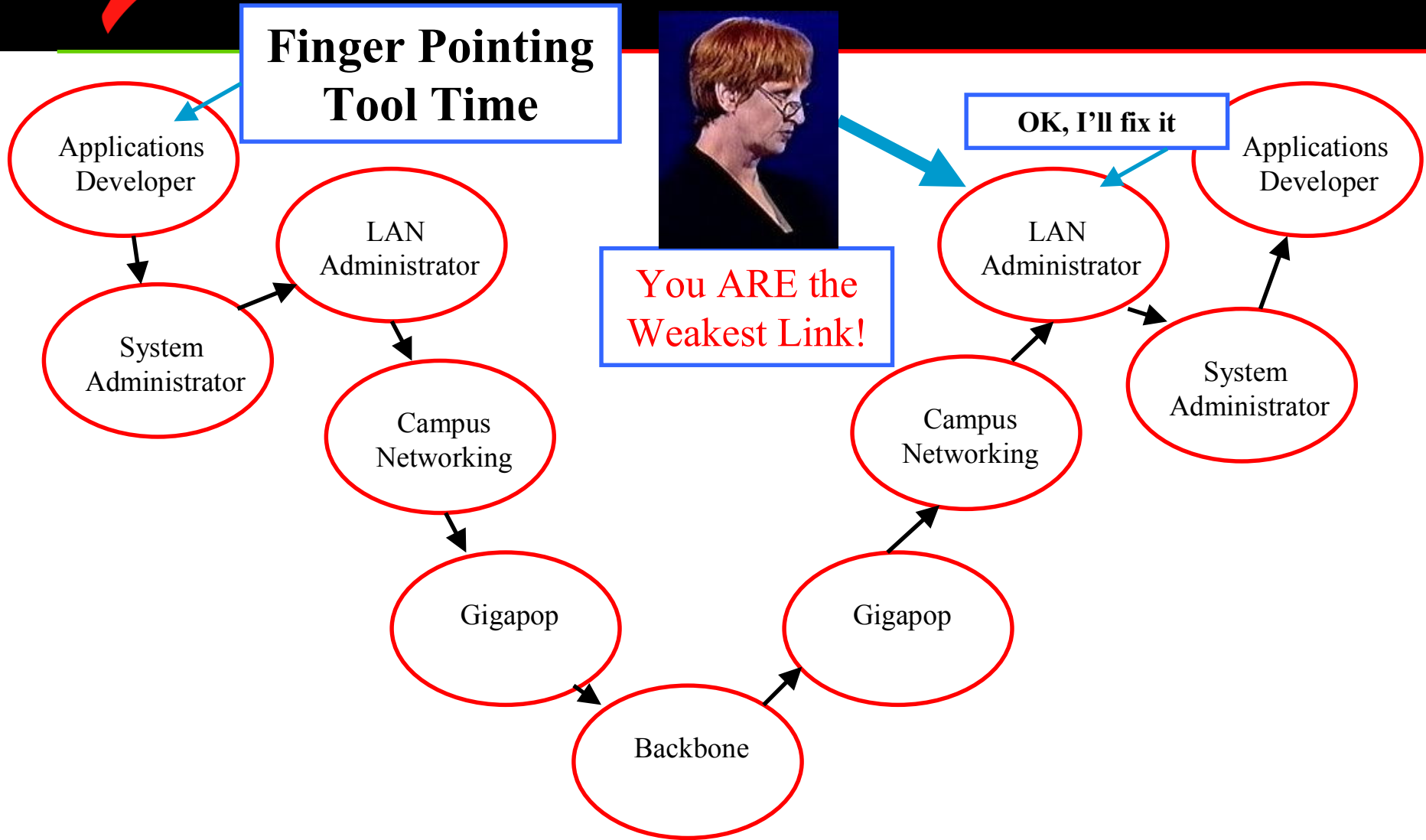"We Need a Finger Pointing Tool"

Finger Pointing Tool Time

Applications Developer

System Administrator

LAN Administrator

Campus Networking

Gigapop

Backbone

OK, I'll fix it

You ARE the Weakest Link!

Applications Developer

LAN Administrator

System Administrator

Campus Networking

Gigapop

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BNI AMI

- Project: Backbone Network Infrastructure Abilene Measurement Infrastructure

- Goal: Instrument Next Generation Abilene network with extensive performance measurement capabilities

- Approach: Collaborative project among BNI, Engineering, and E2E.

E2E piPES

- Project: End-to-End Performance Initiative Performance Environment System (E2E piPES)

- Goal: To allow end-users and network operators to determine performance capabilities, locate problems, and contact the right person to get a problem resolved.

