TI Developer Conference
March 7-9, 2007 • Dallas, TX

Minds in Motion

RapidIO Rev 2.0 for Next-Generation Communication and Embedded Systems

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RapidIO

Rev 2.0 New Features

- Two major areas of concentration
  - New Higher Performance Physical Layer
    - Extending bandwidth with available SerDes technology
  - Significant Data Plane Enhancements
    - Offering carrier grade data fabric performance
- Additional work to standardize Encapsulation
  - Early focus on Ethernet

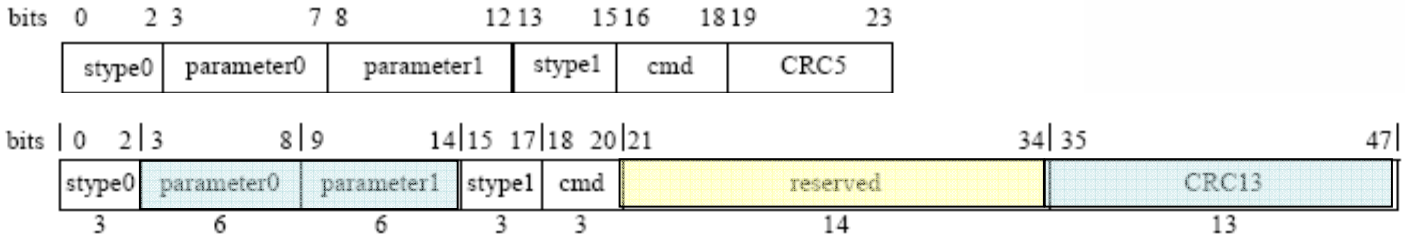
New Serial Physical Layer Feature Overview

- Rev 2.0 is backwards compatible with Rev 1.3
- Link width options are 1x, 2x, 4x, 8x and 16x
- Signaling rates of 1.25, 2.5, 3.125, 5.0 and 6.25 Gbaud
- AC electrical specs
  - Speeds < 3.5 Gbaud are based on XAUI
  - Speeds > 3.5 Gbaud are based on OIF
- Data is scrambled and 8b/10b encoded
- Hot plug support at the electrical level
- Introduction of new functionality in control symbol and Idle pattern

Serial Features Continued…

- Baud rates of 1.25, 2.5 or 3.125 Gbaud
  - Long Reach: 50 cm channel length with 2 connectors
  - Short Reach: 20 cm channel length with 1 connector
- Baud rates of 5.0 and 6.25 Gbaud
  - Long Reach: 100 cm channel length with 2 connectors
  - Medium Reach: 60 cm channel length with 2 connectors
  - Short Reach: 20 cm channel length with 1 connector
- Support for DFE based receivers increases channel choices
- Supports StatEye channel compliance testing
  - Valuable for closed data eye evaluation

New Control Symbol and Idle



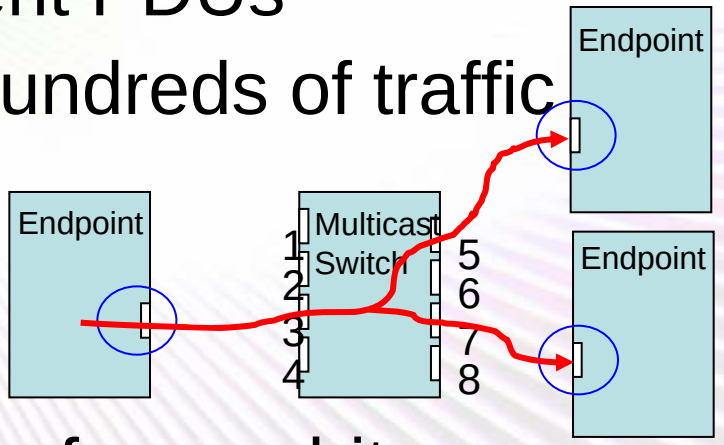
- Control symbol provides better CRC protection for DFE based receivers
- Control symbol allows for virtual output queuing
  - Backpressure indication mechanism
- Idle provides auto detection of
  - Lane polarity, port width/lane number, data rate capabilities
- Idle provides equalizer training and mechanism for RX to adjust TX emphasis settings

