

draft-jjmb-Imap-reference- implementation-guide-00

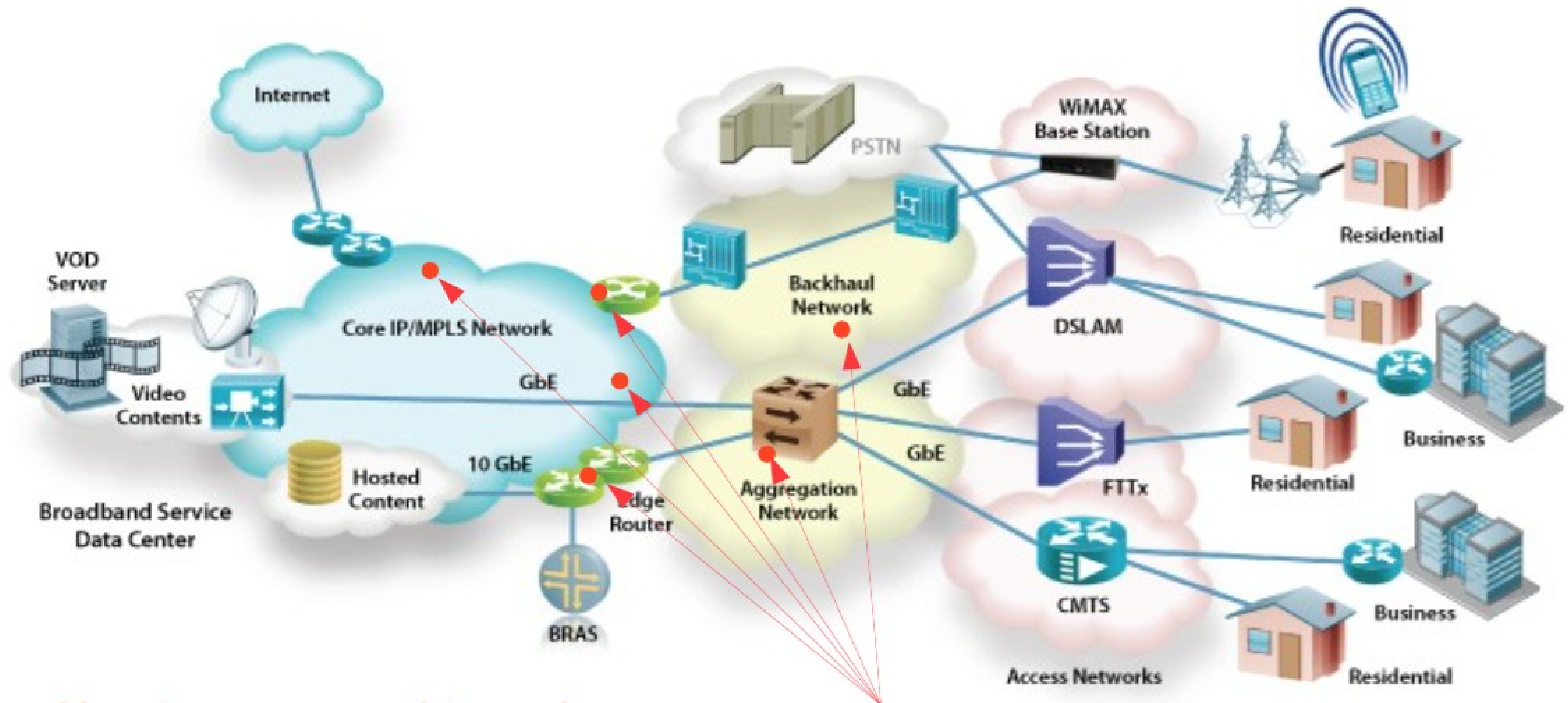
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Background

- Based on Comcast/Villanova University joint R&D that began circa 2012
- Initially developed to measure the deployment of IPv6
- Developed an extensible and scalable system to support large scale measurements
 - Developed before LMAP was formed, mainly because there was a need

