CORBA in Optical Switches with QoS Additions

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Introduction

- Trends in Communications
- CORBA and Network Management
- Challenges in Building Optical Switches
- Using Real-time CORBA in Optical Switches
- Summary

Trends in Communications

Trends in Communications

- High-speed Optical Switches
  - Bigger, faster, and dumber
- IP-based Services
- Bundling of Services
  - Internet connection, local/long distance service and cable TV all from the same company
- New Applications
  - Live, high-definition video,
  - Virtual Private Networks (VPN)
  - Differentiated Internet access
- Changing Business Models
  - Bandwidth-on-demand – what they need, when they need it
  - Contractually mandated service levels
  - Customer self-provisioning and self-management
  - Operations streamlining: more services with less staff

Trends in Communications: New Requirements

- Requires automated and dynamic provisioning of
  - Ports
    - Existing connections used for dynamic creation of new virtual circuits
    - Virtually plug in and connect Joe and Fred
    - They instantly know about each other
    - Hardware provisioning delegated to the home or office
    - Flexible capacity management
  - Wavelength Resources
    - Allocation
    - Provisioning
  - Priority policies
- Requires predictable *and* dynamic service levels
  - Allows service providers to offer differentiated services
  - Allows diverse, multi-level service agreements
    - From guaranteed, fixed bandwidth … to excess capacity use … to …
    - Requires control of both implicit and explicit service levels

Trends in Communications New Requirements (2)

- **Require software-centric system architectures**
- **Need to assimilate new technologies**
  - Migrate quickly and easily to that new cool, fast hardware
- **Reduce time-to-market for new products**
- **Increase product innovations**
- **Allow systems to become policy driven**
  - QoS, load balancing, routing, backup, security, etc.
- **Communications has come to the door of real-time**
  - Market leaders will set themselves apart by the timeliness of how they allocate bandwidth and move data

CORBA in Network Management

CORBA and Network Management

- **Telecom early use of Simple Network Management Protocol (SNMP)**
  - Management Information Base (MIB)
  - Common Management Information Protocol (CMIP)
  - Common Management Information System Element (CMISE)
    - Was industry standard
- **Problems included**
  - No location transparency
  - Poor portability/interoperability
  - Products are cost prohibitive (developer and run-time)
- **CORBA was a better alternative**

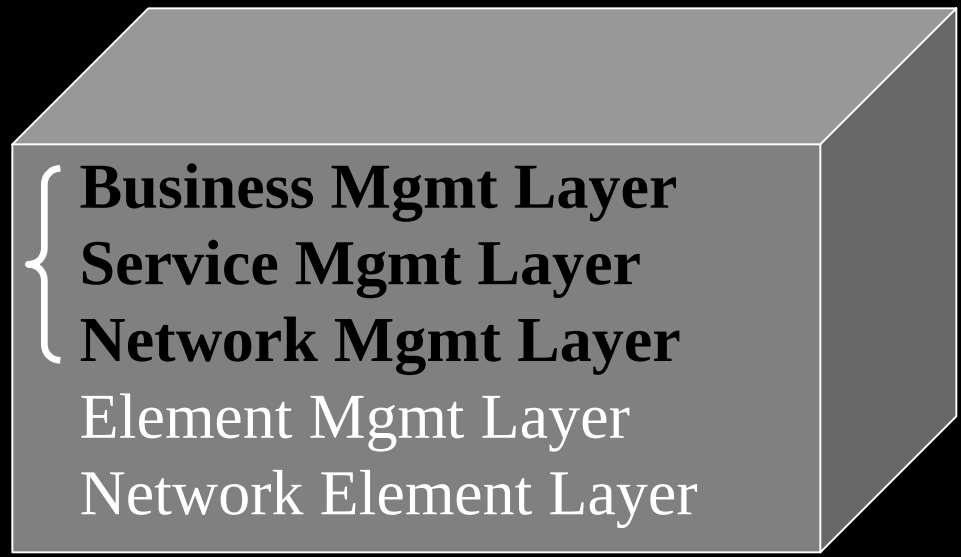
Traditional CORBA in Telecom

- **CORBA Benefits**
  - Interoperability, portability, time-to-market
  - Frees telecom programmers for telecom application programming
  - Emerging industry standard for TNM
  - Well educated culture (tools, doc, available engineers)
  - Good fit to future technologies (ATM, IP applciations)
  - IDL provides a type safe and understandable interface to customers
- **CORBA Drawbacks**
  - Too slow
  - Too unpredictable
  - Too big for use in the network elements

Traditional CORBA in Telecom

- **Network management applications**

Traditional CORBA



High Performance CORBA in Telecom

- ***Embedded*** **network management applications**
- **Self-provisioning of diverse switch equipment from different vendors**