Data Plane Feature Overview

- New Data Streaming Packet Format
- Addition of Virtual Channels (VCs) to Serial Physical Layer
- Virtual Output Queue (VoQ) Spec
- New Endpoint Flow Control Arbitration
- New Traffic Management Spec

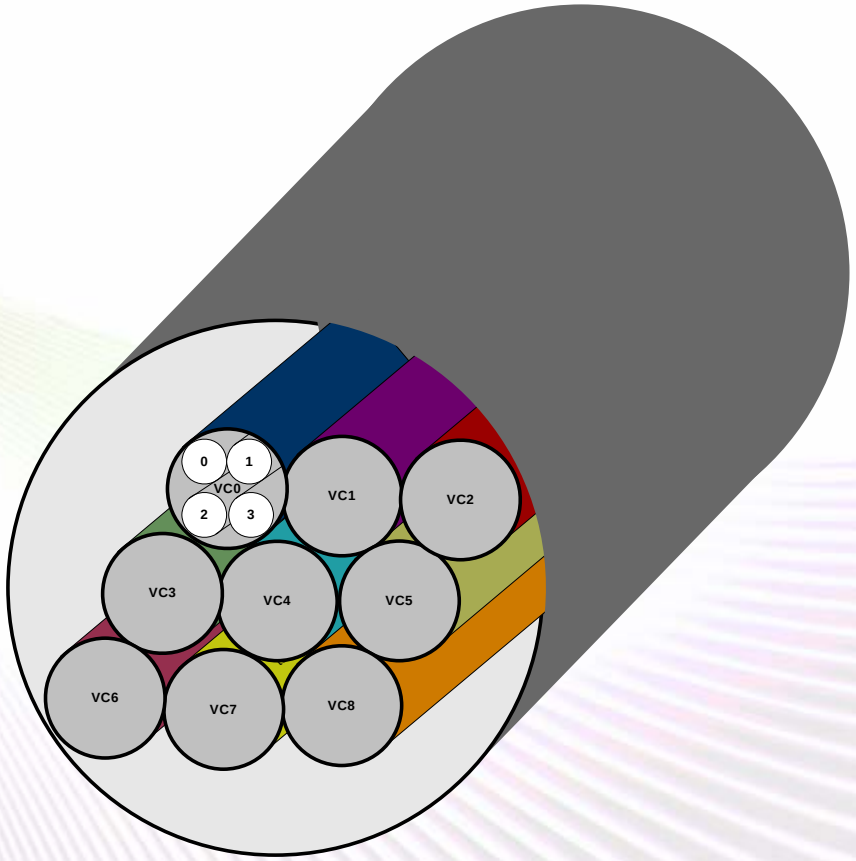
Data Streaming Support

- Type 9 packet format for streaming data
- Supports up to 64-K PDU sizes using selectable MTU size and SAR
- Supports thousands of data streams between endpoints, as well as, concurrent PDUs
- Introduces COS support with hundreds of traffic classes
- Supports multicast
- Supports lossy transactions
- Can be used for encapsulation of any arbitrary protocol



