QoSient LLC
Measuring Assessing and Managing QoS

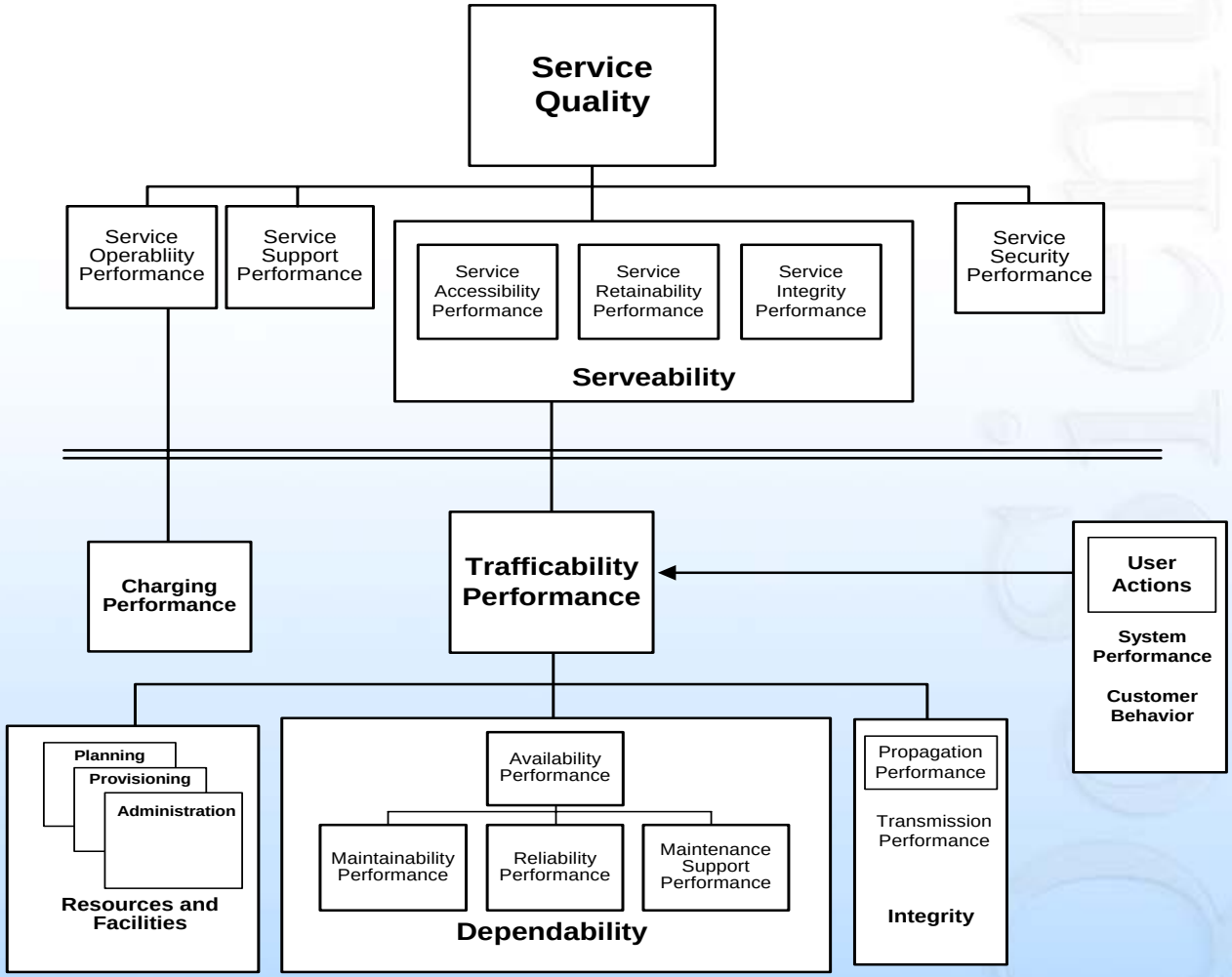
GIG EF
Global Information Grid
Evaluation Facilities

Distributed QoS Monitoring
High Performance Network Assurance

Carter Bullard

FloCon 2005 Pittsburgh, PA

ITU Network Service Quality Taxonomy



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From ITU-T Recommendation E.800 Quality of Service, Network Management and Traffic Engineering

