

Paradox in Network Data Quality of Service: Consumer Perspective vs. Provider Perspective

ABSTRACT

No Abstract Available

BIOGRAPHY

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Dr. Susmit H. Patel is a Senior Principal Engineer with the Army Information Systems within the Command and Control Center (C2C) at MITRE Corporation in McLean, VA. He currently supports tasking and projects for the Army CIO/G6. In this capacity, he provides technical assistance to assignments for network/system architecture definition and development, technology forecast and strategic planning, communications network design and assessment, modeling & simulation, performance engineering, and technology evolution planning. Dr. Patel holds B.S. and M.S. degrees in Electrical Engineering and a Ph.D. in Information Technology. He is a senior member of IEEE (Institute of Electrical and Electronics Engineers) and has held elected position as a Director for the IEEE Northern Virginia Section. He is an adjunct faculty and teaches in the Systems Engineering/Operations Research (SEOR) department at George Mason University (GMU) in Fairfax, VA. Dr. Patel's main area of interest and research is in network communications and computing technologies. As such, Dr. Patel has published several technical papers, has participated in invited sessions, and has been a peer reviewer for technical journal publications.



Paradox in Network Data Quality of Service

Consumer Perspective vs. Provider Perspective



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Topics



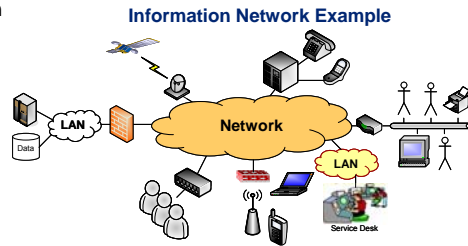
- What is a Network?
- What is Network Data Quality of Service (NDQoS)?
- Consumer Perspective for NDQoS
- Provider Perspective for NDQoS
- End-to-end NDQoS (an enterprise perspective)
- Network Data Problem and Challenges
- Net-centric Approach and Key Tenets
- Solution Strategy to Bridge Gap between Consumer and Provider
- Summary

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What is a Network?

- ❑ An Information Network (to accomplish some business function or mission)
- ❑ Consists of physical and logical networks within an enterprise network
 - Voice + data + video services
- ❑ Could span geographical, national, local boundaries
 - Terrestrial, aerial, space and foundational tiers
 - Various access and transport methods and media
- ❑ Connects consumers and providers
 - Different class of consumers
 - Different types of providers
- ❑ Made up of many heterogeneous sub-systems or components
 - Many vendor products
 - Many service providers
- ❑ Diverse types of requirements
- ❑ Non-homogeneous services, protocols, applications, standards
- ❑ Comparison to Transportation network



Transportation Network Example



What is Network Data Quality of Service (NQoS)

- ❑ What the consumer expects to get out of the “network”
- ❑ What the provider expects to provide as a service for the “network”
- ❑ **Examples:**
 - > **Response Time:** Time to react for a response after initiating a request
 - ❖ Browser response time to display a page, Call placed on hold before answering
 - > **Throughput:** Rate at which request for service is completed
 - ❖ Number of transactions per unit time, Calls answered per hour, HTTP requests/sec, Packets per second, MIPS, I/Os per second
 - ❑ **Utilization:** Use of a resource measured in percentage with overall capacity
 - ❖ Communications link is 60% utilized, totally saturated resource implies 100% utilization
 - ❑ **Availability:** Probability that the system is available at given point in time or fraction of time the system is up and available for use to its customers
 - ❖ 5 9's Availability = 99.999%, Unavailability = 1 - Availability
 - ❑ **Reliability:** Probability that the system functions properly and continuously over a specified period of time
 - ❖ Reliability and Availability are closely related concepts but are different
 - ❑ **Scalability:** A system is said to be scalable if its performance does not degrade significantly as the number of users, or equivalently the load on the system increases
 - ❖ Response time is linear with system load – Scalable system
 - ❑ **Extensibility:** It is the property of the system to easily evolve with new functional and performance requirements (changes in environment in which the system has to operate)
 - ❖ E.g., new laws and regulations, different business models may require that the system evolve to adapt to new circumstances
 - ❑ **Security:** Security is a combination of three basic attributes
 - ❖ Confidentiality: Only authorized individuals are allowed to access relevant information
 - ❖ Data Integrity: Information cannot be modified by unauthorized users
 - ❖ Non-repudiation: Senders of a message are prevented from denying having sent the message

More Examples of NDQoS



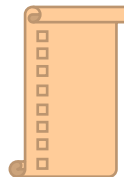
- **Delay (Latency):** Similar to response time.
- **Jitter:** Variation in Delay.
- **Dropped packets:** Packets that fail to deliver (drop) over certain period of time. This is especially important for video and voice streams where quality is dramatically affected by both latency and lack of isochronicity.
- **Packet Error Rate:** Packets that are misdirected, or combined together, or corrupted, while en route over a period of time.
- **Network Discoverability:** Ability to discover right network data or resource in specific amount of time.
- **Network Reachability:** Ability to reach to right network data or resource in specific amount of time.
- **Network Adaptability:** Ability for the network to adapt to surrounding changing conditions.
- **Network Survivability:** Ability for the network to survive certain disruptions and outages.
- Etc.