Traditional CORBA

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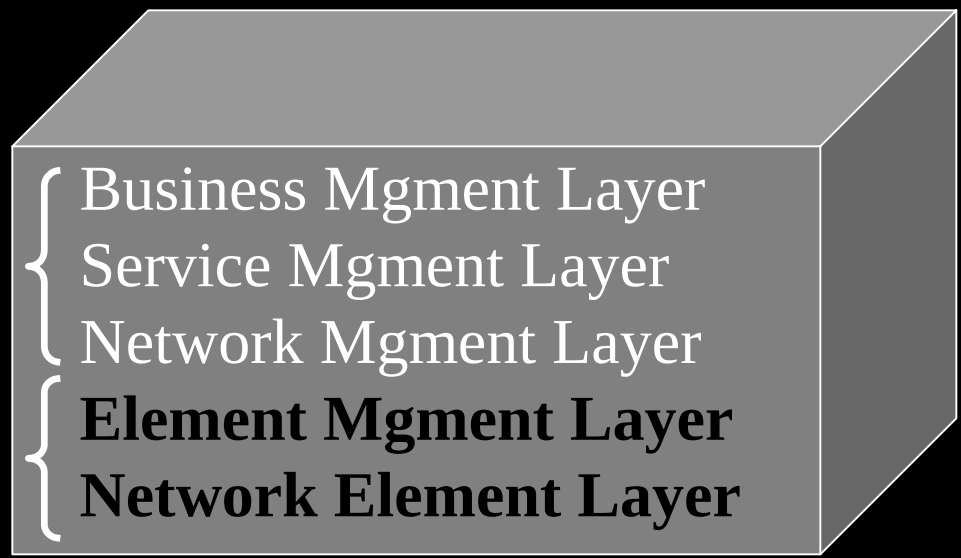


Challenges in Building Optical Switches

Challenges in Building Optical Switches

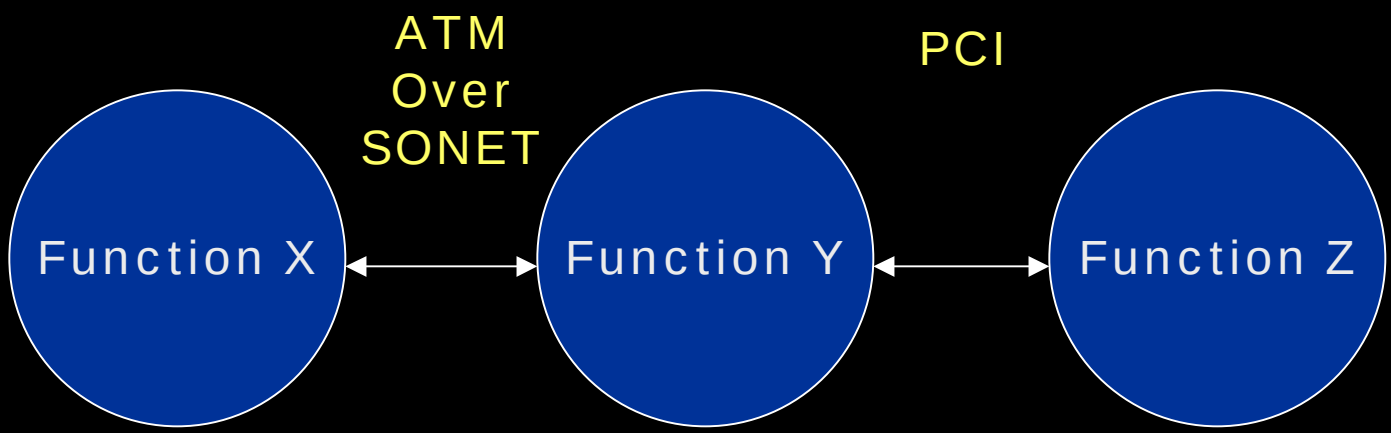
- **Integrating Legacy Technologies**
  - Integrate heterogeneous hardware
    - Use custom transport technologies
    - New hardware talks to old hardware
      - High speed core technologies integrated with “last mile” copper
    - Multi-layered networks inheriting problems of each protocol
      - IP over ATM over Sonet…
  - Integrate heterogeneous operating systems
    - Universal model of thread priority
    - New O/S’s interoperate with old O/S’s
  - Integrate heterogeneous programming languages
    - C, C++, Java, …
    - Latest languages talking to old languages

Challenges in Building Optical Switches (2)