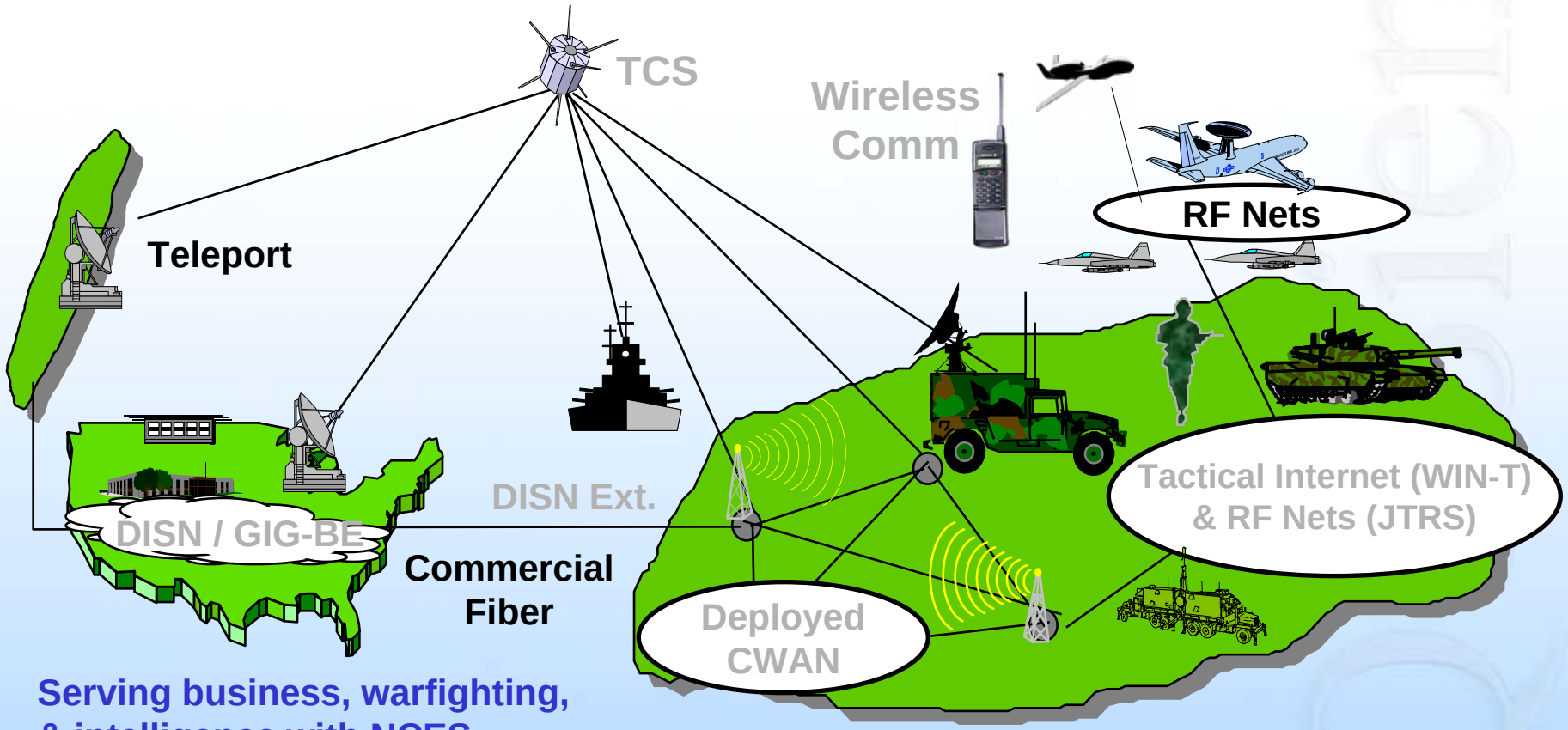
Approach

- Adopt PSTN TMN Usage Strategies
  - Service Oriented Metering
  - Integrated Measurement
  - Establish Comprehensive Transactional Audit
  - Near Real-Time Accessibility
- Extend PSTN Model for Internet Networking
  - Internet Transactional Model
  - Distributed Asymmetric Network Monitoring