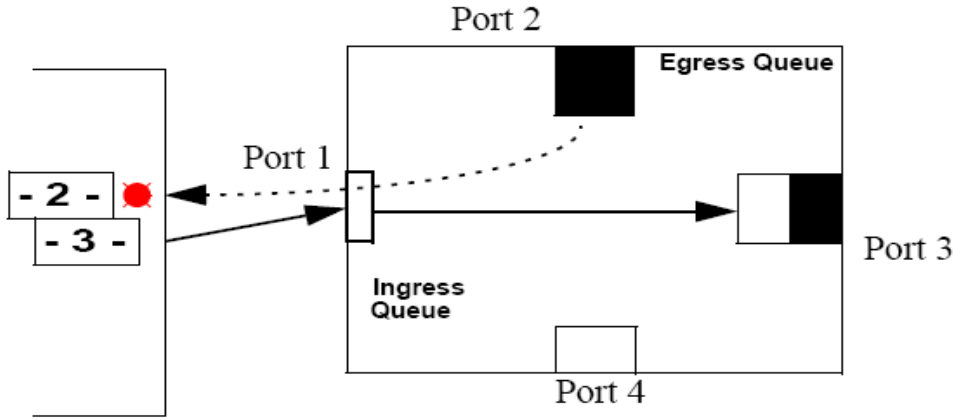
Virtual Channels

- Allows physical channel to be subdivided into independently managed subchannels
  - No ordering guaranteed between VCs
  - Individual link layer flow control and buffers for 9 VCs
- Allows reserving of bandwidth and Quality of Service (QoS) on subchannel granularity
  - Scheduling is Implementation defined
- Introduces Continuous Traffic to existing Reliable Traffic
  - Reliable traffic uses VC0, priority based
  - VC1 – VC8 can support Continuous Traffic
- Increases utilization of the switch fabric



Virtual Output Queuing

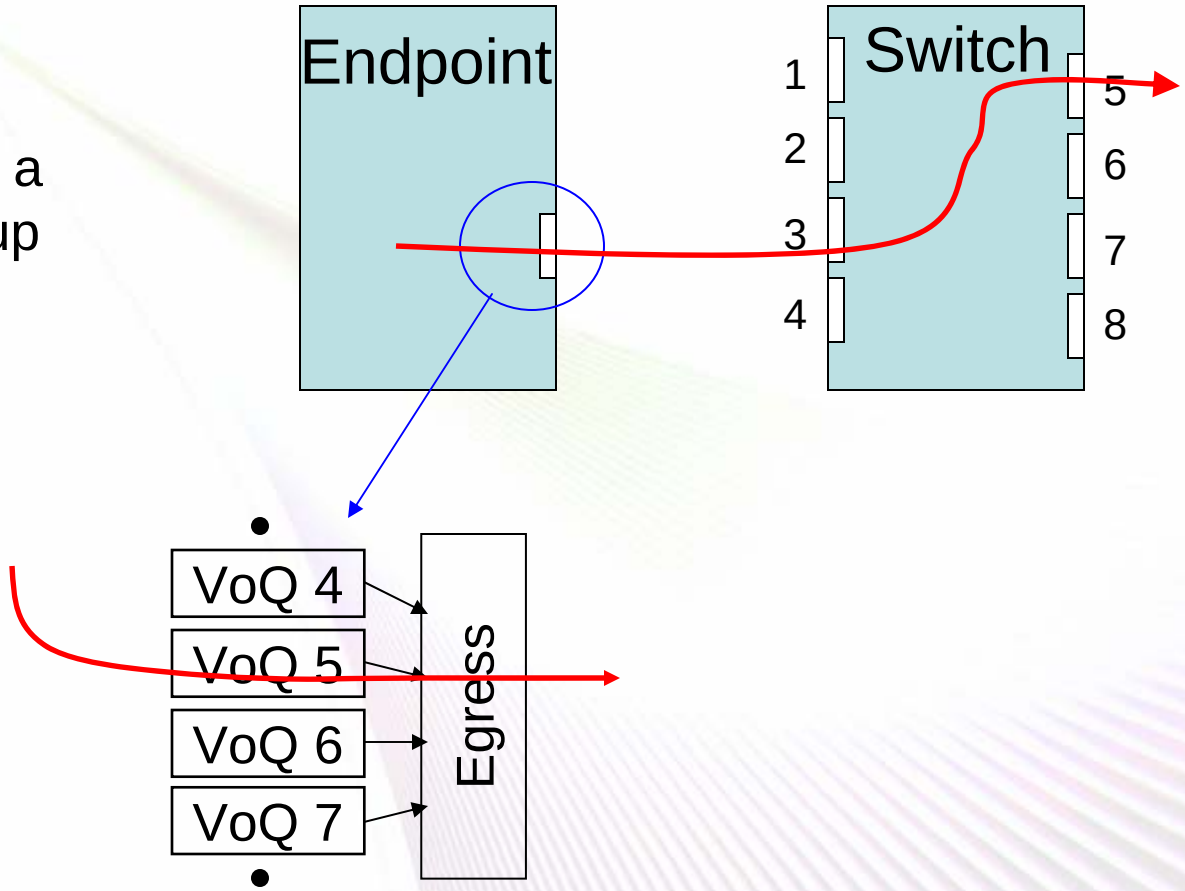
- Method that provides physical layer status messages to communicate congestion status of downstream device's ports.
- Greatly reduces head-of-line (HOL) blocking, increasing fabric performance
- Utilizes the new extended control symbol