Architecture

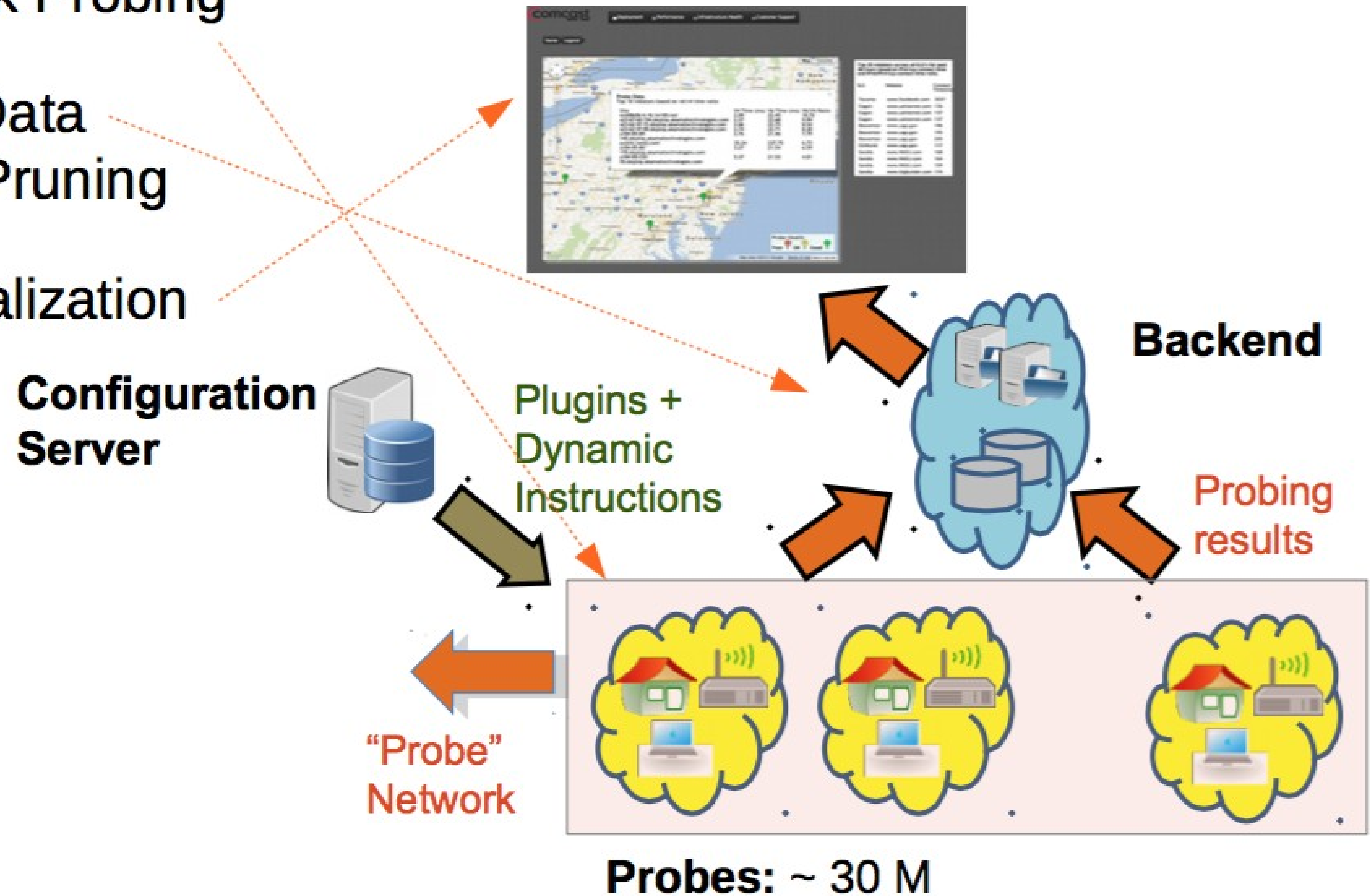


How to assess end-to-end network performance?