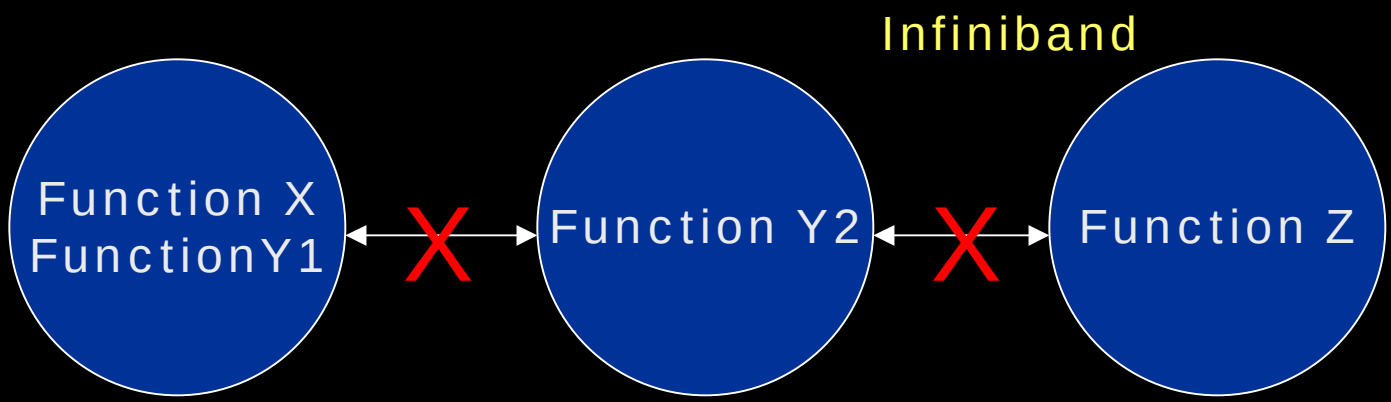
- **Flexibility vs. Performance Tug-of-war**
  - Optical switches must be really *fast*
    - Low latency + high bandwidth
    - Quick, easy solution is to make them dumb
      - Hardware centric, disposable software
      - Software functionality must play catch-up
  - But flexibility+speed will win in the long run
    - Better address business needs of service providers
    - Dramatically better time-to-market for new hardware innovations
    - New product introductions can be software-only

Using Real-Time CORBA in Optical Switches

Understanding CORBA Flexibility



Oops ...



Understanding CORBA Flexibility (2)

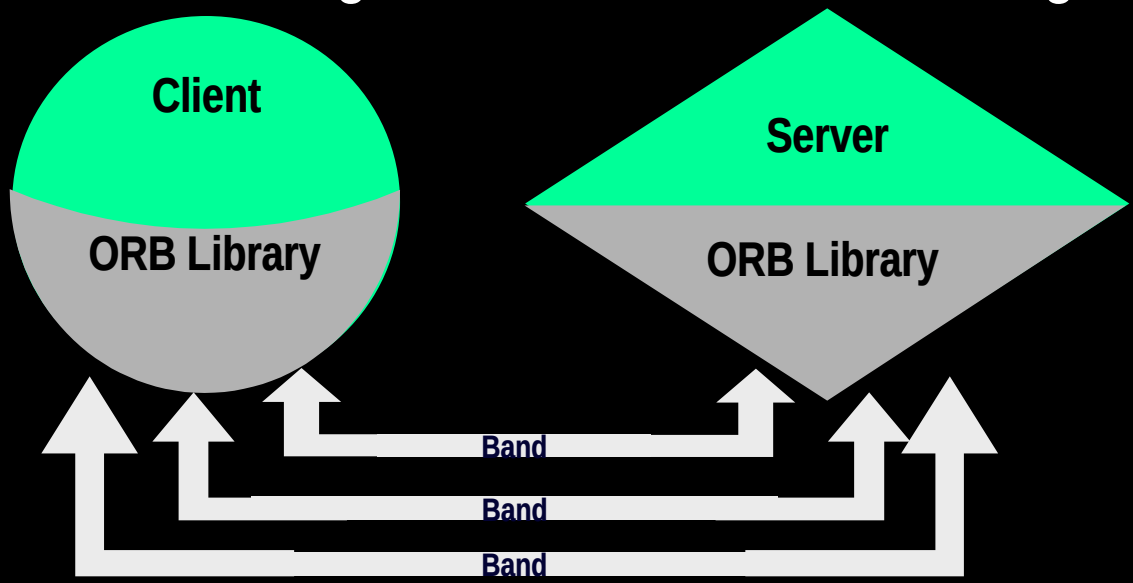
- **X, Y and Z are relocatable, distributed objects**
- **Therefore these objects can reside anywhere on your network**
  - This includes a single process space (collocation)
    - Very fast (20 nsec for a virtual function call)
    - Can be used as a test bed
  - Same host or different host
  - Same language or different language
- **And protocols can be replaced without total rework of applications**

Real-time CORBA

- **Multi-service optical switches must be absolutely non-blocking with service level queuing**
- **Real-time CORBA adds control of time**
- **Priority insures latency requirements which might be separate from bandwidth considerations**
  - High priority, low latency, moderate bandwidth
  - Moderate-to-low priority, high latency, high bandwidth
- **RTCORBA priorities map to RTOS priorities**
  - Can be altered via custom mapping function
- **End-to-End predictability**

