
What QoS Research Hasn't Understood About Risk

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De Facto QoS Problem Statement

“The Holy Grail of computer networking is to design a network that has the flexibility and low cost of the Internet, yet offers the end-to-end quality-of-service guarantees of the telephone network”

S. Keshav, *An Engineering Approach to Computer Networking*

Our Position

- Keshav's Holy Grail is unattainable and does not make a good problem statement
- QoS researchers have been too quick to assume that underlying congestion-control mechanisms translate obviously into marketable services
- Neither customers nor ISPs need or want hard performance guarantees
- Instead, each wants tools to manage risk
- These tools may be economic, rather than technical

Costs & Benefits

- QoS is essentially a cost/benefit proposition
- Assume 100% of congestion risk component could be removed¹, what would be costs/benefits?
 - +Isolation from congestion
 - Pricier line cards
 - More complex network engineering
 - Worse average case performance
 - More complex peering & settlement arrangements
- Network transactions still exposed to other risks (e.g. equipment failures, fiber cuts)
- Engineering cost-effective QoS is a tall order

1. Big assumption! See “*QoS and DoS*” position paper.

What do Customers Want?

- Customers are rational agents, but have complex and diverse utility functions
 - Customers want...
 - Good typical performance
 - Low cost
 - Simple pricing
 - Low transaction overheads
 - Means to manage exposure to worst case performance
- ... and the ability to trade off among these demands
- QoS could eliminate **a component** of risk exposure, but with significant costs

New Problem Statement

- Keshav's statement articulates a “Holy Grail”
- It's great to have ideals, but it is the realists who deliver results
- Need a new problem statement
- Perhaps, something like...

How can network services offer customers and providers flexible management of exposure to poor network performance?

Internet Performance Risk Management Today

- Multi-homing
- Use of adaptive / loss-tolerant applications
- Implementation of rigorous host security practices
- Flat-rate pricing (not economically optimal, but customers receive predictable monthly bills)
- What other risk management tools might be applied to the market for Internet services?

From Assurance to Insurance

- In other markets, customers neither want nor expect infallible service
Why would networks be any different?
- Many systems reach a point where it is cheaper to reduce risk through economic or regulatory means than to “add more nines” to the system
- Such economic/regulatory means might include...
 - Warranties
 - Insurance
 - Certification

Warranted Performance

- Because customers value simplicity...
 - ...providers will sell simple SLAs (e.g. “*Premium service with zero loss and jitter!*”)
- Because providers value their profits...
 - ...they will engineer services very differently from how they advertise them...
 - ...and will trade off statistical over-booking and operational corner-cutting against the risk of having to honor redeemed warranties
- Providers need tools to understand and manage these risks

Insured Performance_{1/2}

- Customers are savvy enough to know that providers will try to cheat
- Hence, they will demand warranty remedies that at least reimburse actual losses
- Logical option: **third-party insurers**
- Insurance is a financial/legal instrument for managing risk
 - Customers trade higher cost for lowered risk
 - Insurers manage pools of risk and profit on the “float”
 - Regulated insurance markets can manage risk efficiently

Insured Performance_{2/2}

- Insurance markets are not created without significant government involvement
 - Liability must be clear for network incidents
 - Insurance must be required
 - An entire new segment of insurance industry would need to be regulated
 - International treaties may even be needed
- Clearly, there are *significant costs*, but insurance is used to lower risk for other goods and services
- Just how outrageous is the idea of Internet performance insurance?

Certified Performance

- Government or third-party quality auditors might regulate the Internet to reduce risk to consumers
- Certification could be required to...
 - Operate an ISP
 - Sell Internet service backed by an SLA
 - Connect a corporate network
 - Use a computer ;-)
- Regulation could also require open disclosure of network performance outages (as with phone system in US)

Conclusions

- Hard QoS without steep costs is unattainable
- Low-level traffic control mechanisms do not translate obviously into salable services
- Customers and ISPs want flexible tools to manage risk, not engineered infallibility
- Technical, non-technical, and hybrid approaches must be studied
- QoS research must become interdisciplinary
- Any approach must be regarded as a cost/benefit proposition