Comprehensive Data Network Accountability

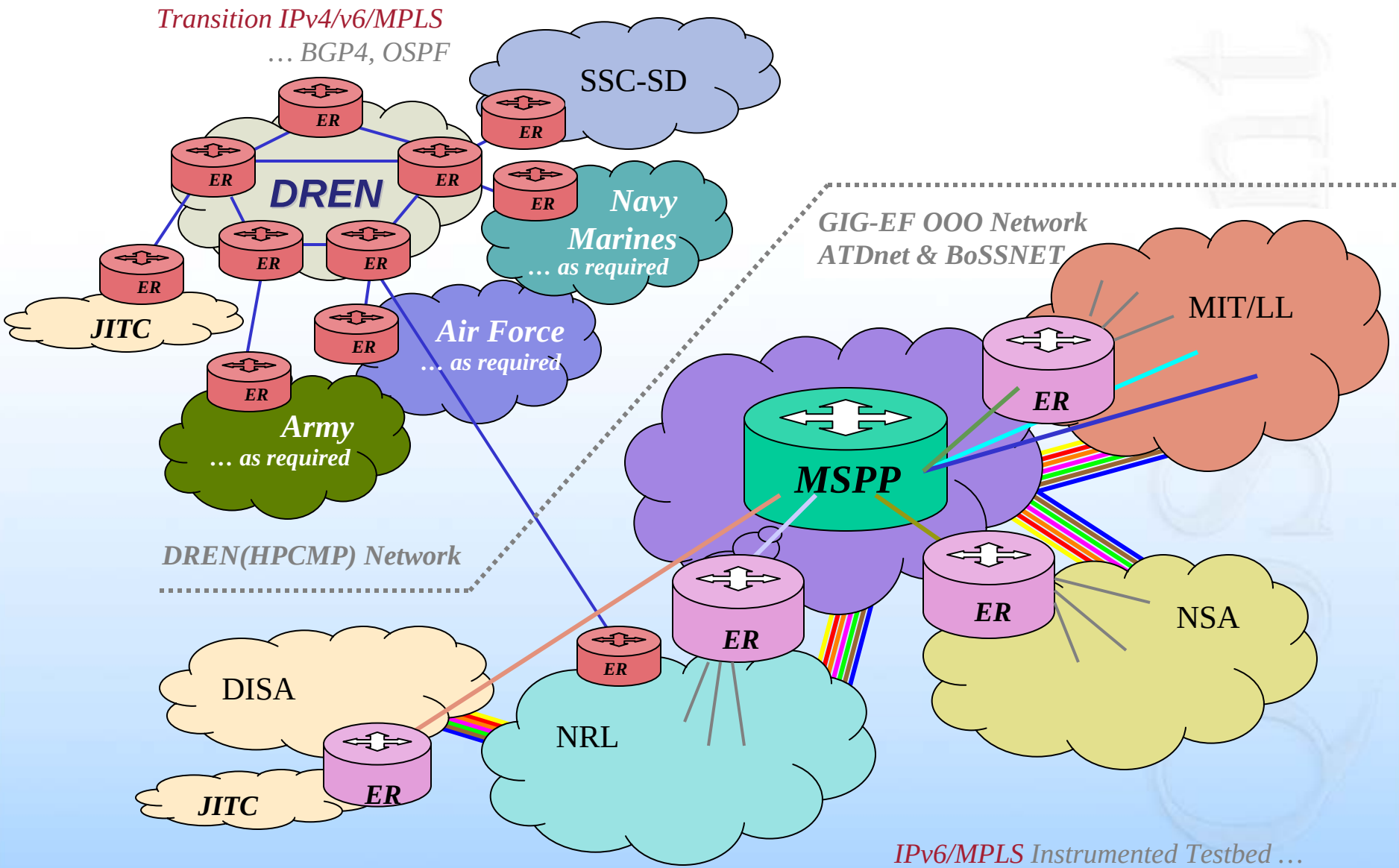
- Ability to account for all/any network use
- At a level of abstraction that is useful
  - Network Service Functional Assurance
    - Was the network service available?
    - Was the service request appropriate?
    - Did the traffic come and go appropriately?
    - Did it get the treatment it was suppose to receive?
    - Did the service initiate and terminate in a normal manner?
  - Network Control Assurance
    - Is network control plane operational?
    - Was the last network shift initiated by the control plane?
    - Has the routing service converged?