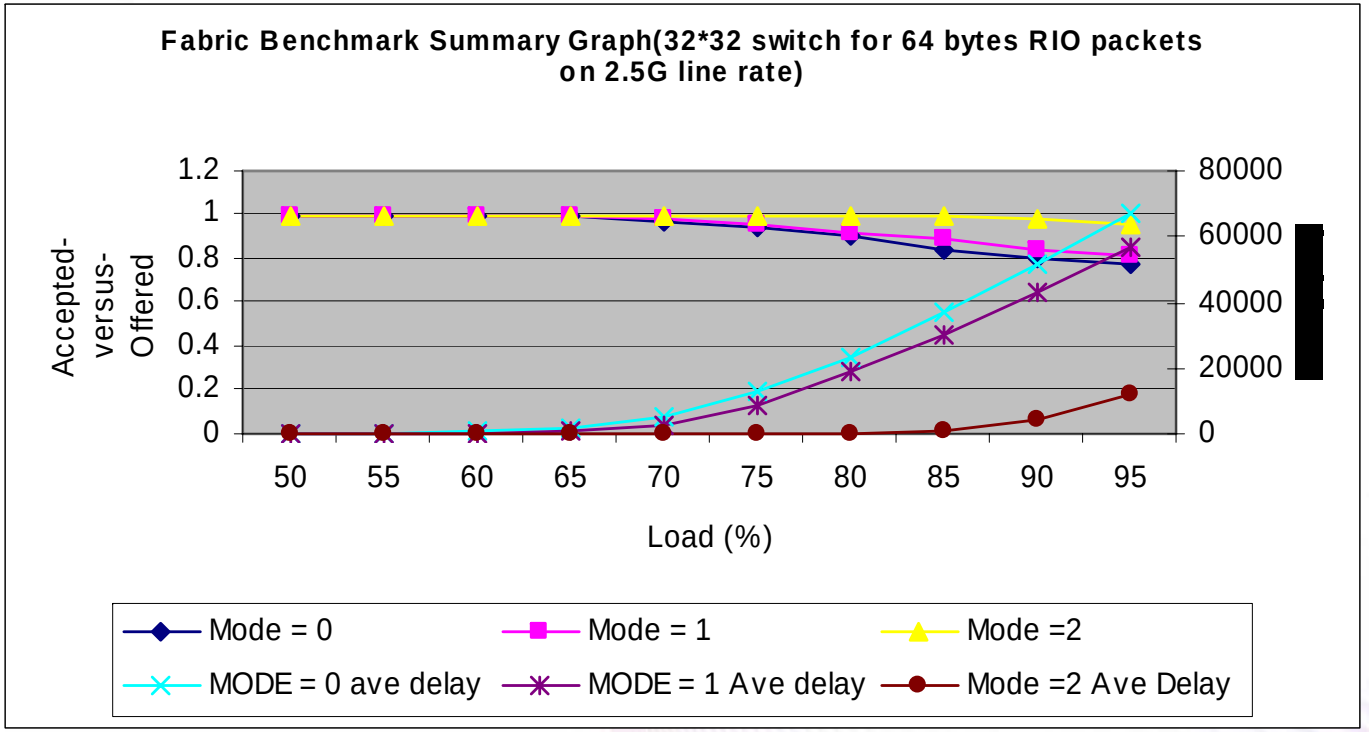


VoQ Looks Forward

DestID	VoQ

Endpoints require a single stage lookup table





Mode 0 = v1.3 based traffic
Mode 1 = VC based
Mode 2 = VC + VoQ

Courtesy of Chunhua Hu, Erlang Technologies

Flow Control Options

- Goal of flow control is to prevent traffic from being admitted to fabric if resources aren't available at the destination
- Course grain flow control using Type 7 packets allows arbitration of segmentation contexts at the PDU level
- Fine Grain flow control uses Type 9 extended header which allows receiver to throttle back the transmitter based on COS and stream based queues.

Encapsulation

- Specification of Encapsulation over RapidIO
  - Standard is agnostic of encapsulated protocol