Consumer Perspective for NDQoS



- **I want the network to be available, all the time**
 - "always-on" network
- **I want the network to be reliable**
 - My connection should not drop (even when I am roaming, driving, sitting at home, work or at air-port)
- **I want the network to be accessible and flexible**
 - I can reach the network from anywhere, anytime, using any device and any method
- **I want the network to be smart, adaptable and evolving**
 - More features, more data, more information, more connectivity, more bandwidth than what I have today
- **I want the network to be fast and responsive**
 - I can do my transactions fast without waiting
- **I want the network to be secured**
 - I can trust the network and the network can trust me
- **I want the network for free or pay for only what I use**
 - Free, Pay-as-you-go or all-you-can-eat for fixed price
- **I want choices in my network, I want SLAs**
 - I can choose between options, shorter contract/period term

Consumer
Want List
for Network

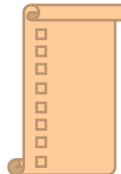


Provider Perspective for NDQoS

- ❑ I need the network to be visible all the time
 - I can see all parts of the network in real-time, all the time
- ❑ I need the network to be re-configurable and adjustable under my control
 - Dynamic re-configuration allows adjustment to consumer needs and demands under my control (bandwidth allocation)
- ❑ I need the network to be manageable and secured
 - Well-managed and secured network causes less consumer complaints, less outage and hence more revenue
- ❑ I need the network to be reliable and resilient
 - Built-in redundant network components, alternate routing, negotiation with other carriers, resilient to network attacks (down network or unhappy customers means loss in revenue)
- ❑ I need the network to be profitable
 - Apply different means to build the network, offer new incentives to attract new customers, offer longer duration contracts to lock-in
- ❑ I need the network resources to be used at a maximum capacity
 - More customers means more profit, want to get more usage
- ❑ I can offer SLAs to my terms
 - I have OLAs with other service providers



Provider
Need List
for Network



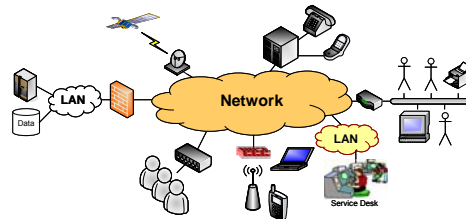
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Provider view: savings is important

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End-to-end NDQoS – An Enterprise Perspective

- ❑ When you traverse more than one network
- ❑ When your network is provided by more than one carrier (supplier)
- ❑ When your network is made up of heterogeneous components (computers, devices, platforms, applications, software)
- ❑ When you span more than one time zone and language
- ❑ Consumer cares about response time and speed of transaction and not underlying network infrastructure
- ❑ SLA and SLO between consumer and provider
- ❑ Provider needs to make sure billing and OLA are properly levied upon other network(s) that may not be under his primary control



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Enterprise view: service, savings and security are important

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The Network Data Problem



- n Due to advancements of Internet and the widespread ubiquity of (cheap) computing technology, there is more data available now than ever before
- n However, the ability to process and understand the data has not scaled as quickly as the ability to generate and collect data, thus leading to an environment with the following characteristics:
 - Large amounts of currently available data
 - A high rate of new data being generated
 - Contradictions in available data
 - An imbalance of relevant data compared to data found
 - Inefficient methods for comparing and processing different kinds of data
 - Stale data not going away or being discarded



Decision-makers are inundated with large amounts of data resulting in more time spent analyzing data rather than taking timely action

Why is Network Data so Important for Army/DoD?



- n Information Superiority on a Battle-field (mission advantage)
 - Establish and defend competitive advantage
 - Focus on operational excellence across all major assets
 - Leverage enterprise-wide data and intelligence to measure and manage results and speed the delivery of critical information to decision makers
 - Increase user confidence in the quality of data
- n Efficiency (performance and information assurance)
 - Unlock information that is trapped in stovepipes
 - Get the right data to the right user at the right time to enable better informed decisions
 - Establishing authoritative data sources will reduce redundancies of data and effort
 - Reduce time spent correcting inaccurate data
 - Reduce risk of breach through improved data masking and encryption and access rights to ensure that sensitive data is protected
 - Regulatory compliance and monitoring, e.g.,
 - o Clinger-Cohen
 - o Sarbanes-Oxley
 - o AAA Audit
 - o OMB/GAO inquiry
- n Economies (cost)
 - Traditional large enterprise ROI over 3 years is 7% with more significant return realized over longer term
 - Runaway costs and process inefficiencies caused by bad data
 - Protect large investments by improving data quality