- Approach: Collaborative project combining the best work of many organizations.
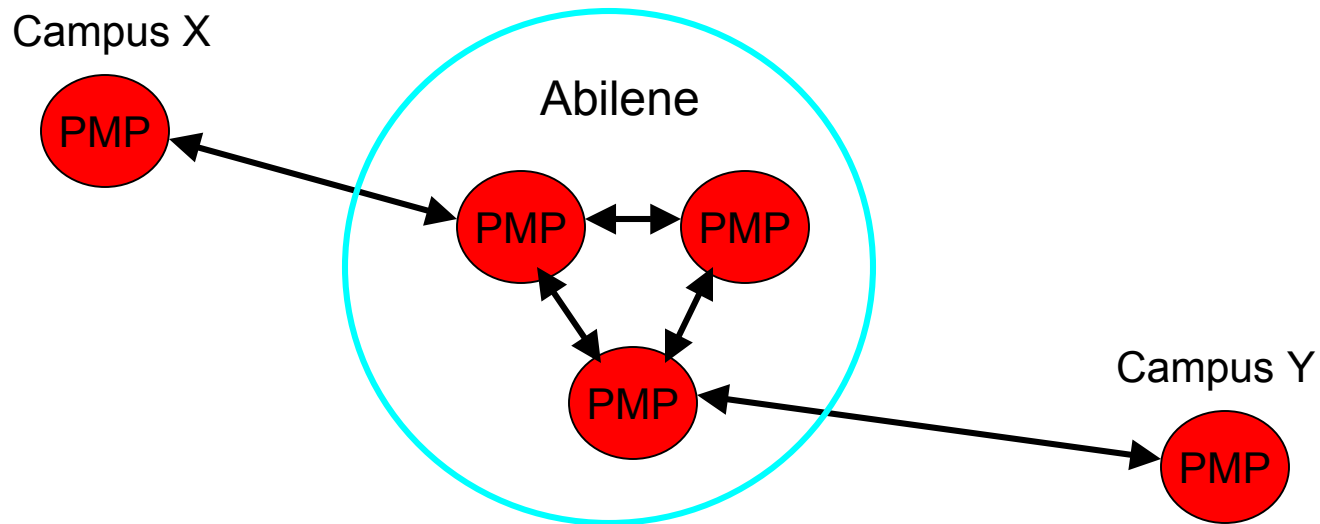
The Measurement System

The New Abilene will have measurement devices as part of its structure

Abilene
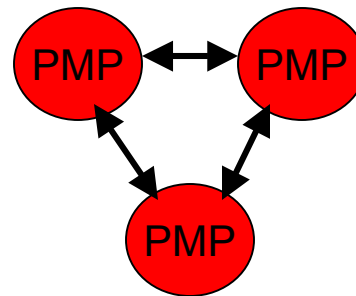
PMP = Performance Measurement Point (at each Abilene Node)

The Measurement System
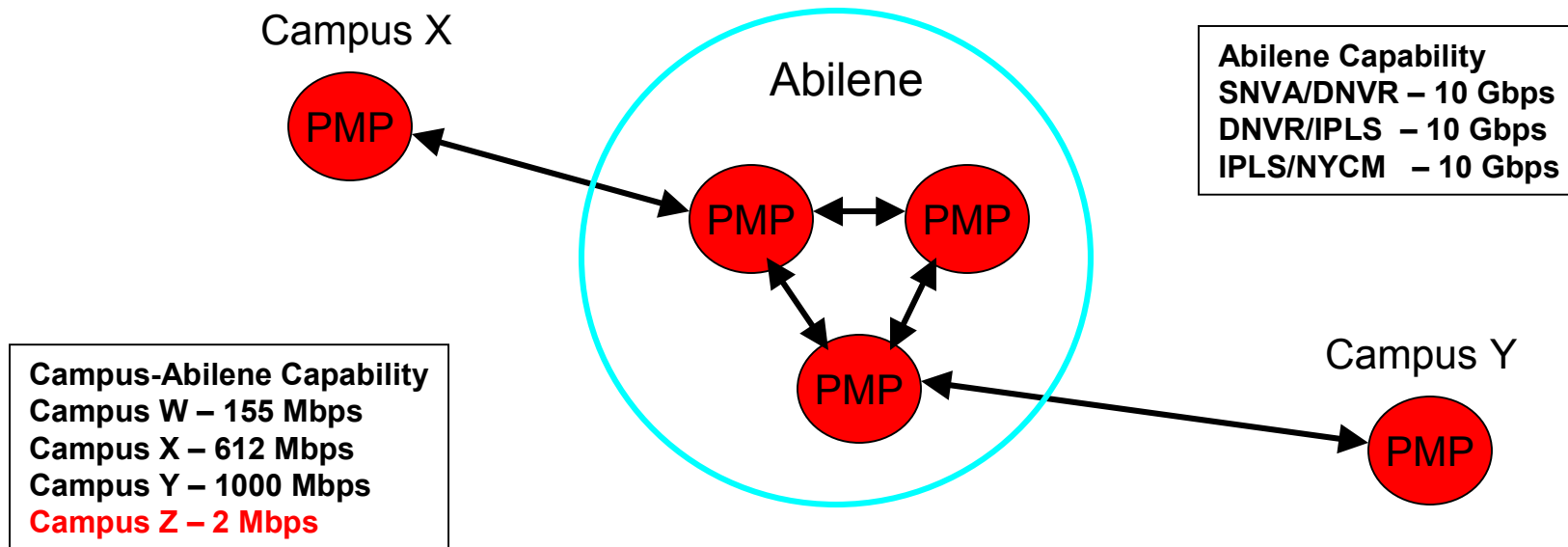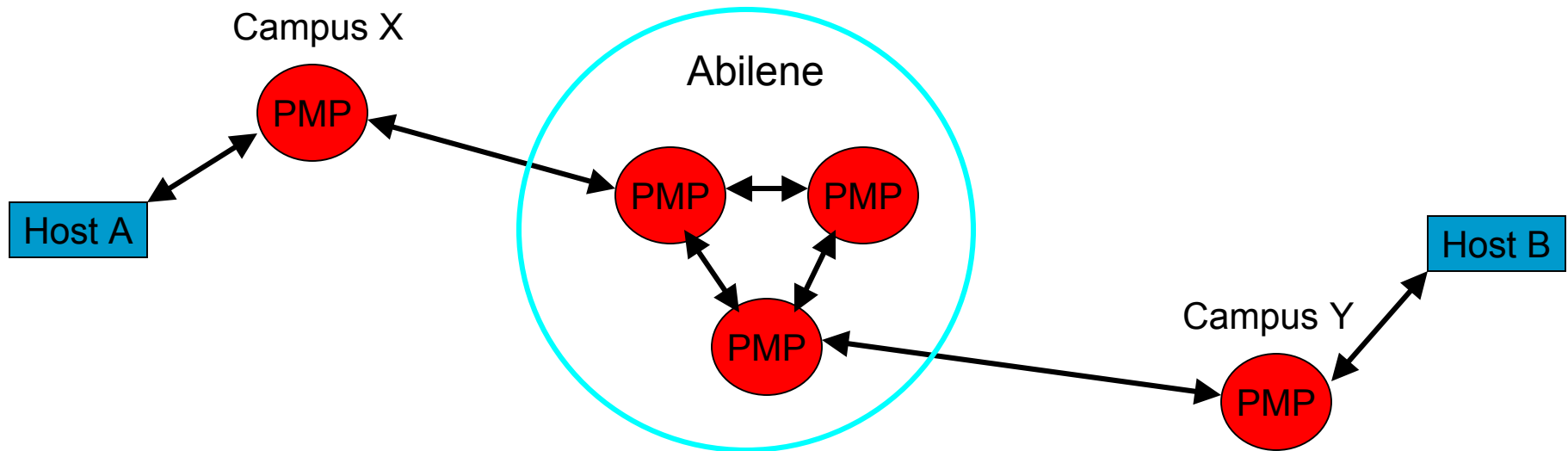
Extend the System to Campuses

