QUALIT:
QBone University and (DoE) Lab Interconnect Testbed

DoE NGI PI Meeting
Washington, DC

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QUALIT Background

- Proposal submitted in response to DoE Office of Science Notice 99-10: *Next Generation Internet—University Network Technology Testbeds*

- Two central foci of 99-10:
  - *"Deployment of advanced differentiated services technology across autonomous networks"*
  - Advanced interoperable network services along university-DoE lab paths

Basic idea

- Internet2 QBone initiative has brought togethe leading universities, gigaPoPs, and R&E networks (including ESNet) and **is working towards the same goal!**

QUALIT Overview

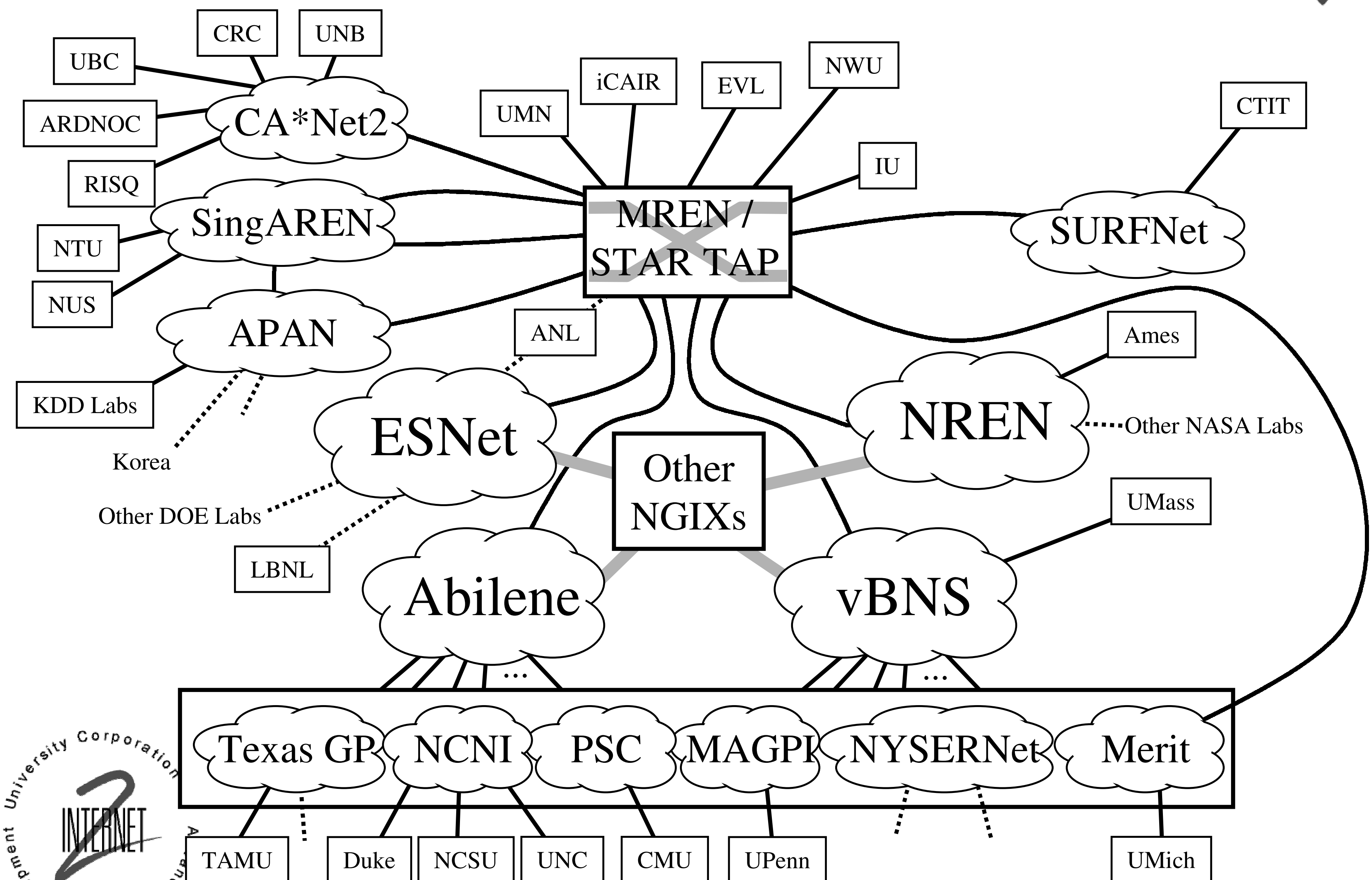
- Project-wide support for:
  - QBone engineering and planning
  - Development and deployment of the QBone Architecture:
    - QBone Measurement Architecture
    - QBone inter-Bandwidth Broker signaling protocol
  - Workshops
- Targeted support for:
  - Measurement equipment for emerging DoE/NGI testbed
  - QBone engineering and integration consultation to DoE/NGI testbed participants