Priority Banded Connections

- **Multiple connections, to reduce priority inversion**
  - Each connection handling different priority invocations
- **Banding**
  - Each connection may represent a range of priorities, to allow resources to be traded off against limited inversion
  - May have different ranges in each band, including range of 1

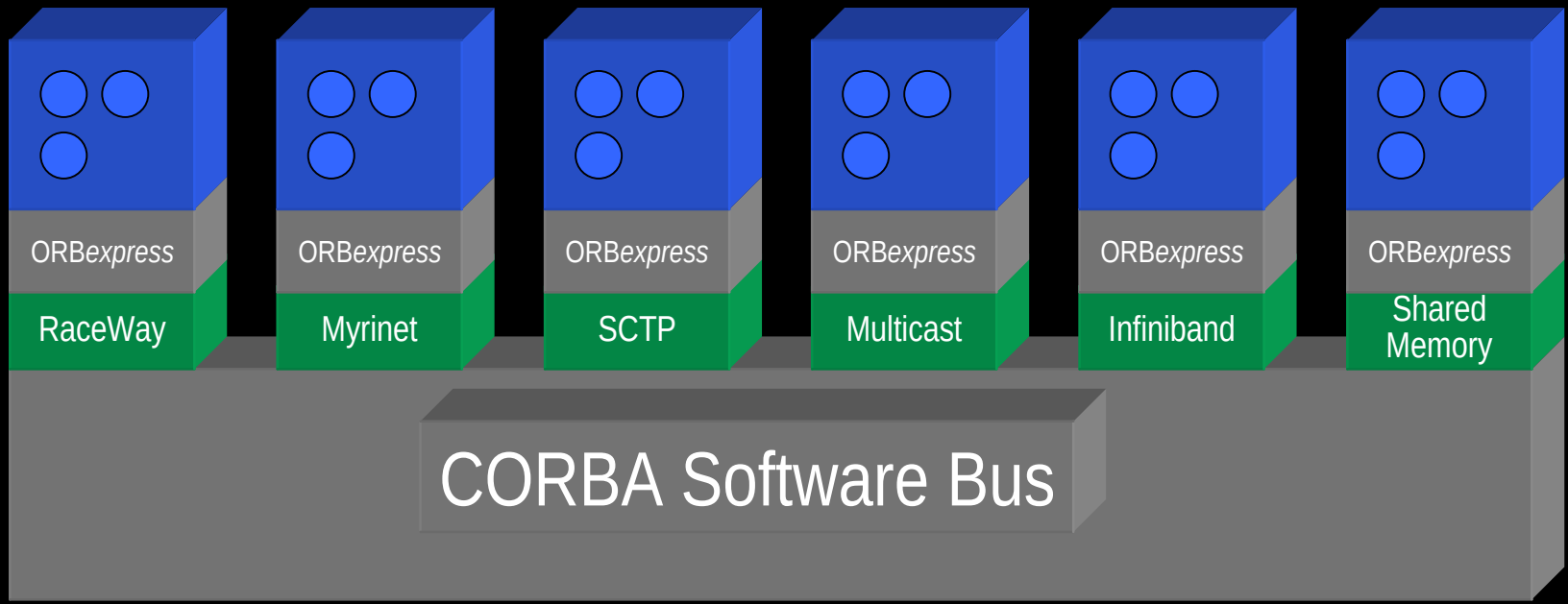


Using Real-Time CORBA in Optical Switches

- **Real-time ORBs can provide both:**
  - Real-Time CORBA = Performance + Flexibility
  - Unparalleled flexibility
  - Low latency and high throughput (some ORBs)
- **New hardware doesn't have to mean a rebuild**
  - Change backplanes/buses without changing software
    - VME – PCI – USB – Switched Fabric – …
  - Allow switch to extend over non-backplane technologies
    - ATM
    - Ethernet (10Mb, 100Mb, 1Gb, 10Gb, …)
    - Fibre Channel
    - IEEE 1394
    - …

Using Real-Time CORBA in Optical Switches (2)