PMP at each **Campus Border**

Performance Reporting

Perform regular tests to provide web based Performance
Reports across Abilene and for Campus-Abilene paths

Campus X

Abilene

Abilene Capability
**SNVA/DNVR – 10 Gbps**
DNVR/IPLS – 10 Gbps
IPLS/NYCM   – 10 Gbps

PMP

PMP ↔ PMP

PMP

Campus Y

PMP

Campus-Abilene Capability
Campus W – 155 Mbps
Campus X – 612 Mbps
Campus Y – 1000 Mbps
Campus Z – 2 Mbps

Provide a Testing Tool for the End-Users Computer to test across campus and beyond

Campus X

Abilene

PMP

PMP   PMP

Host A

PMP

Host B

Campus Y

PMP

The tool reports performance of the path to a specified destination by using active tests (like to the campus border) or using stored test results from regularly scheduled tests. It also performs tests on the host system to check host tuning parameters

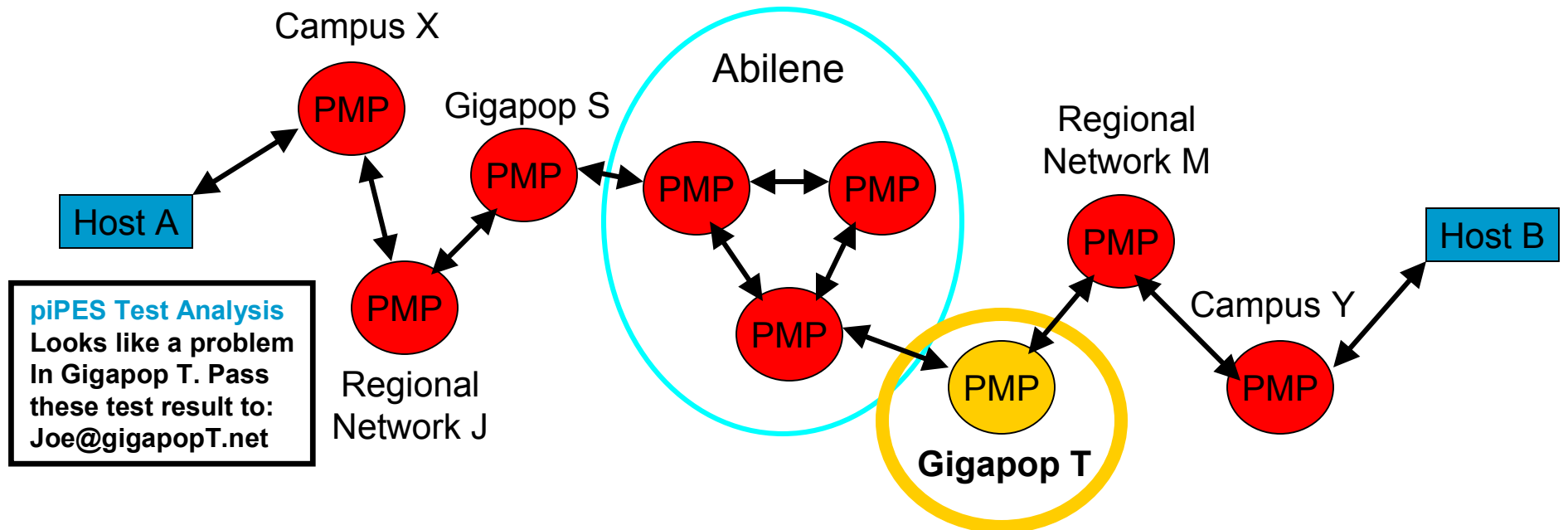## Add PMP along paths to provide additional detail
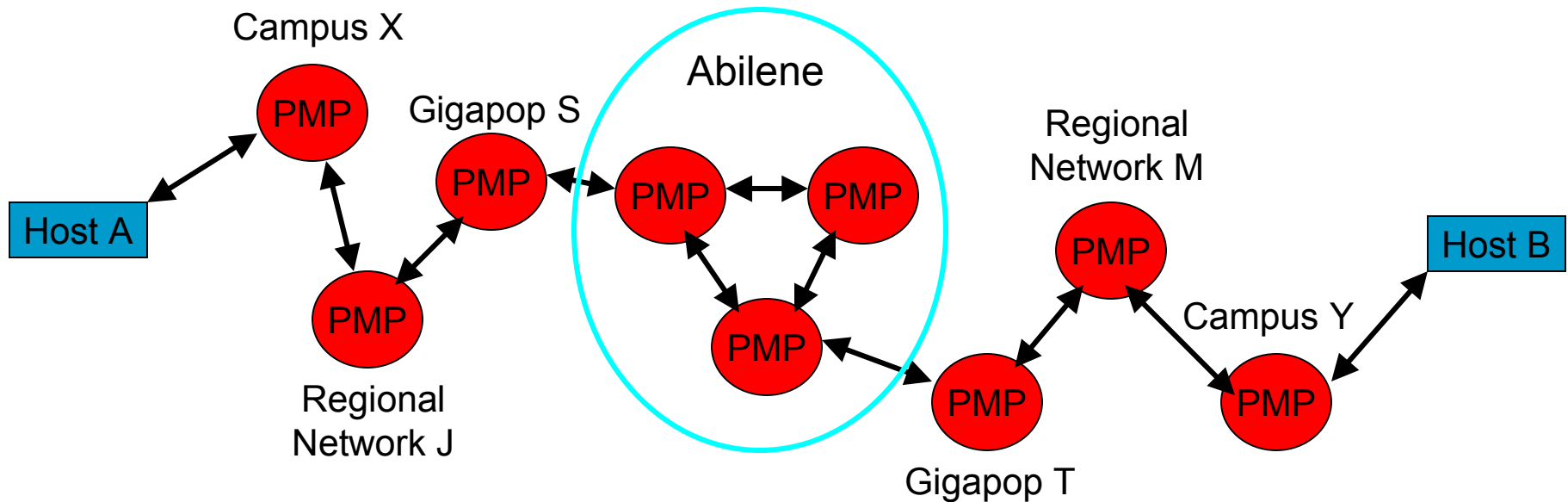
**Regular tests are performed between adjacent PMP and stored in a Data Repository.
This information is used by the End-User tool to reduce the number or active tests needed.**
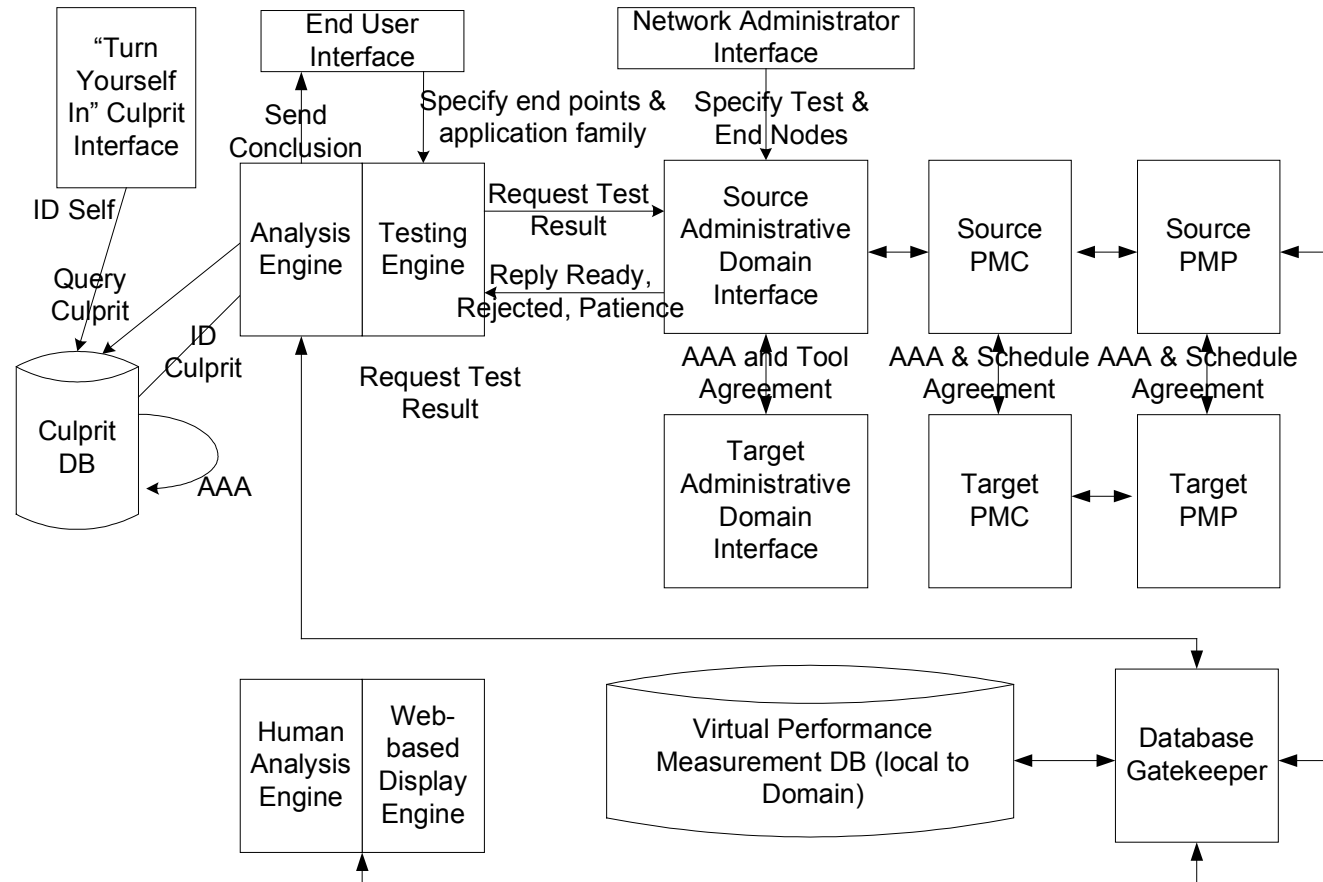
Who You Gonna Call?