Internet2 QBone Initiative

- Build interdomain testbed infrastructure
  - Balance networking research with providing a service
  - Experiment and improve understanding of DiffServ
  - Iterate and improve testbed design
- Support *intra*domain and *inter*domain deployment
- Lead and follow IETF standards work
  - Some parts of DiffServ architecture cooked; others not
  - Our experience will inform standards process

Initial QIG*

* 11 February 1999 (actual connectivity and participating networks may vary as deployment progresses)



QBone BB Group

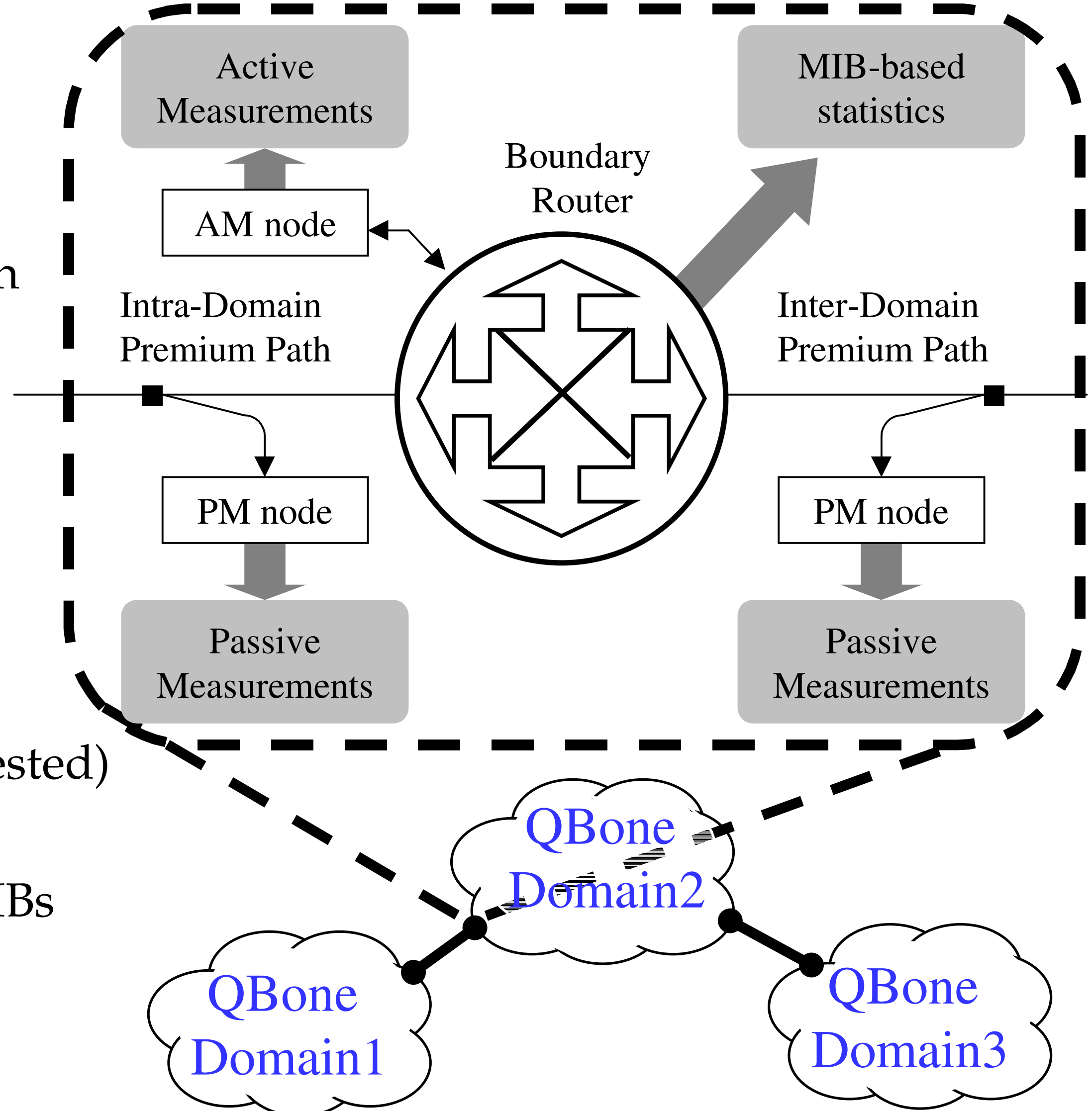
- Open group to recommend QBone BB solutions
- Led by Sue Hares, of Merit
- Current R&E proto-BB efforts:
  - Merit
  - BCIT
  - UCLA
  - Univ Kansas
  - Telia / Luleå Univ of Technology
  - Globus Scheduler
  - LBNL Clipper
- Extensive participation from corporate partners
- QBone BB requirements/protocol draft on web site