  - Standard supports existing devices which support Message (type 11) packets
  - Standard also supports Data Streaming (Type 9) packets
  - Does not support memory mapped transfers
- Defines Software and Hardware Methodology for Advertising participation, managing the session, and actual packet encapsulation formats

Summary

- Higher Bandwidth, Maintaining Low Overhead
- Complete Set of Transactions
  - I/O
  - Messaging
  - Globally Shared Memory
  - Streaming Data
- Carrier Grade Data Fabric Performance
  - Deterministic Latency
  - Quality of Service
  - End to End Data Management
- Standardization of Encapsulation

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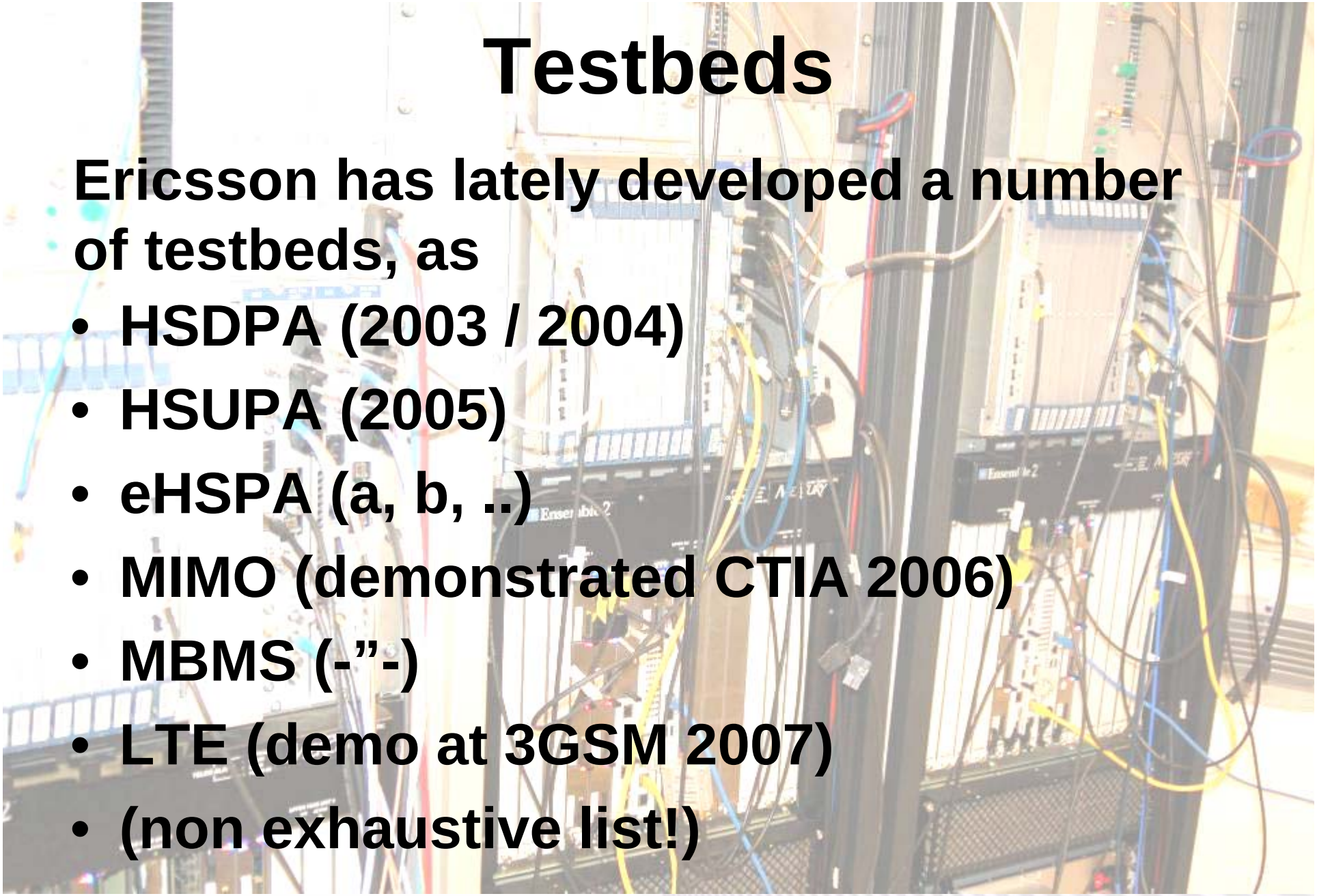
Some experiences from actually using sRIO