The Global Information Grid
A Diverse Environment



Serving business, warfighting, & intelligence with NCES --

- Collaboration, messaging, & applications
- Storage and mediation
- User assistance
- Information Assurance
- Enterprise Services Management and Operations



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Abstract QoS Control Plane

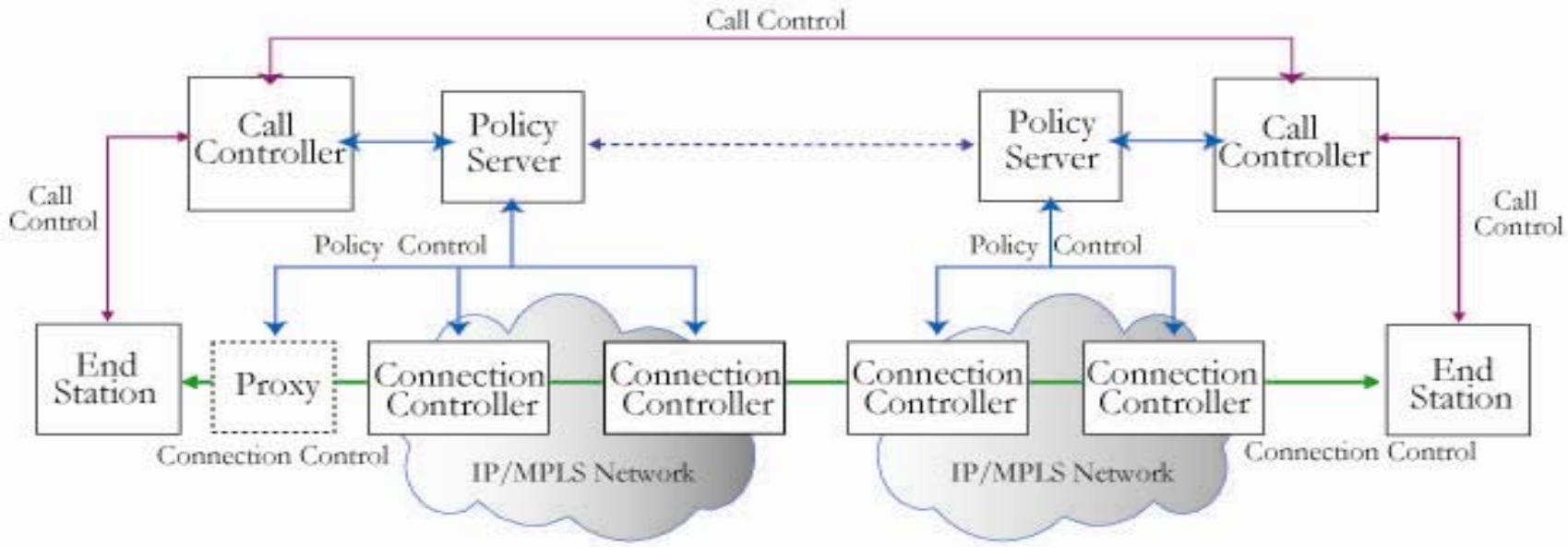


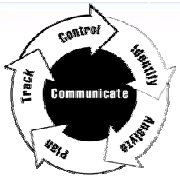
Figure 1. Reference QoS Control Architecture

Project Methodology

- New Distributed Network Monitoring Strategy
  - Comprehensive Network Usage Measurement (IETF IPFIX WG)
  - User Data Loss Detection (IETF RFC 2680)
  - Generic One-way Delay Monitor (IETF RFC 2679)
  - User Data Jitter Measurements (IETF RFC 3393)
  - Comprehensive Reachability Monitor (IETF RFC 2678)
  - Capacity/Utilization Monitor (IETF RFC 3148)
  - High Performance (OC-192) IPv4/IPv6 Passive Approach
- Establish Comprehensive Audit (IETF RTFM, ITU TMN)
- Utilize Uniform Data Collection (IETF IPFIX, ITU TMN)
- Perform fundamentally sound statistical analysis
- To Enable Effective Network Optimization