QBone Architecture

- IETF **Diff** + QBone **Serv**
  - **Diff**: Underlying building blocks on which DiffServ forwarding services are built
  - **Serv**: QBone Premium Service (QPS)
    - {**source**, **dest**, **route**, **timeSpan**, **peakRate**, **MTU**, **jitter**}
    - Near-zero loss
    - Low, bounded jitter
- Reservation Setup Protocol
  - Phase0: long-lived, manual setup, campus-to-campus extent
  - Phase1: more dynamic, automatic setup, flexible extent
- QBone Measurement Architecture
  - Uniform collection of QoS metrics
  - Uniform dissemination interface

QBone Measurement Architecture$_1$

- Collection
  - ∀ metrics, EF and BE…
  - Active metrics
    - One-way delay-variation
    - One-way loss
    - Traceroutes
    - *e.g.* IPPM Surveyors
  - Passive metrics
    - Load
    - Discards (suggested)
    - Link bandwidths (suggested)
    - EF reservation load
    - *e.g.* OCxMon, RTFM, MIBs



QBone Measurement Architecture

- Dissemination
  - HTTP, even for raw data
  - real-time + archived measurements
  - Canonical names for:
    - Metrics
    - Domains
  - Standard metric aggregations:
    - Mostly 5-minute aggregations
  - Standard URL name space for:
    - MRTG-style plots
    - Raw ASCII data
    - **http://<root_URL>/<source_domain>/<dest_domain>/<first_hop>/<date>/<type>.<aggregation>.{html | gi | txt}**

Testbed Overview

	ANL	LBNL	LANL	LLNL	SNL	SLAC	JLAB	FNAL	BNL	CIT	SDSC	NCAR	Indiana	Utah	Princeton	USC/ISI	Wisc	EVL	UIUC	NWU	UC
CorridorOne																					
Combustion																					
EarthGrid																					
EMERGE																					
PPDG																					
Xray																					
prod b	622	622	155	155	155	155	45	155	155	622	622	155	622	155	155	155	155	155	155	155	155
premium (30%	187	187	47	47	47	47	14	47	47	187	187	47	187	47	47	47	47	47	47	47	47
testbed router	Y	Y			Y	Y															
Network	E	E	E	E	E	E	E	E	E	C	C	v	A	v	v	C	M/v	M/A	M/A	M/v	M/A
Surveyor	Y					Y		Y	Y			Y	Y	Y			Y	Y			Y
AMP	Y					Y						Y		Y	Y						
OCxMON	Y																				