Dr Peter Olanders
Ericsson AB

ERICSSON
TAKING YOU FORWARD

Testbeds



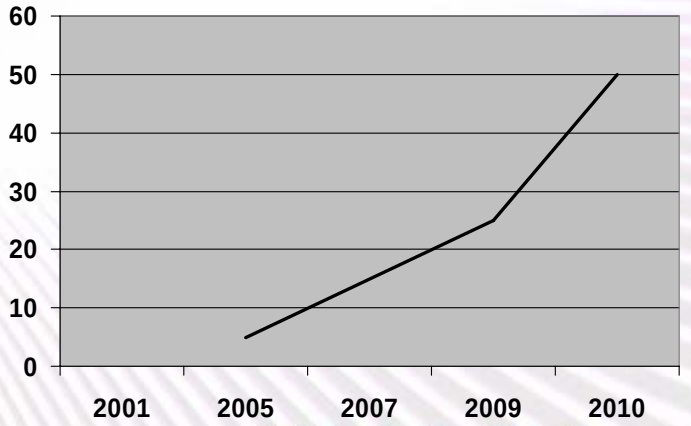
Ericsson has lately developed a number of testbeds, as

- **HSDPA (2003 / 2004)**
- **HSUPA (2005)**
- **eHSPA (a, b, ..)**
- **MIMO (demonstrated CTIA 2006)**
- **MBMS (-”-)**
- **LTE (demo at 3GSM 2007)**
- **(non exhaustive list!)**