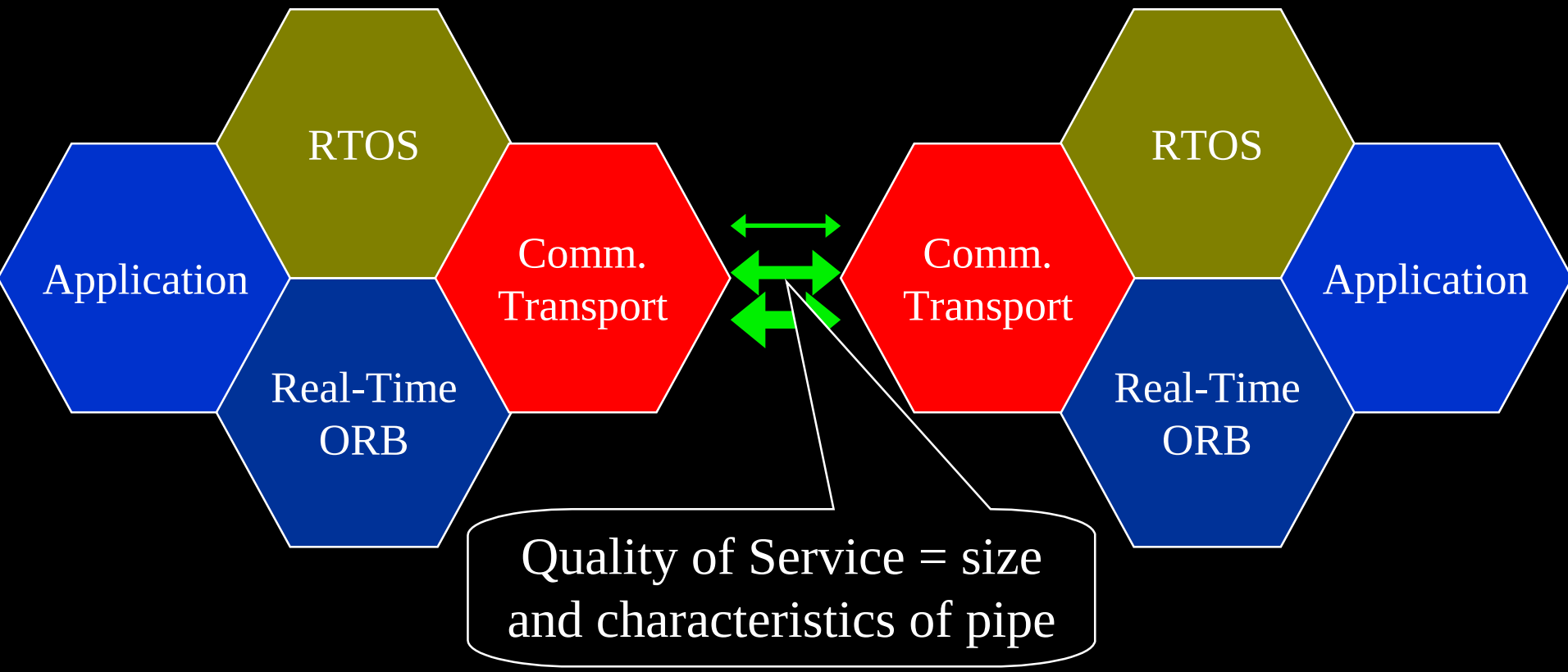
- **Plug in a custom transport into the RT ORB**
  - Only a few engineers need understand the transport details
- **RT CORBA application code doesn't have to change to use new transport**



What is QoS?