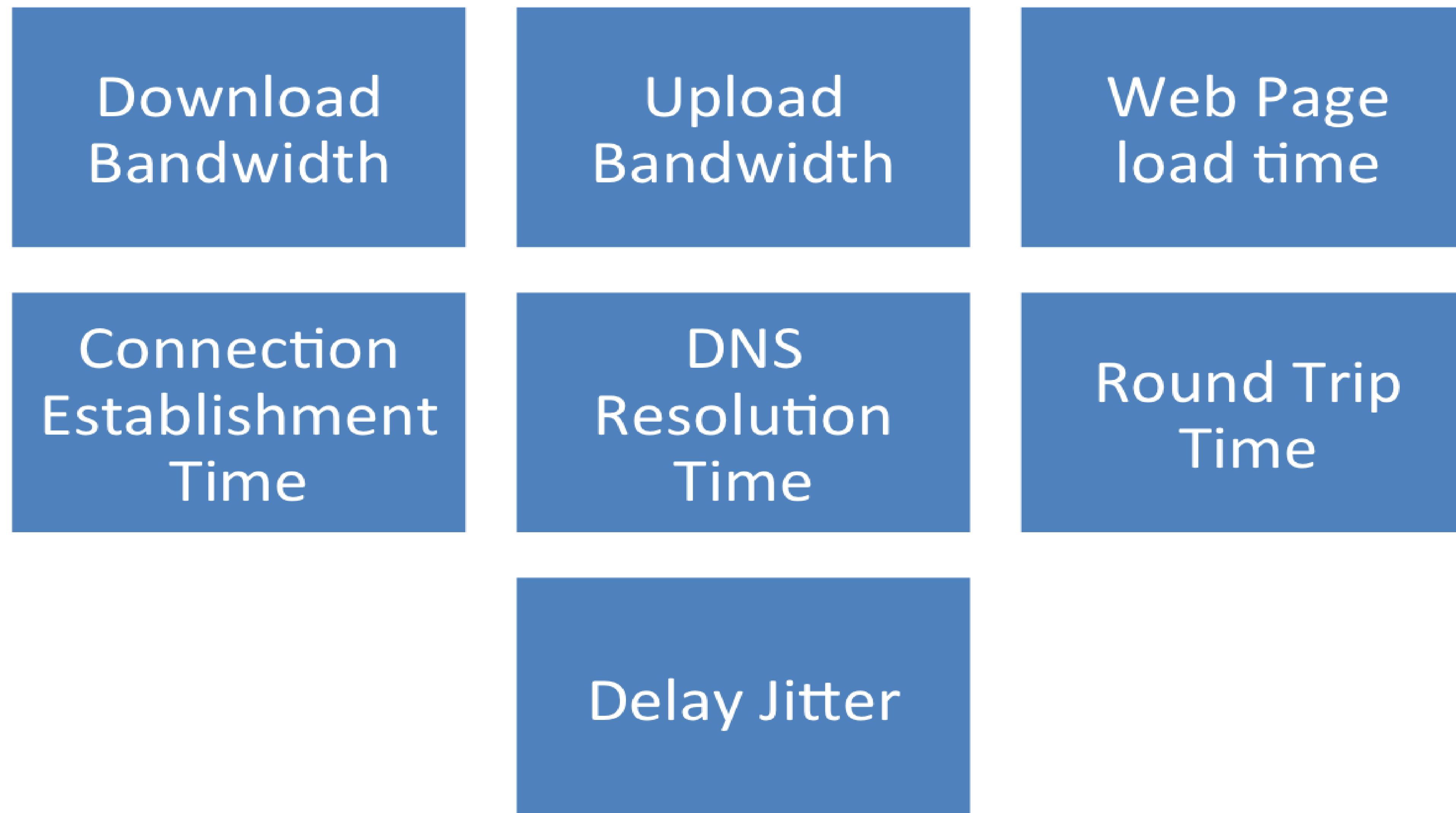
Perf data collection points

Our Network Monitoring Architecture

- Active Network Probing
- QoS Metrics Data Collection & Pruning
- Effective Visualization

