



IBM Research

Who is the customer?

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Introduction

- **QoS Research has been going on for over two decades**
 - small level of adoption of some concepts.
- **What we have missed out on**
 - Who is the customer for QoS?

QoS is the Answer- So What was the Question?

???

IP defeats ATM

How do we support different services on IP Network

Out from Left Field: Massive Increase in Bandwidth/Processor Speed

B-ISDN/ATM

How do we support multiple services on same network

How do we support Audio or Video in the Network

1985

1990

1995

2000

2005

The Customer Question?

- **The most important question in Universities?**

- Not “Which Problem do I Solve?”.
- Not “How do I solve this Problems?”
- But “Which agency will fund the research to solve this problem?”

- **The most important question in Industrial Research?**

- Which Product Division will benefit from this Research?

Who is the customer for my Research?

The Critical Questions:

- **Who is the customer for QoS Research today?**
 - Sub-questions:
 - Which customer problems are we solving ?
 - Are we solving an important problem for that customer ?
 - Is QoS the best way to solve this customer problem ?
 - What is missing from QoS Research to solve this problem ?

The Internet Service Provider as a QoS Customer

- **ISP Context today**
 - The Core Network is largely under-utilized.
 - Access Networks run at higher utilization
 - but can be upgraded to higher bandwidth links.
 - Inter-Provider SLAs pose a problem.
- **Telco ISP's Important problem**
 - Connectivity is becoming commodity
 - How do I move to higher level services?
 - For ISP's customers
 - Best effort is delivery good-enough performance.
- **ISPs are a bad customer for QoS Research**

Emerging Technology Areas as QoS Customers?

- **Several new types of networks are emerging:**
 - Peer-to-Peer Networks
 - Sensor Networks
 - Mobile Ad-hoc Networks
 - Wireless Networks
 - Delay/Disruption Tolerant Networks.
 - GENI

The Natural Approach

- **Let us marry QoS with the emerging networks:**
- **Not a bad idea**
 - specially if it gets some funding from GENI ☺
- **But**
 - Are QoS mechanisms their top concerns?
 - Are QoS mechanisms a good match for them
- **And Remember “B-ISDN/ATM”**
 - Success can not be taken for granted
 - even if the industry seems to be behind it.
 - which of these technologies will be successful is unclear.

Some Other Areas for QoS

- **Limited Domain Applications**

- Storage Networks
- Data Center Networks
- Enterprise Intranets

- **Adjacent Domains**

- End-to-End Applications
- VoIP
- IP Multimedia Systems.

What are the key requirements of a good domain for QoS

- **There must be a persistent resource problem.**
 - The resource can not be easily obtained or procured.
- **Good Enough should not be acceptable**
 - Application must have a reason to desire QoS.
 - Ideally financial reasons, though others also okay.
- **The need should justify the complexity of QoS**
 - Management of QoS is an outstanding issue
- **There should not be easy alternative approaches**
 - e.g. take an insurance approach to mitigate risk of performance.

*So, which of the many
new areas seem to fit the
requirements?*

Peer to Peer Networks

- **Current model**
 - Offer Content for Free
 - Using Connectivity/Desktop Resources that are available for free.
- **Important needs of the P2P Developers**
 - How to get end-users to sign up to their systems.
 - QoS will surface only if there are different classes of users.
- **You really can not expect too much QoS for free.**
- **Research papers to improve performance is fine**
 - but probably not the best place to get traction.

Persistent Resource Problem	Yes
Good Enough is not Acceptable	No
Need should justify Complexity	No
No Easy Alternatives	No

Sensor Networks

Persistent Resource Problem	Yes
Good Enough is not Acceptable	Sometimes
Need should justify Complexity	Sometimes
No Easy Alternatives	Sometimes

Have limited processing capabilities and limited bandwidth

- In some contexts, the real-time requirements are crucial
 - e.g. Military environments, Homeland Security environments.
- In other contexts, a bit of latency is quite acceptable
 - tracking wild-life, meteorological data collection
- **Some contexts may have different classes of users**
 - e.g different military agencies, different DHS agencies.
- **Opinion:**
 - Possibly a potential area for QoS Research, but we need to simplify the complexity of QoS management.
 - and possibly consider the quality of data and information received from sensors and their processing elements.