INTERNET2®

E2E piPES will provide contact information when a segment in the path appears to have a problem

Campus X

Abilene

PMP

Gigapop S

PMP

Regional
Network M

PMP

PMP

PMP

PMP

Host A

Host B

piPES Test Analysis
Looks like a problem
In Gigapop T. Pass
these test result to:
Joe@gigapopT.net

PMP

PMP

Campus Y

Regional
Network J

PMP

Gigapop T

PMP

The test results obtained by the End-User will be passed on to the contact person

Testing / Analysis Engine

Problem: Encode Matt Z.'s Brain

Open Questions:

- What are measurement results are "acceptable" for a given application (family)?

- What tools generate those results?

- How do you handle incomplete data?

- How do you rank multiple result-generators?

- What is the iterative decision tree to understand E2E problem?

Measurement Types?

e.g. BW, Latency, Loss, Jitter

Measurement Units?

e.g. Seconds vs. Microseconds

Map Tools to Measurements?

e.g. OWAMP -> 1-way Latency

Measurement Metadata?

Database Table Design?

Access, Authentication, Authorization

Roles for Access

- Standard End-User?

- Near Neighbor (Test Buddy)?

- NOC Staff / Network Engineer?

Shibboleth for Implementation

- Each campus decides who in each role

- Others trust campus designation

Other R&D Issues

Design system to scale (eliminate centralization)?

How to "discover" PMPs?

How to insert On-Demand tests into Regularly-Scheduled test set

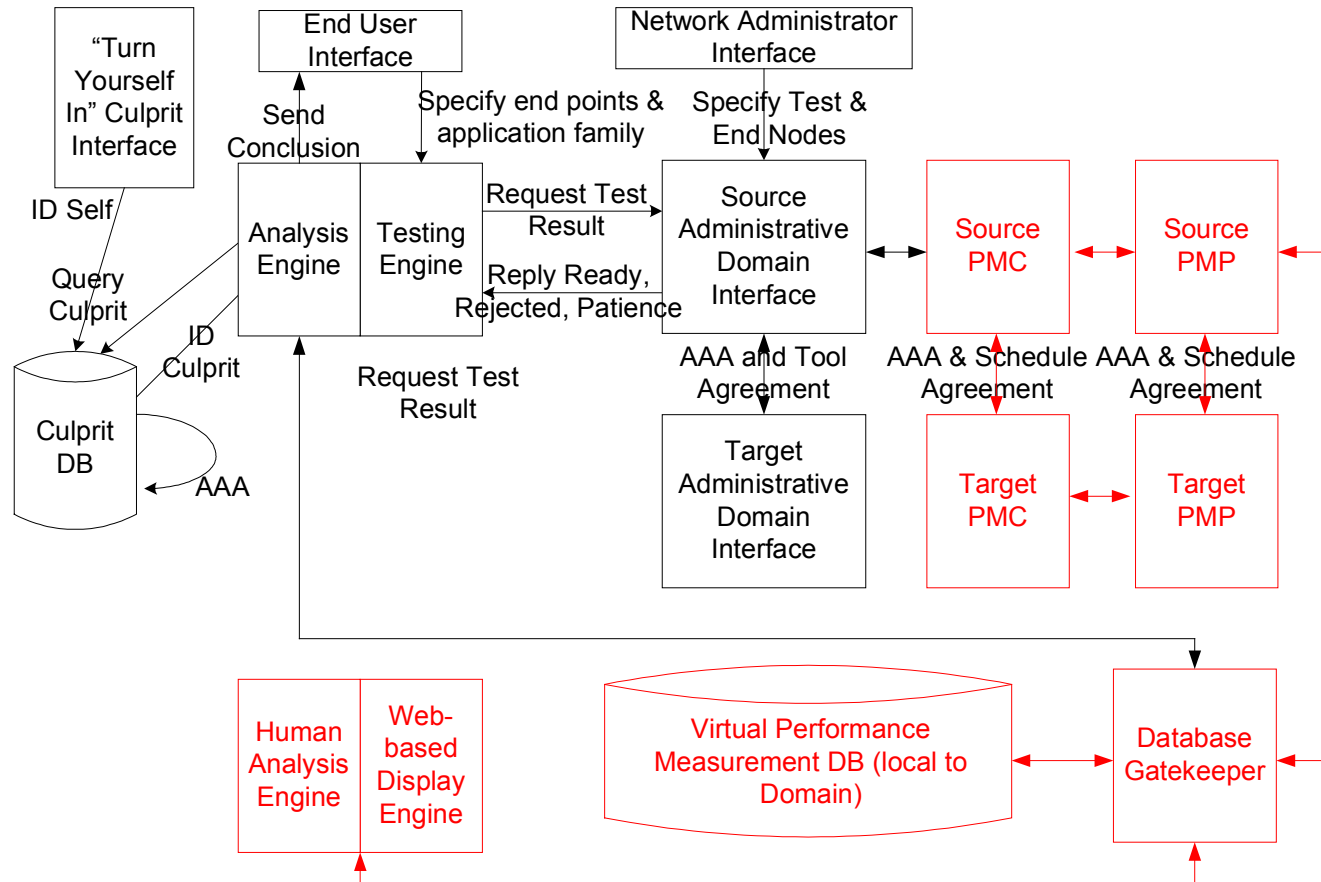Balance centralization and distributed database requirements