Testbeds and purpose

- Demonstrate high data rates in mobile systems

	Mbit/s
• HSDPA	5-15 DL
• HSUPA	2-5 UL
• eHSPA	25 / 10 -> 50/20 ->??
• LTE	100 / 50 ++



- MBMS: Multimedia Broadcast Multicast service

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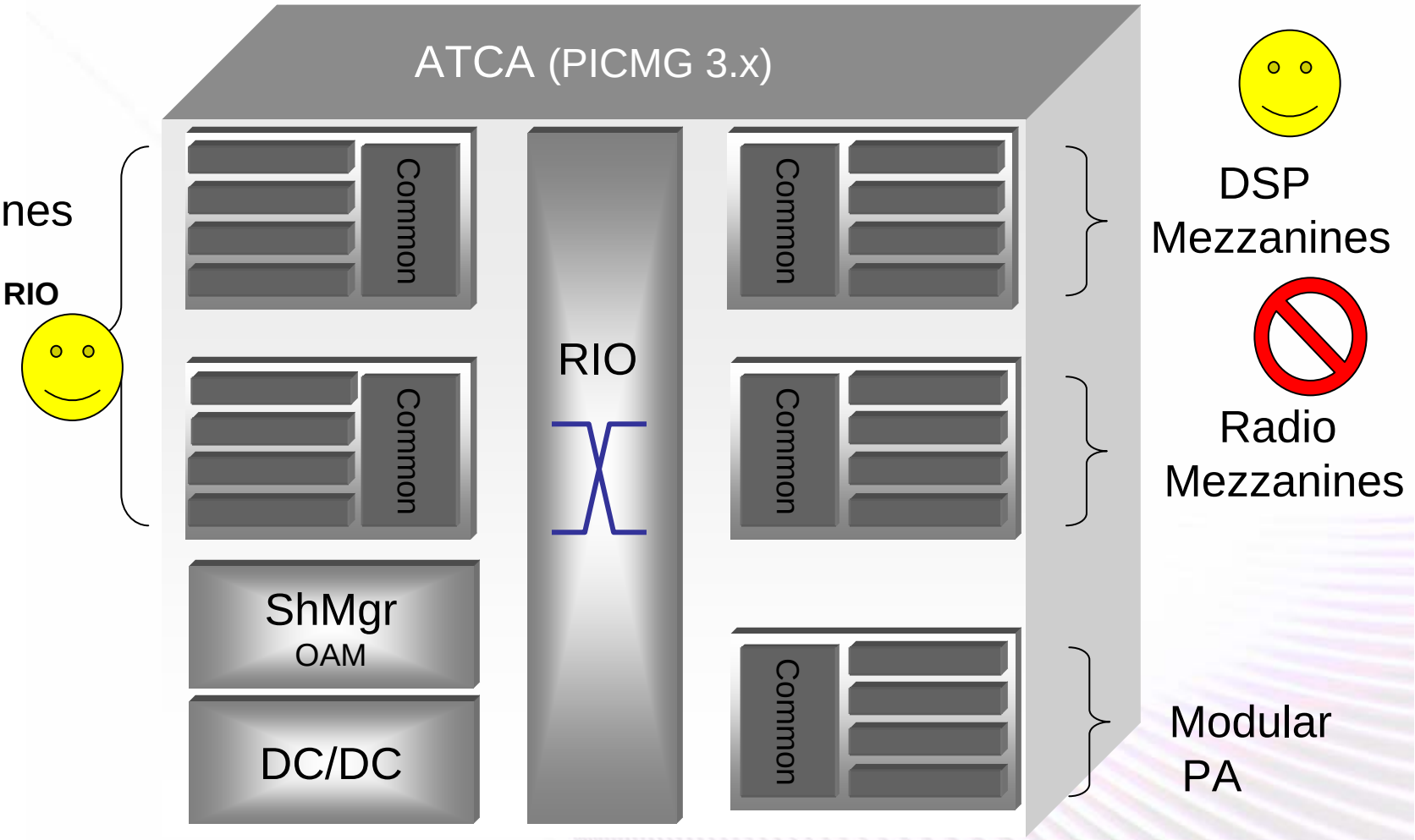
We all start from somewhere

- First building practise
- Propretiary format
- In a PC case

- It worked fine
- But hardly flexible, re-usable, scalable ....

Long term vision, 2003



Note: this is for testbeds, not for products!