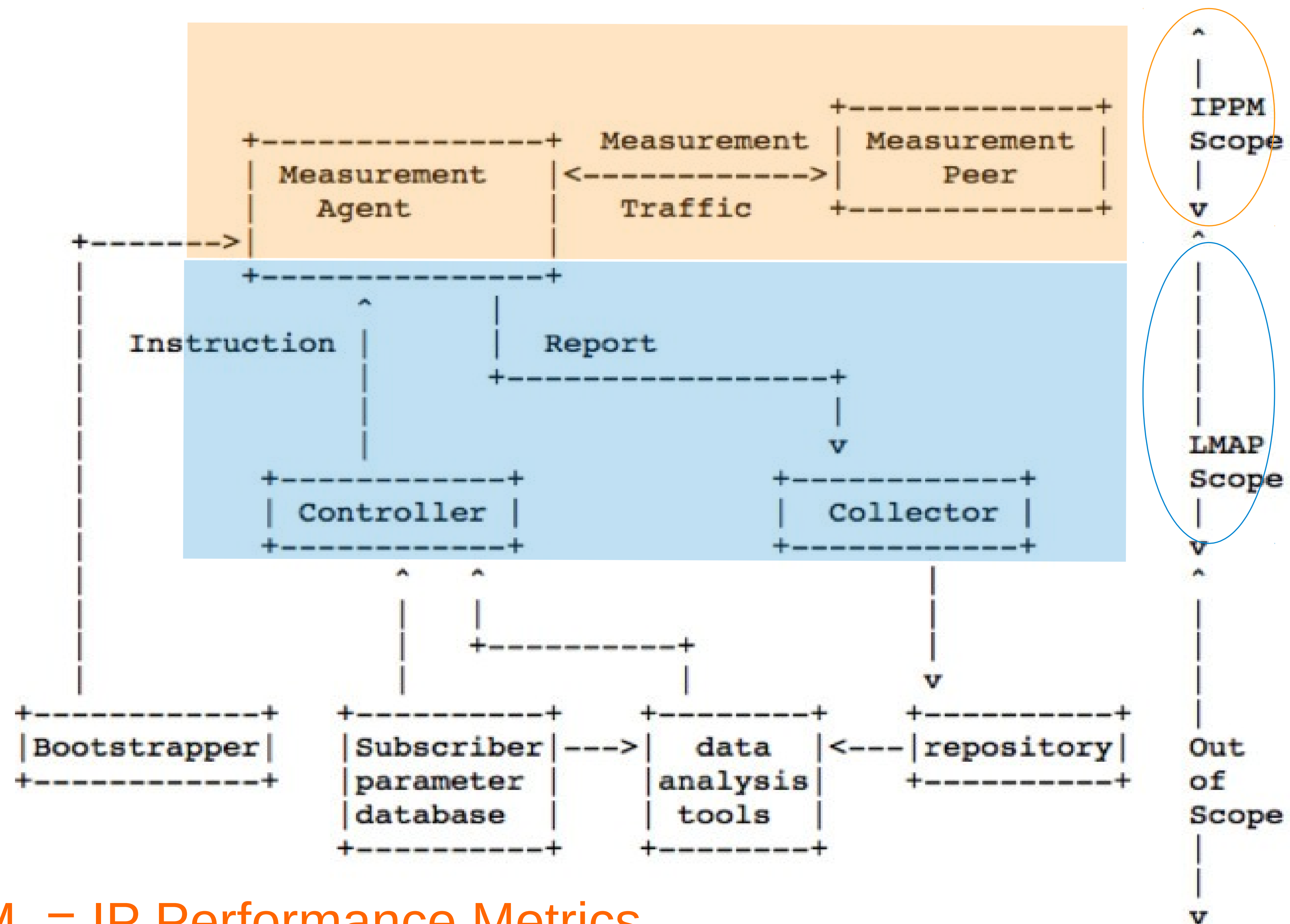


QoS Metrics Collected by Probe



▫ Distribute tests among probes, test top ~2000 servers across the world

How Our Work Relates to IETF IPPM & LMAP WG's Standardization Efforts



IPPM = IP Performance Metrics

LMAP = Large-Scale Measurement of Broadband Performance

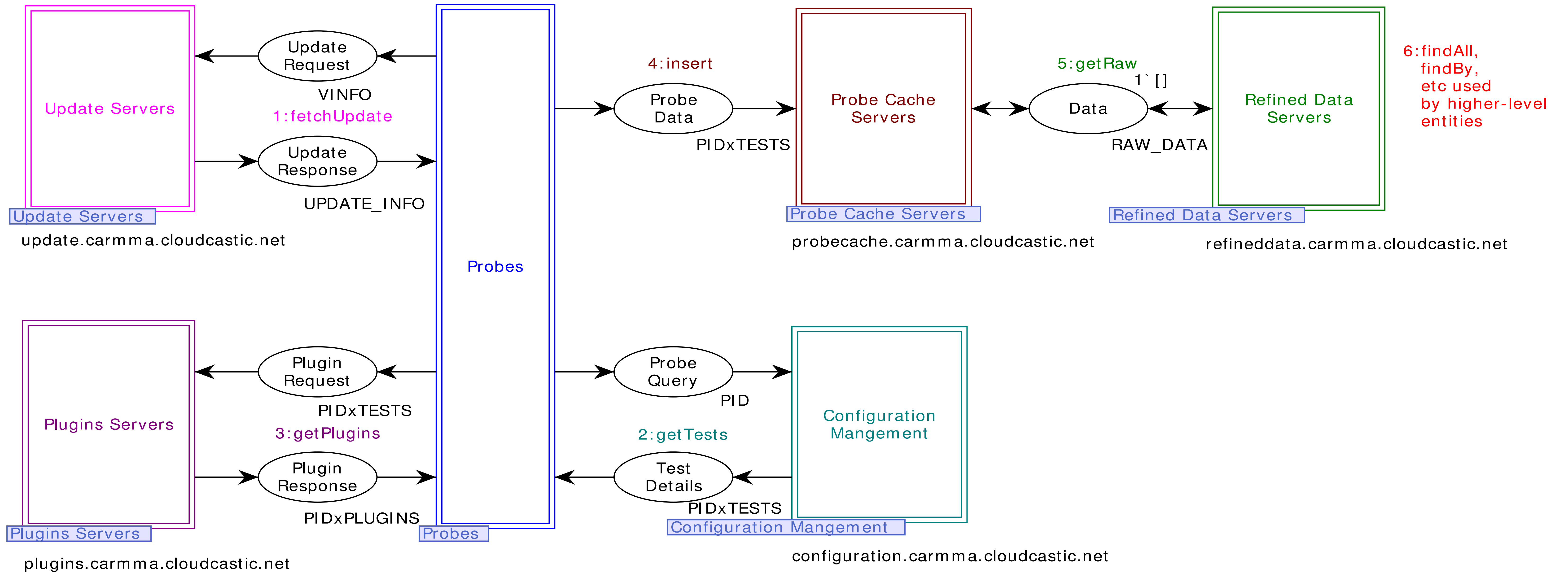
Probe Design

- Minimal resource usage on probe client
- Randomized delays to prevent DDoS
- Situation-dependent workload per probe
- Load balancing on servers easily possible
- Robust and lightweight messaging protocol

Back-end Design

- Probes in one geographical area send data to local “Collectors”
 - Fast database insertions, avoid relational databases
 - In process of scaling-up performance
- Collectors “process” data for fault patterns, fault localization
- Scrub identifying info from data, upload highly reduced (aggregated) data set to Aggregation Server
 - Aggregated data ► trend analysis, fault forensics
- Data coherence is important

Colored PetriNet Models of Probe + Back-end



Note: Multi-level nesting of functional modules is possible

Visualization: IPv6 Deployment, Region-wise

comcast
NETO - NAD

Deployment Performance Infrastructure Health Customer Support

IPv6 CMM
IPv6 CPE
IPv6 CMTS

Home Legend

Deployment Layers enabled

IPv4 Mix IPv6

49thst, PA
Adams, PA
Balacynwyd, PA
Beaverfalls, PA
Bensalem, PA
Bethelpark, PA
Blairsville, PA
Bluemountain, PA
Canonsburg, PA
Carlisle, PA
Carrolltown, PA
Centralcity, PA
Chambersburg, PA
Chestnuthill, PA
Christianst, PA
Clarion, PA
Coatesville, PA
Columbsblvd, PA
Comcastcntr, PA
Dillburg, PA

PA CMTS & Modem IPv6 Status

Category	IPv6 Status
CMTS	~25% IPv6 enabled
Modems	~75% IPv6 enabled
Modems	~95% IPv6 enabled
Leased Devices	~35% IPv6 enabled