NTAIS FDO Optimization

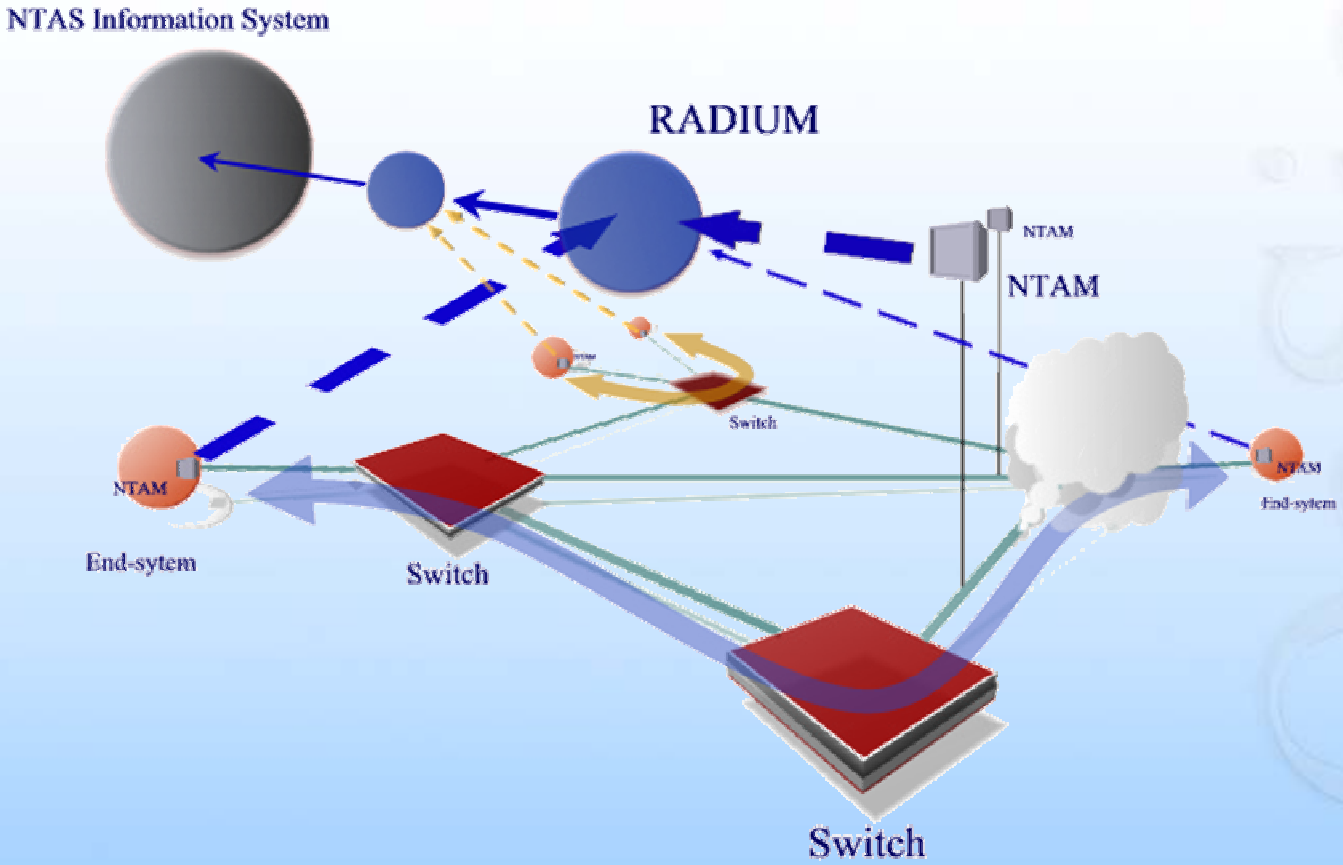
Function	Description	
Identify	Discover and Identify comprehensive network behavior.	Collect and Process Network Behavioral Data
Analyze	Collect and transform data into optimization metrics. Establish baselines, occurrence probabilities, and prioritize efforts.	
Plan	Establish optimization criteria (both present and future) and implement actions, if needed. This could involve reallocation of network resources, physical modifications, etc.	Provide information and feedback internal and external to the project on the optimization outcomes as events.
Track	Monitor network behavioral indicators to realize an effect.	
Control	Correct for deviations from the criteria.	