MANETS

■ Status

- Bandwidth seems to keep on increasing with technology
- Bandwidth not as plentiful as wired networks,
 - but applications that stress bandwidth are somewhat dubious
- Different level of users
 - not required at least in the commercial context.

■ Opinion

- Probably not the best match for QoS activities.

Persistent Resource Problem	No
Good Enough is not Acceptable	No
Need should justify Complexity	No
No Easy Alternatives	No

DSTNs

Persistent Resource Problem	Yes
Good Enough is not Acceptable	Maybe
Need should justify Complexity	Maybe
No Easy Alternatives	Yes

- **The resource in shortage is connectivity**
 - You delivery information in hops with whom you have limited connectivity
 - Context:
 - Inter-Planetary Networks
 - Urban networks on buses and cars, etc ...
- **QoS Issues**
 - are present – specially if one is running out of storage space at a storage issues.
- **Opinion**
 - Could be an interesting application area for QoS
 - and it is an early stage of development so commercial concerns are still not predominant 😊
 - .

Storage Networks

Persistent Resource Problem	Yes
Good Enough is not Acceptable	Maybe
Need should justify Complexity	Maybe
No Easy Alternatives	Yes

- **Provide a simplified context for application of QoS**
 - Needs: Different existing protocols e.g. SCSI require some hard time-line for performance.
 - Different levels of service
 - Storage data is growing by leaps and bounds
 - and some of that will need to be discarded – ideally during communication.
 - Bandwidth may not be the critical resource.
 - Commercial Interests – product differentiator, interoperability with legacy environments.
- **Opinion:**
 - Perhaps the best possible domain for commercial deployment.

Data Center Networks

Inter-Processor Networks

Persistent Resource Problem	Maybe
Good Enough is not Acceptable	Maybe
Need should justify Complexity	No
No Easy Alternatives	No

- **Systems Inter-Connections typically designed for**
 - in-order delivery with bounded delays
 - almost a perfect match with traditional QoS Statements.
- **Challenges:**
 - existing approaches that provided QoS (IB) are more expensive than best-effort interconnections.
- **Opinion**
 - Would not put my money on this area
 - remember ST-II/RSVP/real-time channel approach versus RTP.

Applications

Persistent Resource Problem	Maybe
Good Enough is not Acceptable	No
Need should justify Complexity	No
No Easy Alternatives	No

- **Several Applications are getting commercial deployment on IP networks**
 - VoIP
 - IPTV
- **End to End QoS will be needed for these applications**
 - Provided different grades of service exist on same network.
 - and needs are not so acute that setting up a separate network is justified.
 - and resources remain constrained enough.
- **Opinion**
 - A window of opportunity exists for high-bandwidth apps like IPTV
 - But the QoS level needs to be provided on an end-to-end basis.
 - And for bulk of applications, Qos is not just worth doing even end-to-end
 - just rely on increasing processor speeds, multi-core processing, increasing bandwidth.

The End Goal of QoS

- **What is the definition of QoS for Customers?**
 - It is not providing guaranteed performance.
 - It is not providing different classes of service.
 - It is not providing resource arbitration and allocation.
 - It is not writing Service Level Agreements.
- **What Application & Network Providers want:**
 - Reduce the number of calls to help-desk?
 - Reduce the chance of ending up on the evening news.

Conclusions

- **If we want to see QoS Deployed**
 - We need to focus on niche areas
 - Storage Networks, Military Context, IPTV
 - and customize QoS solutions with a holistic perspective
 - not just the network, but include the end-systems as well.
- **If we want to write fun papers**
 - niche areas are again QoS's best friends
 - sensor networks, DSTNs etc.
- **If we want to get business people excited**
 - QoS mechanisms needs to reduce calls to help-desk.