Source (except network): Linda Winkler

DOE/NGI Surveyor Deployments

ANL	argonne.ti (*,+)
LBNL	
LANL	
LLNL	
SNL	
SLAC	slac.doe (+)
JLAB	
FNAL	fermilab.doe (+)
NWU	
BNL	bnl.doe (+)
Abilene	all internal nodes

CalTech	
SDSC	(*)
NCAR	ncar (+)
IU	indiana.gigapop
UUtah	utah.csg (+)
Princeton	(+)
USC/ISI	
UWisc	wisc.csg
EVL	ncsa
UIUC	
NWU	
UChicago	uchicago.csg

* = also OCXmon + = also AMP

Internet2/Abilene Connectivity

- ANL
- LBNL
- LANL
- LLNL
- SNL
- SLAC
- JLAB
- FNAL
- NWU
- BNL

Caltech	CalREN2-south
SDSC	OC12 soon, now via CalREN2-south
NCAR	FrontRange, now vBNS
IU	OC3
UUtah	OC3 soon, no vBNS
Princeton	vBNS
USC/ISI	CalREN2-south
UWisc	vBNS, MREN
EVL	MREN
UIUC	MREN
NWU	vBNS, MREN
UChicago	MREN

QBone Near Future

- QBone BB Advisory Council to recommend a prototype inter-BB protocol
- "Phase 0" rollout planning
- "QCon" interoperability event: Nov-99
- DoE/NGI testbed participation (instrumentation, consultation)
- Abilene QBone deployment
- "Phase 0" interdomain testing

Testbed participation

- Work with testbed WG, measurement WG
  - Verify viability of Internet2 backbone paths
  - Align QBone measurement and DoE measurement
    - transfer technology where applicable
    - convert/modify if necessary
- Work with applications groups to examine specific paths
  - place OCXmon monitors (3) and Surveyors (4)
  - measurement reporting
  - determine any Internet2-side assistance that is helpful

Project Timeline

- 4Q99
  - Participate in working groups
  - Concentrate on two apps (likely candidates: Xray, EarthGrid, Combustion)
  - Surveyor and OCXmon placement plans
  - Measurement integration plans
  - Abilene integration plans

Project Timeline

- 1Q00
  - Place measurement machines
  - Any software development for integration with DoE measurements begin
  - Re-evaluate applications to concentrate on
  - End-to-end measurements along application paths
  - Consult where problems arise
  - Bandwidth Broker consultation

QUALIT Budget Items (Personnel)

- Senior Internet2 QoS and measurement engineers
- Consulting QoS network engineer
  - Study performance of key Internet2 univ-to-lab paths and provide consultation to networks along these paths
- QoS measurement engineer
  - Assist in design and deployment of QBone measurement architecture along key univ-to-lab paths
- Bandwidth broker coordinato
  - Leadership and architecture guidance
  - Specific focus on leveraging the ANL Globus and LBNL Clipper projects within the DoE/NGI testbed

QUALIT Budget Items (Equipment

- Database increases for new measurements
- CORAL-class passive flow measurement machines (three in FY99, one in FY00, one in FY01)
- IPPM Surveyor active measurement nodes (four in FY99, three in FY00, one in FY01)

QUALIT Budget Items (Other)

- Consulting web engineer
  - Small amount of support in FY00 and FY01 for help with web-based presentation of QUALIT measurement data
- Workshops
  - Annual joint Internet2/DoE QBone workshops to focus on university-DoE QBone connectivity issues
  - Support for materials, documentation/dissemination, & travel stipends

For more information...

- QBone home page:
  http://www.internet2.edu/qbone
- QUALIT home page:
  http://www.internet2.edu/qbone/qualit
- Internet2 QoS Working Group home page:
  http://www.internet2.edu/qos/wg

University Corporation for Advanced Internet Development