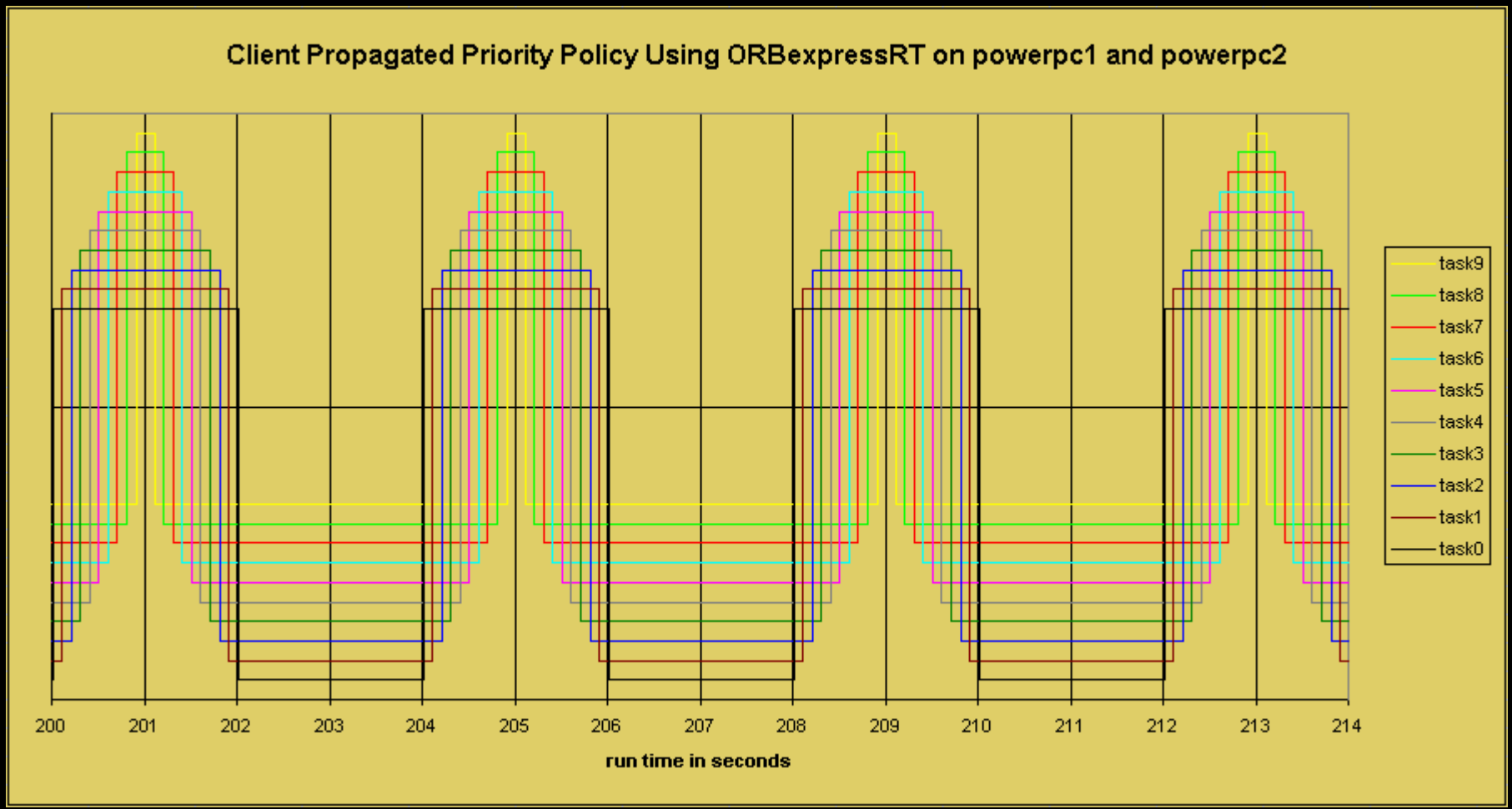
- **QoS = Quality of Service**
- **QoS means different things to different people**
- **QoS definition for this presentation**
  - QoS is the collective effect of service performance that determines the satisfaction of a network subscriber with a contracted offering
- **Facilitates transports that can**
  - maintain priority
  - distribute bandwidth
  - guarantee jitter
  - bound latency