Agenda
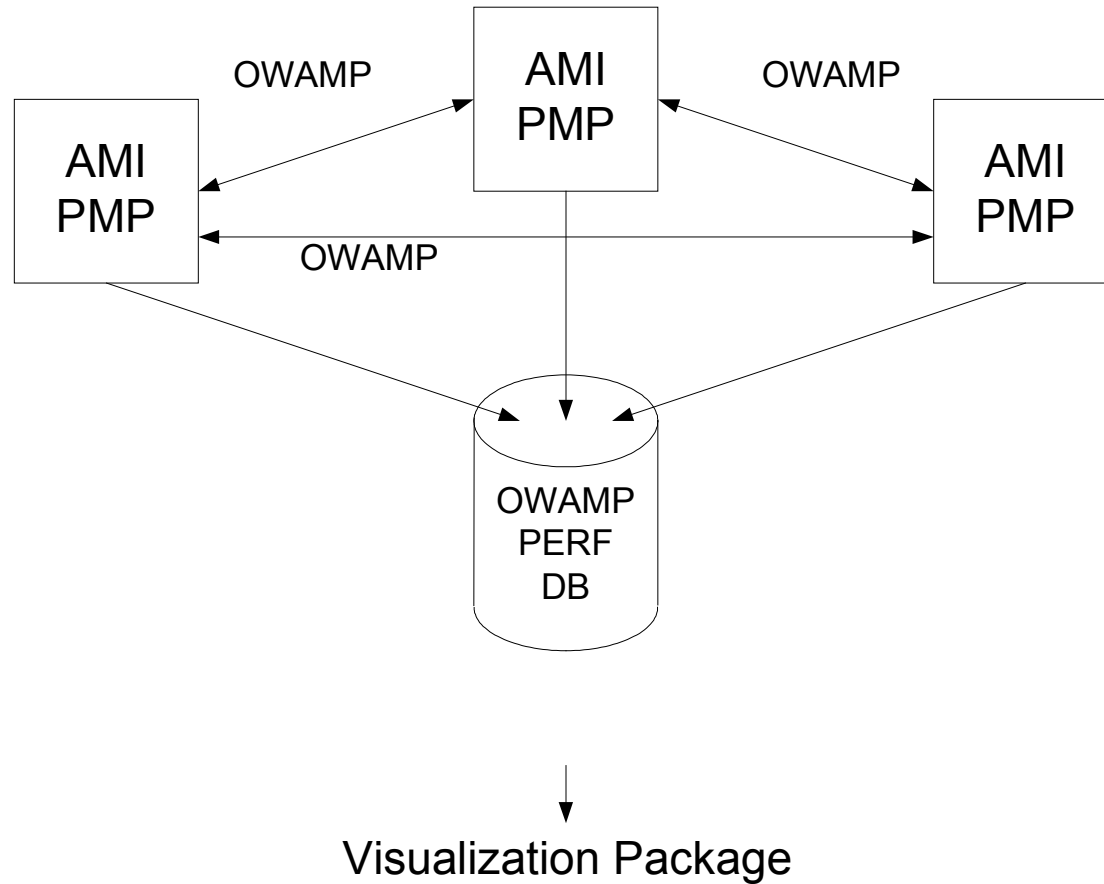
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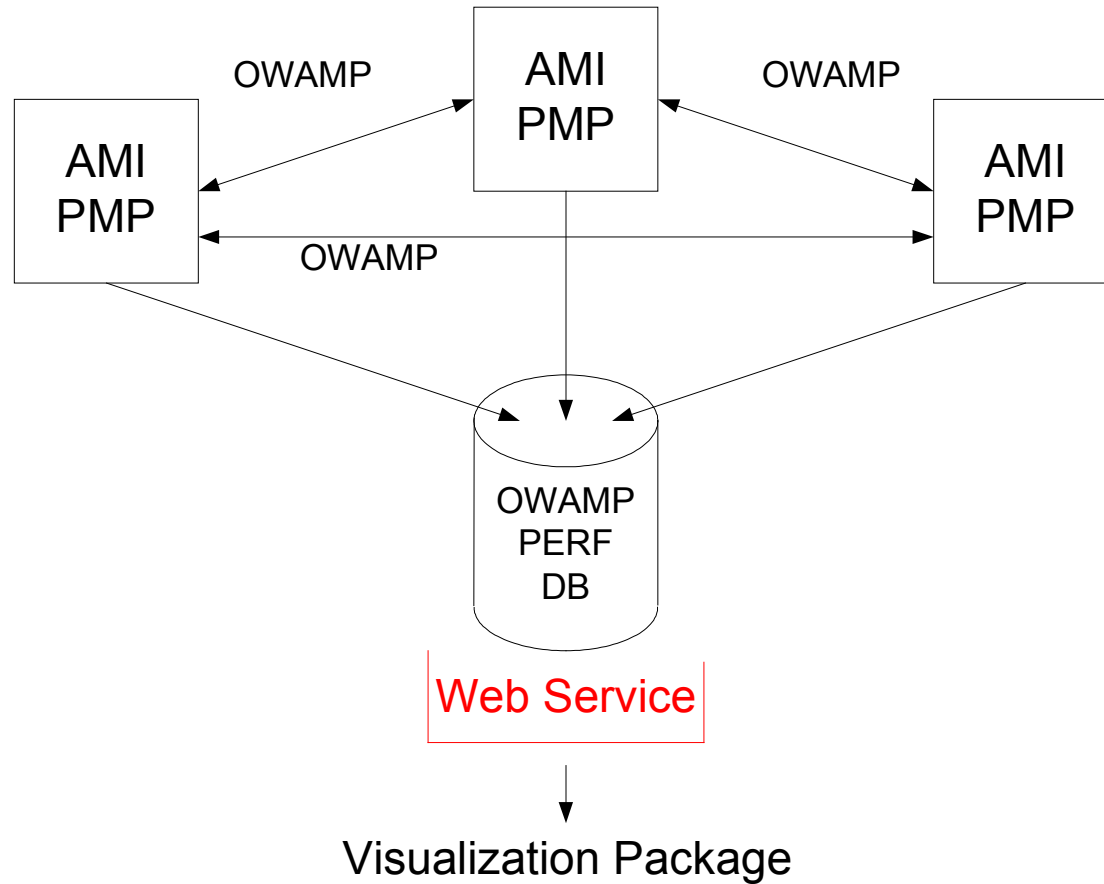
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"Turn Yourself In" Culprit Interface