Challenges to Overcome



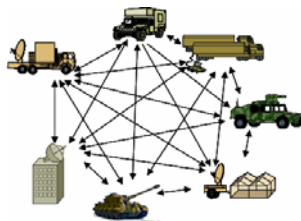
- n **Siloed Architectures**
 - Data is tightly coupled inside the applications
 - Separately managed products, programs, and services result in a lack of visibility and where improvements can be made
- n **Diversity of delivery channels**
 - Today's consumer wants information accessible from a variety of platforms (e.g., PDAs, laptops, smart phones, cell phones)
- n **Data Issues**
 - The variance in data expression across siloed systems (i.e., the same data is expressed in different ways)
 - What database is the authoritative or centralized source of the data?
 - Unknown quality of data
- n **Improper implementation can propagate less-than-trustworthy data across the enterprise**
- n **Paper Legacy**
- n **Data lives for ever on the Internet (stale data problem)**

DoD/Army Network Data Strategy Vision



Current

- Pre-determined "point to point" connections between systems and applications on disparate networks
- Producer "pushes" information to pre-defined consumers



Information not easily shared

Future

- Authorized known and unanticipated consumers access data they need regardless of who produced the information
- Systems and applications are web-enabled to expose their information



Information Ubiquitous on the Net

Net-Centricity

Network Data Consumer

“What data exists?”
 “How do I access the data?”
 “How do I know this data is what I need?”
 “How can I tell someone what data I need?”

- Content Discovery
- Service Discovery
- Locator Service

Network Data Producer

“How do I share my data with others?”
 “How do I manage access to my data?”
 “How do I describe my data so others can understand it?”

- Metadata Services
- Service Management

CCSD Attributes	
Class	
Title	
Abstract	
Keywords	
Contributor	
Date	
Language	
File	
Image	
General	
Temporal Coverage	
Version	
Accession	
Version	

Information Sharing with Unfettered Access for Unanticipated Users

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Key Tenets of the DOD Net-Centric Data Strategy

- Make Data Visible**
- Make Data Accessible**
- Make Data Understandable**
- Make Data Governable**
- Enable Data to Be Trusted**
- Make Data Interoperable**
- Be Responsive to User Needs**

- Is an information resource discoverable by end-users?
- Is it connected to the network(s), and are tools readily available to use and allow assured access to it?
- Can it be used intelligibly? Are the semantics well documented?
- Are data processes governed with sustained leadership?
- Is the authority (pedigree, security level, and access control level) known and available?
- Can it be easily combined or compared with other information and/or mediated?
- Are users involved in COIs? Are robust, direct user feedback mechanisms in place to guide development?

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Key Tenets of the DOD Net-Centric Services Strategy



Provide Services

Are information resources and functional capabilities available as services on the network? Are services visible, accessible, and understandable?

Use Services

Are existing services (including Core Enterprise Services) used to satisfy mission needs before creating duplicative capabilities?

Govern the Infrastructure and Services

Are policies and processes established to govern how to provide, secure, use and operate services?

Monitor and Manage Services via GIG NetOps

Are services implemented in accordance with DoD's GIG NetOps Strategy and concept of operations to ensure situational awareness of the Net-Centric Environment?

Solution Strategy to Bridge Gap between Consumer and Provider



- Establish Community of Interest (COI) with key stakeholders to include both Consumer and Provider
- Create, develop, publish and communicate a vision and strategy with key attributes and principles in a collaborative manner (e.g., use of Wiki)
- Create an environment of trust, transparency and openness between the consumer and provider
- Establish role of Network Data Stewardship to help identify, define network data standards, policies, practices, and adjudication
 - Identify authoritative data sources and register them in the appropriate Authoritative Data Source Registry
 - Develop and coordinate the management and integration of data related architecture and products to achieve data interoperability
 - Establish a baseline to identify and track performance metrics and develop benchmarks for comparison
- Challenge, encourage and reward both consumer and provider

Summary



- **There are differing views between the Consumer and Provider about Network Data Quality of Service**
 - Consumer view focus is on service, Producer view focus is on savings, Enterprise view focus is on service, savings and security
- **Data problem, in general, is due to:**
 - Large amounts of currently available data and new high rate of new data being generated
 - Siloed Architectures and contradictions in available data
 - Data is tightly coupled inside the applications
 - Unknown quality of data to include improper implementation and less-than-trustworthy data across the enterprise
 - Data lives for ever on the Internet (stale data problem)
- **Solution Approaches:**
 - Establish Community of Interest (COI) with key stake-holders to include both Consumer and Provider
 - Create, develop, publish and communicate a vision and strategy with key attributes and principles in a collaborative manner (e.g., use of Wiki)
 - Create an environment of trust, transparency and openness between the consumer and provider
 - Establish role of Network Data Stewardship to help identify, define network data standards, policies, practices, and adjudication