Quality of Service in a Real-time CORBA Application

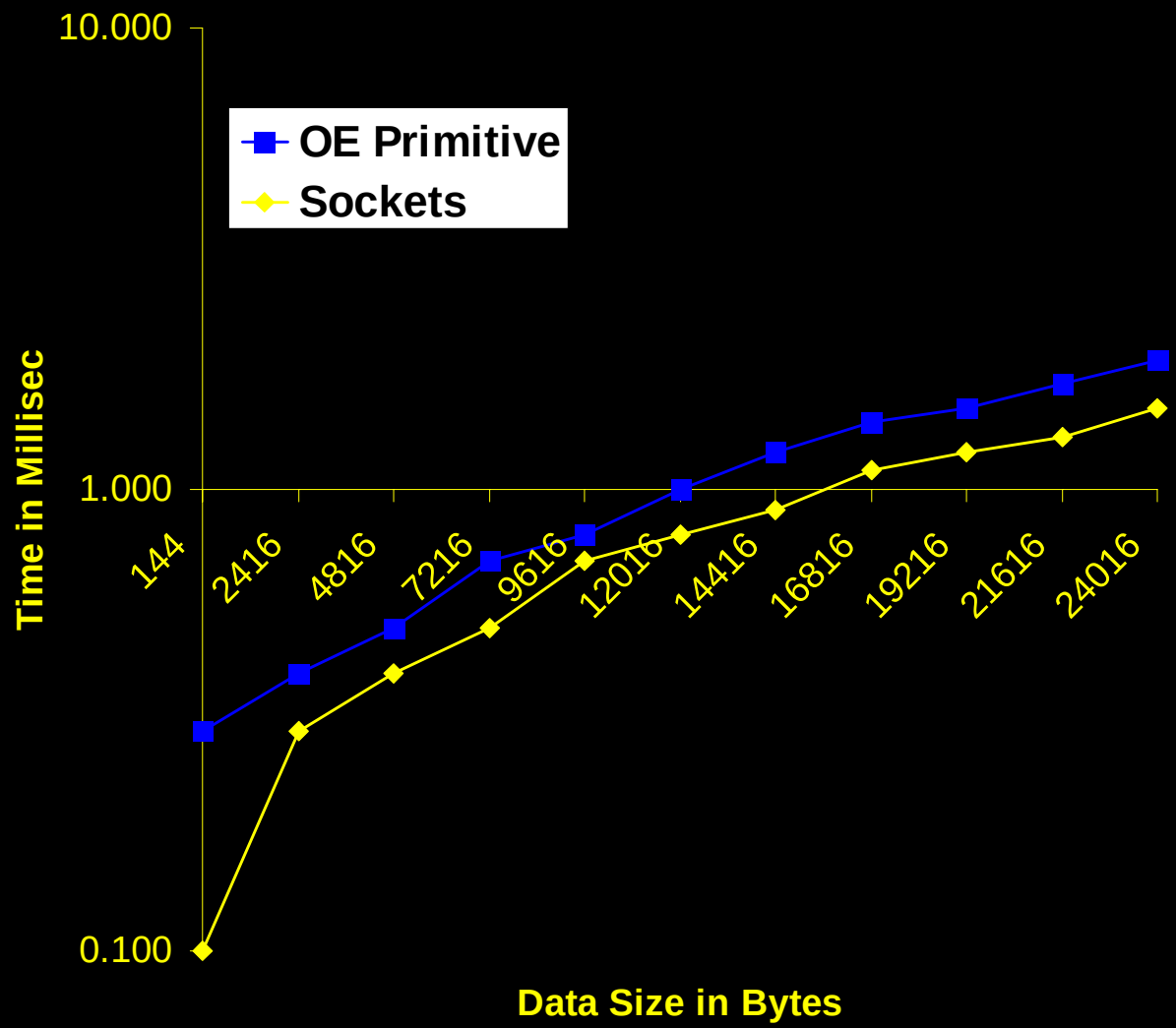


Real-Time ORB Priority Testing

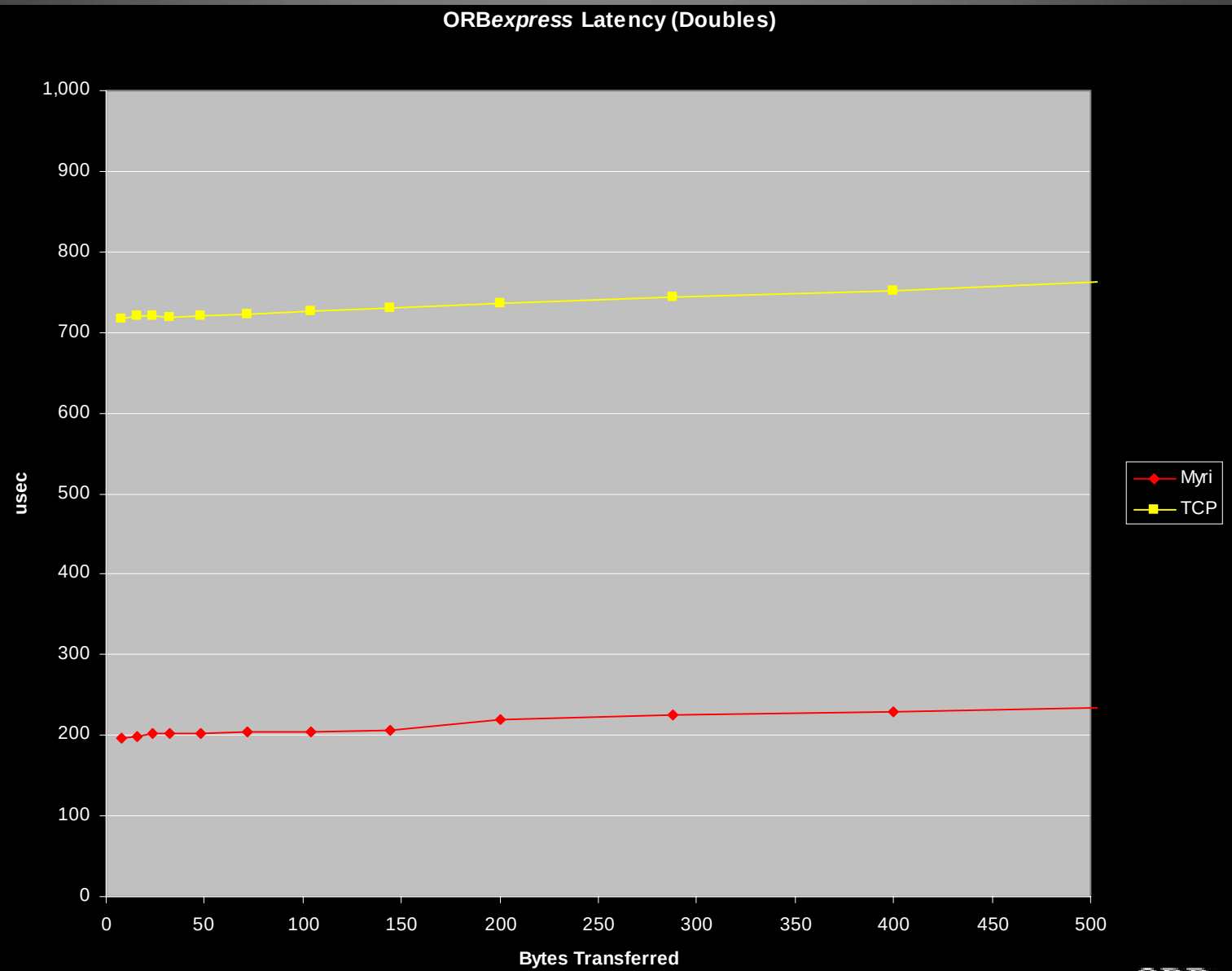
Boeing Second Phase Test Results – Nov 20, 2000