End User Interface

Network Administrator Interface

Send Conclusion

Specify end points & application family

Specify Test & End Nodes

ID Self

Query Culprit

Analysis Engine

Testing Engine

Request Test Result

Reply Ready, Rejected, Patience

Source Administrative Domain Interface

Source PMC

Source PMP

ID Culprit

Culprit DB

AAA

Request Test Result

AAA and Tool Agreement

AAA & Schedule Agreement

AAA & Schedule Agreement

Target Administrative Domain Interface

Target PMC

Target PMP

Human Analysis Engine

Web-based Display Engine

Virtual Performance Measurement DB (local to Domain)

Database Gatekeeper

piPEs / AMI Rollout
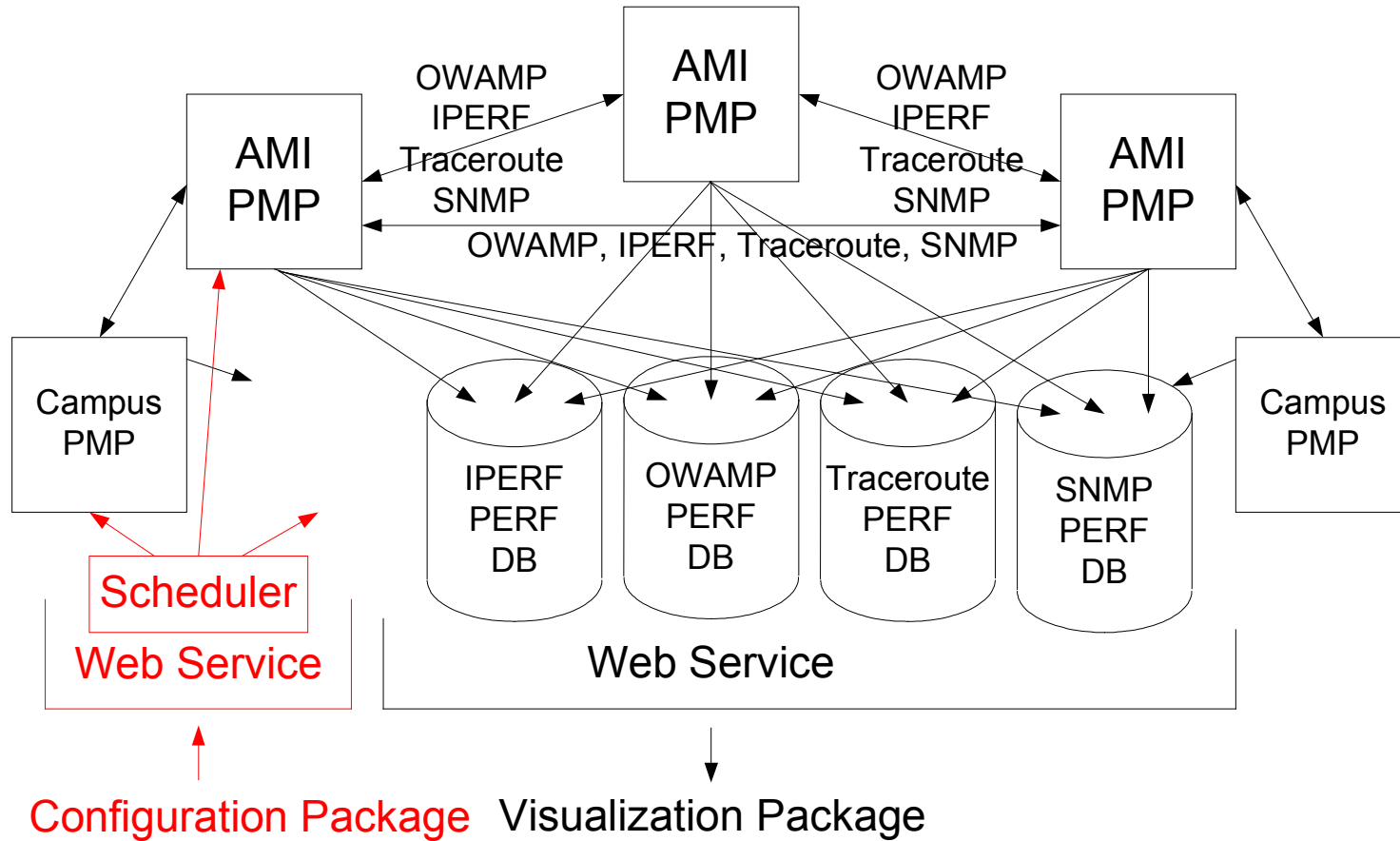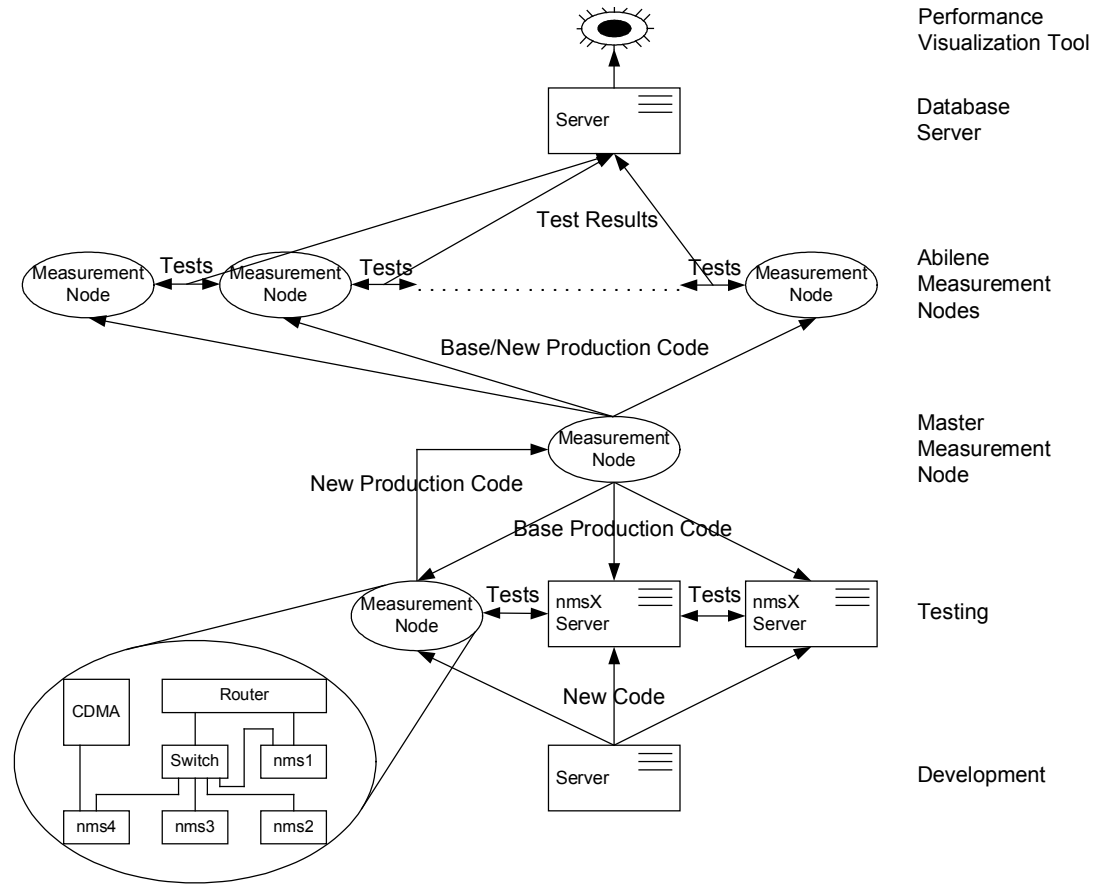
piPEs / AMI Internal Resources

Eric Boyd – piPEs development, project coordination

Jeff Boote – OWAMP, piPEs development

Prasad Calyam – piPEs development

Chris Heermann – AMI

Matt Zekauskas - AMI

Susan Evett - Documentation

Russ Hobby – Campus Deployment

George Brett – Schema, "Grid Service"

piPEs External Resources

Yee-Ting Li – UCL (50%)

Paul Mealor – UCL (up to 100%)

PhD Student – UCL (contingent on grant)

Warren Matthews – SLAC

Jim Ferguson et al – NLANR / DAST

Nicolas Simar et al – DANTE

Many early adopter volunteers

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Problem: Existing platforms are not interoperable (SURVEYOR,RIPE,…)

Solution: Standards

OWAMP

One-Way-Active-Measurement-Protocol

- Possible due to growing availability of good time sources

- Wide deployment of "open" servers would allow measurement of one-way delay to become as commonplace as measurement of RTT using ICMP tools such as ping.

- Current Draft: draft-ietf-ippm-owdp-05.txt
  - Shalunov,Teitelbaum,Zekauskas

OWAMP Implementation

Basically:

- NTP system call interface
- Multiple processes for recv/send loops
- Written as an API to allow one-off implementations

Sample implementation

http://owamp.internet2.edu/

- Beta Release:
  - No "policy"
  - No authentication/encryption
  - FreeBSD only

2 overlapping full meshes (IPv4 & IPv6)

- 11 measurement nodes = 220 ongoing tests

- UDP singletons

- Rate: 10 packets/second*

- Packetsize: (32 byte payload)*

- Results are continuously streamed back to "Measurement Portal" for long-term archive and data dissemination (Near real-time)

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More Internet2 Information

On the Web

- www.internet2.edu
- e2epi.internet2.edu

Email

- Info-e2epi@internet2.edu

Questions?