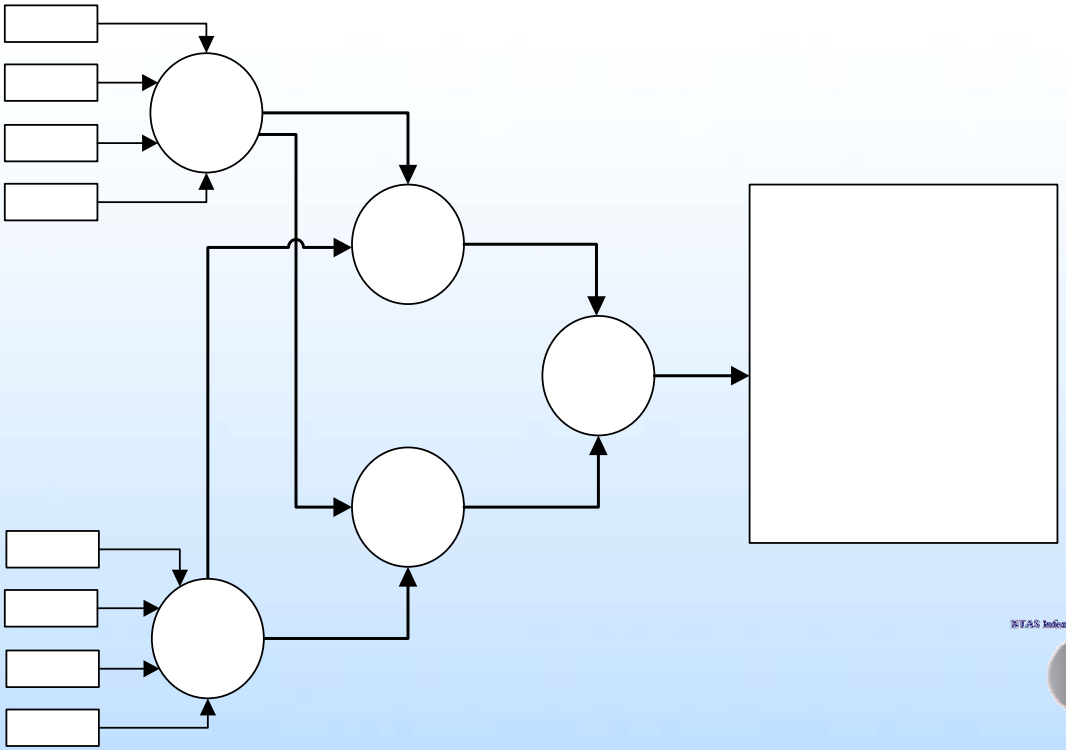
Gargoyle Probe

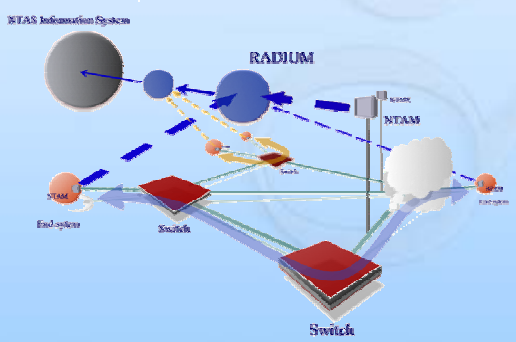
- Comprehensive Passive Real-Time Flow Monitor
  - User Plane and Control Plane Transaction Monitoring
  - Reporting on System/Network QoS status with every use
    - Capacity, Reachability, Responsiveness, Loss, Jitter
    - ICMP, ECN, Source Quench, DS Byte, TTL
- Multiple Flow Strategies
  - Layer 2, MPLS, VLAN, IPv4, IPv6, Layer 4 (TCP, IGMP, RTP)
- Small Footprint
  - 200K binary
- Performance
  - OC-192, 10GB Ethernet, OC-48, OC-12, 100/10 MB Ethernet, SLIP
  - POS, ATM, Ethernet, FDDI, SLIP, PPP
  - > 1.2 Mpkts/sec Dual 2GHz G5 MacOS X.
  - > 800Kpkts/sec Dual 2GHz Xeon Linux RH Enterprise
- Supporting Multiple OS's
  - Linux, Unix, Solaris, IRIX, MacOS X, Windows XP