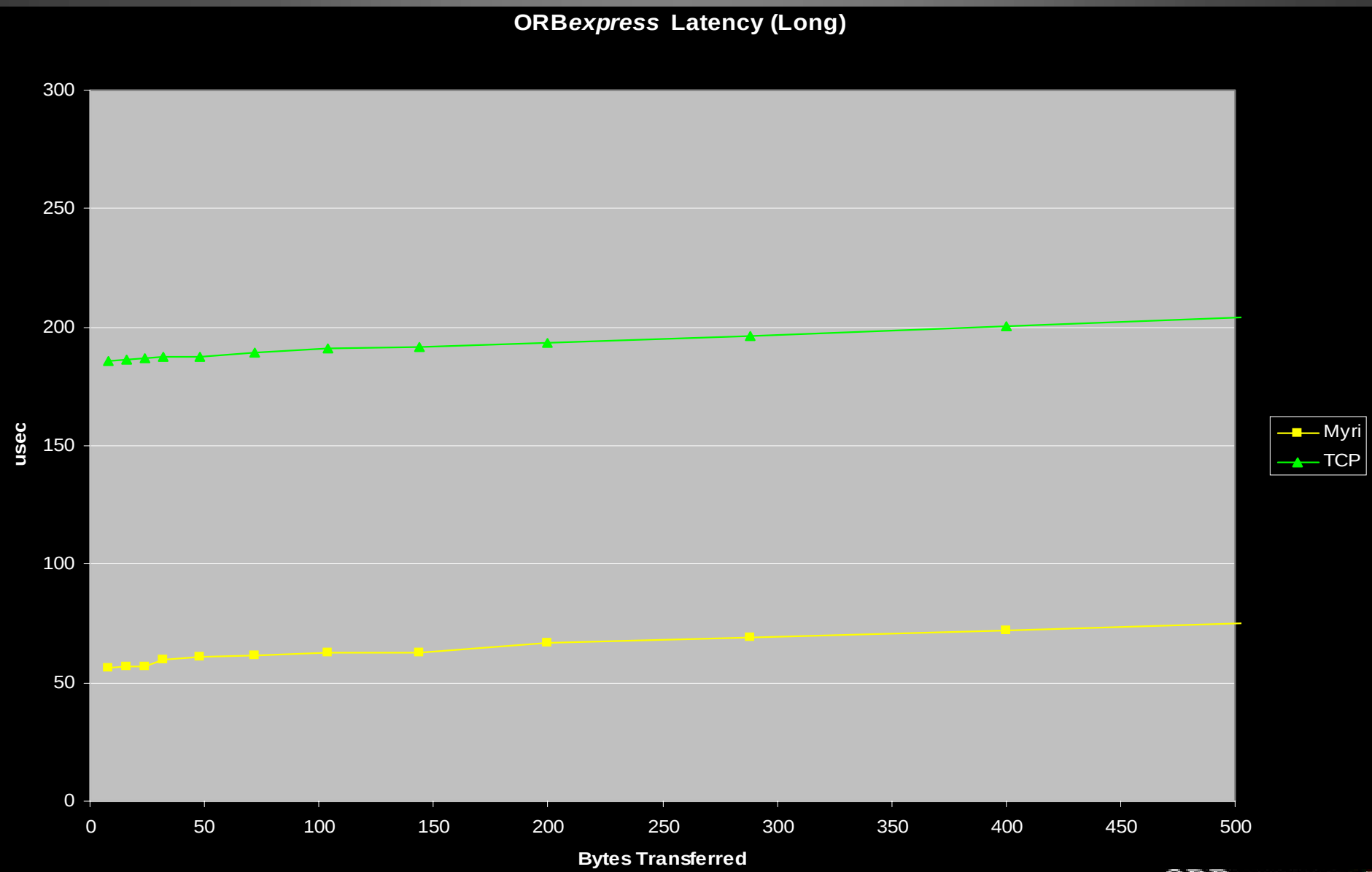
Real-Time ORB Performance - TCP/IP Loopback



Myrinet Transport-2641



Myrinet Transport-2841



Summary

- **Real-time ORB's allow for better optical switches**
  - Faster
  - More flexible
  - Extensible
  - More easily adapted to new hardware
  - Better leveraging of legacy technologies

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