View Connected Devices

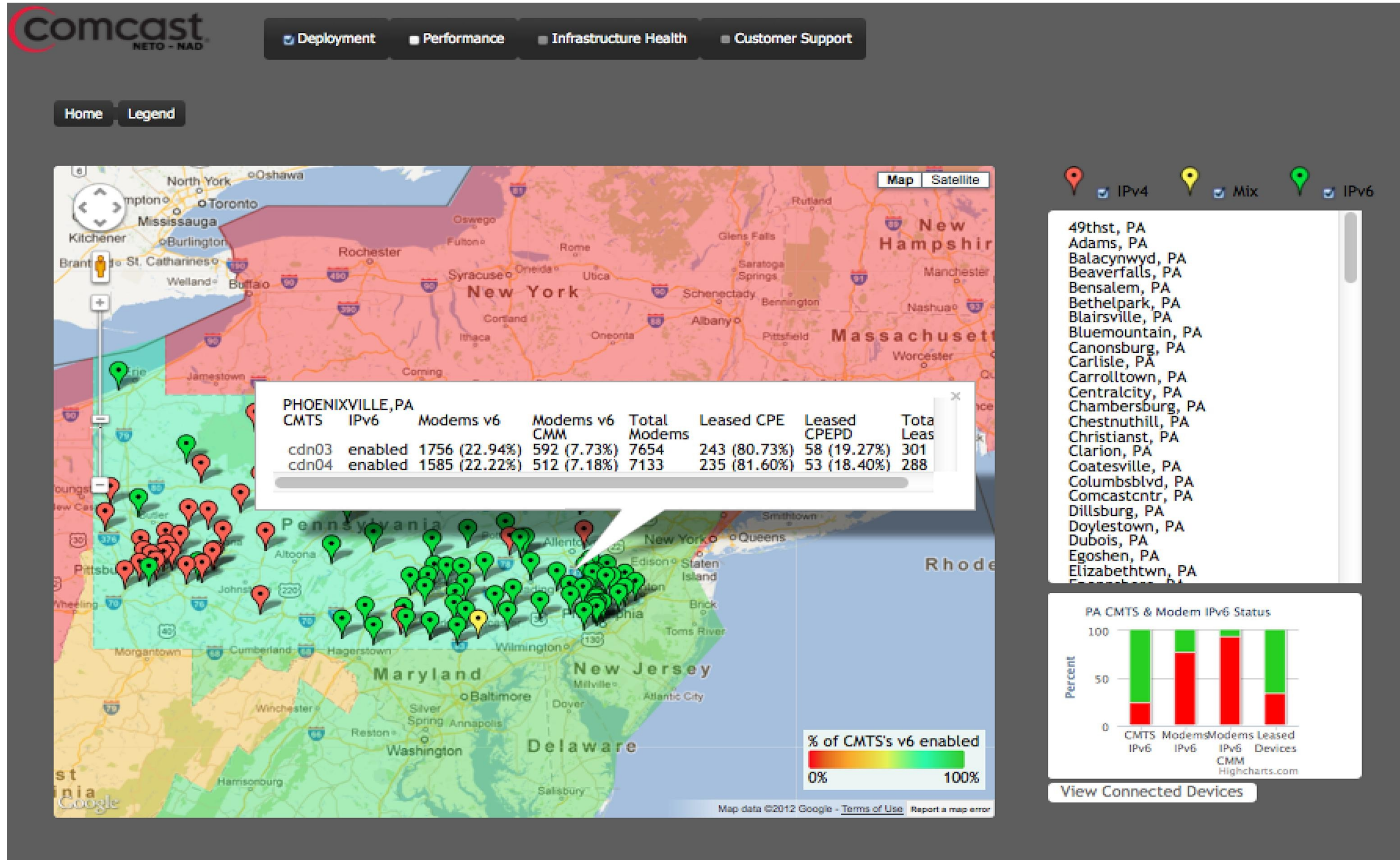
Cluster of dense deployment activity

% of CMTS's v6 enabled
0% 100%

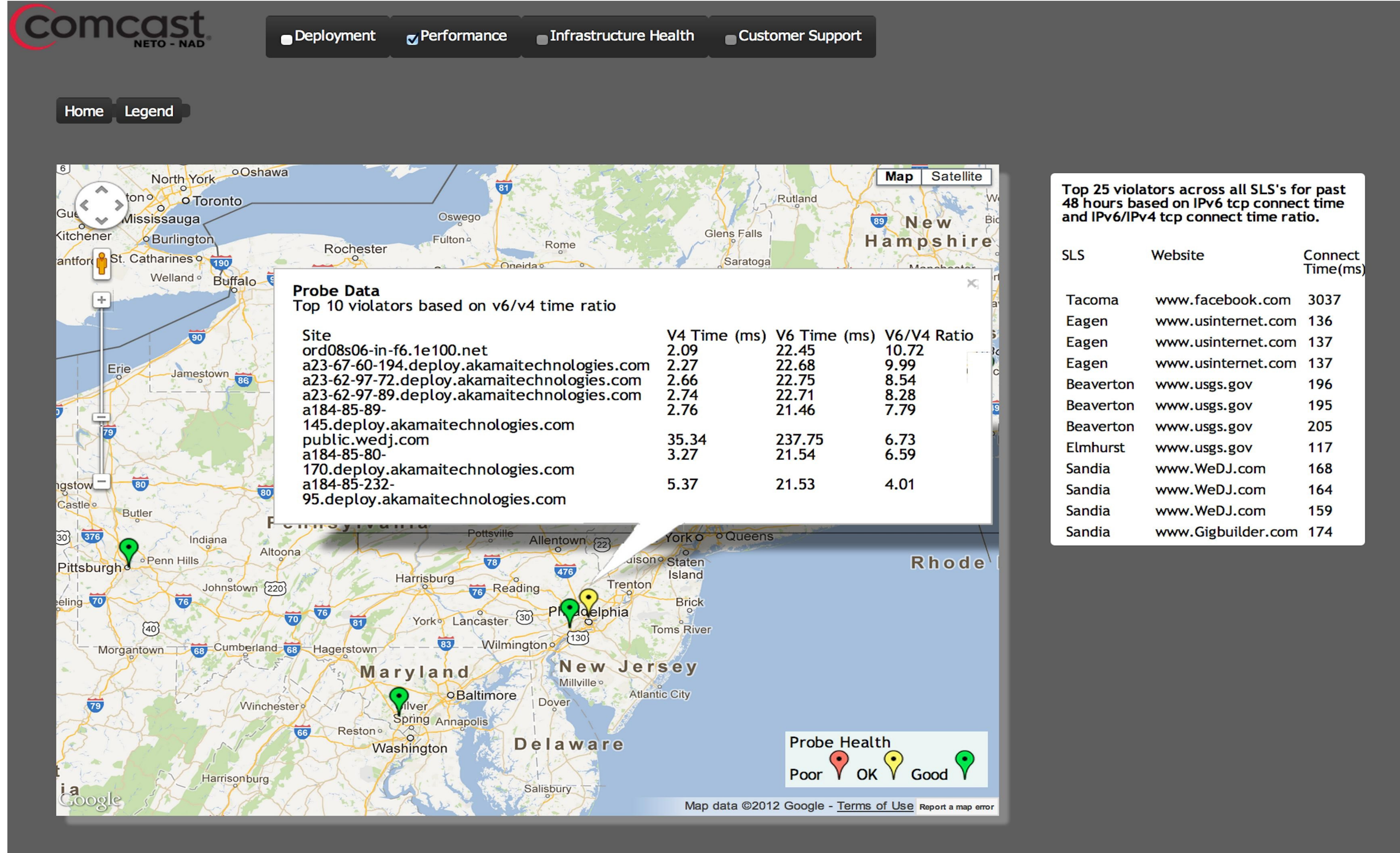
Pin color = CMTS IPv6 capability

carmma.nad.comcast.net/#

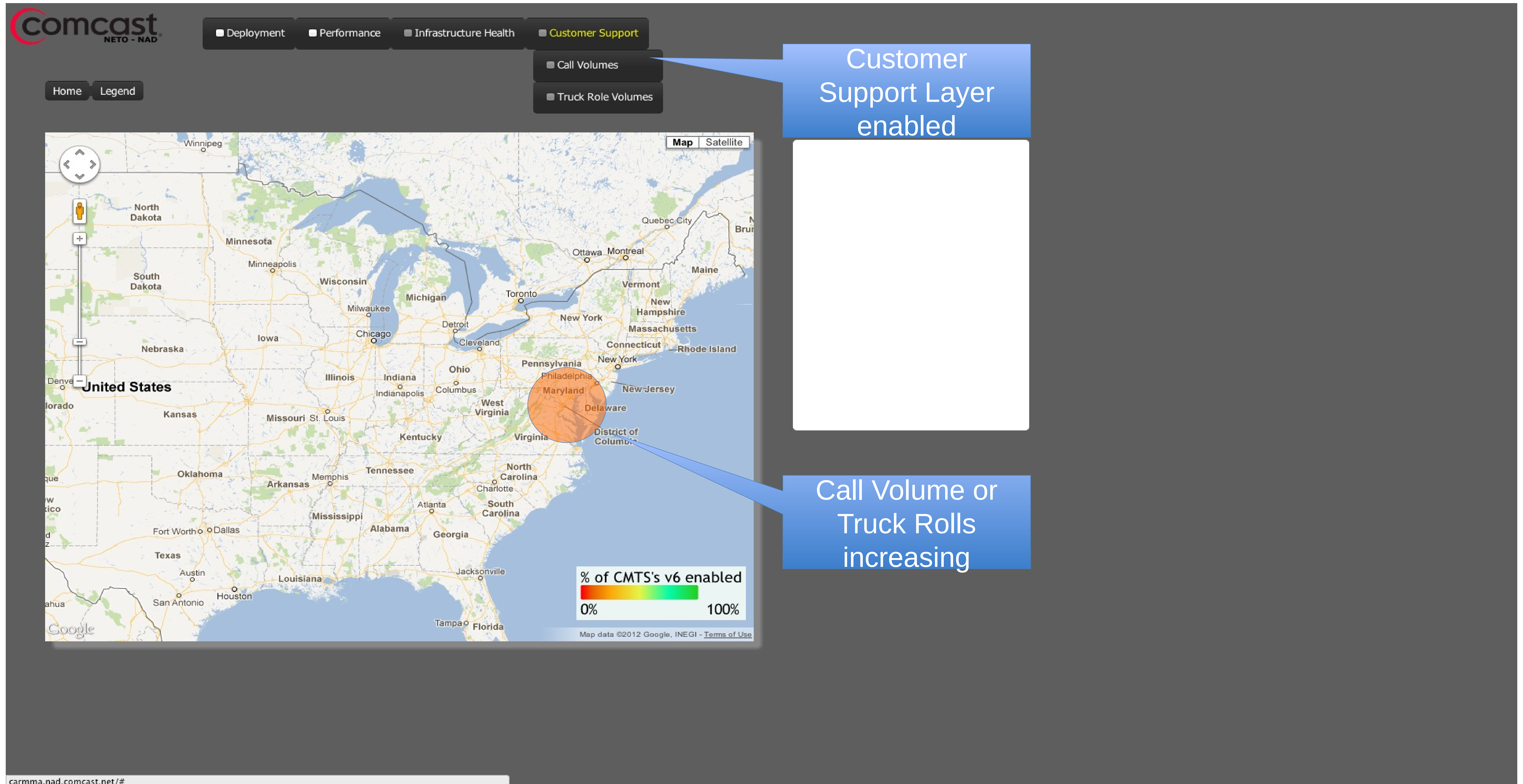
Visualization: IPv6 Deployment, Zoomed-in



IPv6 Performance: IPv6/IPv4 Site Latency Ratio



Visualization: Cust. Support – Call Volumes, Truck Rolls



Conclusion

- Architectural framework for
 - Fine-grained, end-to-end QoS measurements (bandwidth, delay, etc.)
 - Back-end support architecture for metric storage, processing and aggregation
 - Visualization front-end for presentation at multiple levels (customer service, engineering, executive functions)
- Fits-in with IPPP, LMAP broad architecture
- Can be expanded to fiber, DSL access networks, not just cable
- Proof of concept with valuable implementation lessons

Related work

- "A Scalable Architecture for Performance Measurement in Broadband Networks", IEEE Conference on Standards for Communications and Networking (CSCN)", October 2015

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