NTAS Architecture



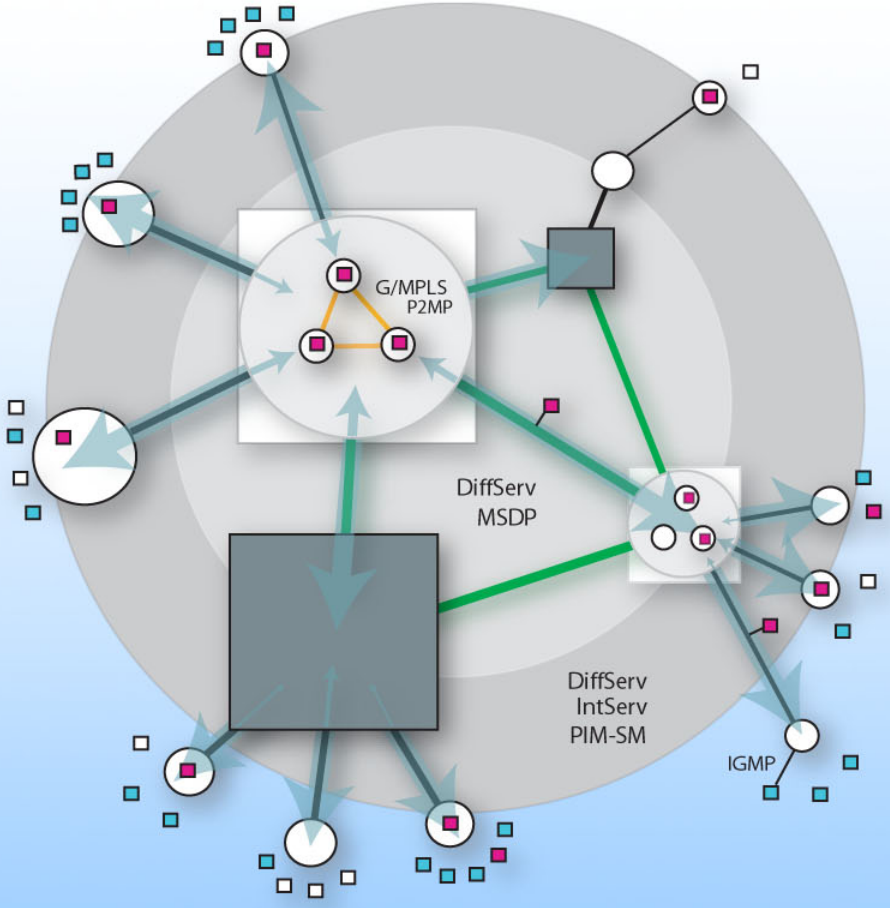
NTAS Distributed Architecture





Unicast/Multicast QoS Monitor Strategies

Mixed Black-box White-box Approach



PIM-SM - IntServ
MSDP - DiffServ
P2MP - G/MPLS

Core Transport
Multicast Router
NTAIS Gargoyle
Multicast Sender/Receiver
Multicast Traffic

So, …, what is a flow?

- Classic 5-Tuple IP flow
- Encrypted VPN IP-Sec Tunnel
- MPLS based Label Switched Path (LSP)
- ATM Virtual Circuit
- PPP Association
- Routing Protocol Peer Adjacency
- Multicast Group Join Request/Reply
- Abstract Object <-> Abstract Object

And what metrics?

- Rate, Load, Bytes, Pkts, Goodput, Max Capacity
- Unidirectional? Bidirectional?
  - Connectivity, Reachability
  - RTT, One-way Delay
- Loss, Packet Size, Jitter, Retransmission Rate
- Protocol specific values (flags, sequence #)
- DS Code points
- TTL, Flow IDs
- Routing Flap Metrics
- Hello Arrival Rates

How Should They Be Transported

- Push/Pull?
- Reliable/Unreliable
- Unicast/Multicast
- Stream/Block/Datagram?
- Encrypted? Authenticated?

Argus

- Argus started 1990 – Georgia Tech
- Redesigned CERT/SEI/CMU – 1993
- Version 1.0 Open Source – 1995
  - Over 1M downloads
    - ~100,000 estimated sites worldwide
    - Unknown sites in production
- Supports 13 Type P and P1/P2 Flows
  - http://qosient.com/argus/flow.htm
- 117 Element Attribute Definitions
  - http://qosient.com/argus/Xml/ArgusRecord_xsd/ArgusRecord.htm

Argus Transport

- Pure Pull Strategy
  - Simplifies Probe Design
- Reliable Stream Transport (TCP)
  - Can support UDP/Multicast Datagram
- Supports TLS “On the Wire” Strong Authentication/Confidentiality
  - Probe Specifies Security Policy

Maybe Incompatible with IPFIX

- Template strategy can’t work with all the combinations of flow types supported.
- Distribution strategies make it even harder.
- Lack of identifiers to support flow objects
- Missing metric types.
- Vendor specific support is minimal
- Resulting in no motiviation to adopt.