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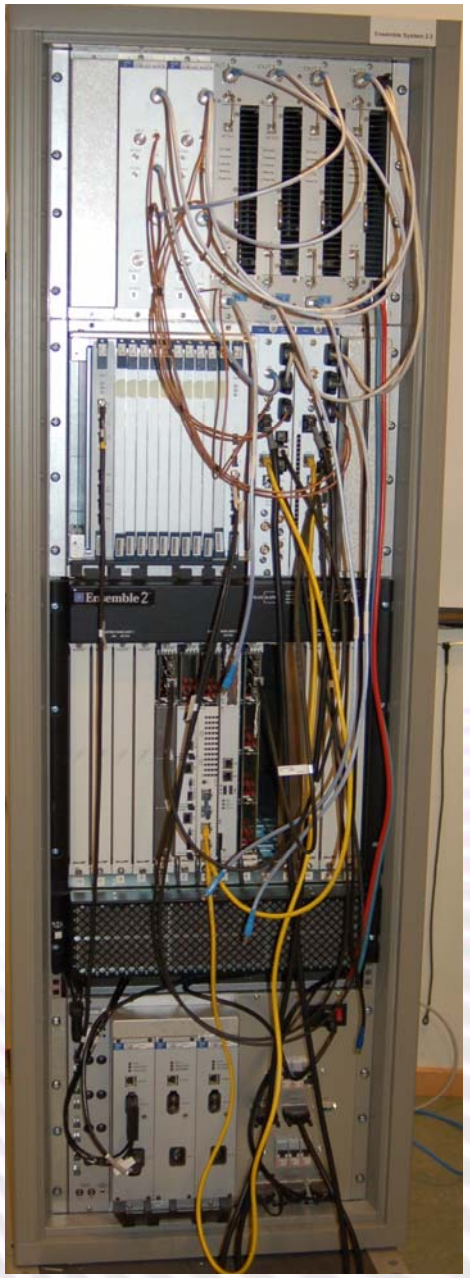
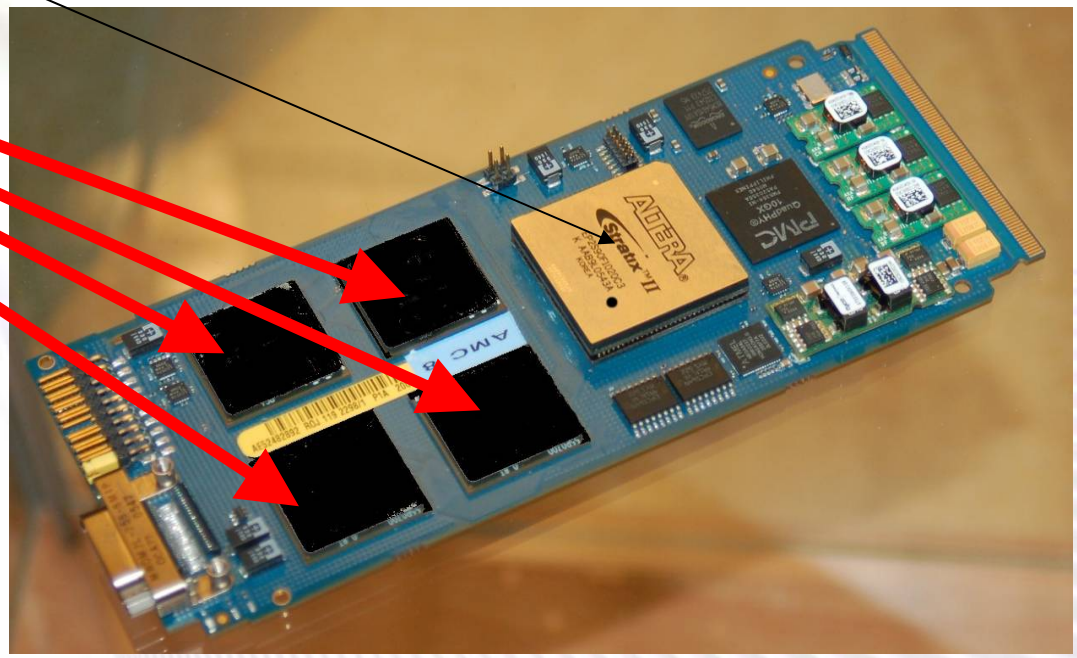
High data rate RBS testbed

- Clearly, **not** an Ericsson product
- It is a testbed!
- sRIO in all digital parts



Mezzanine level

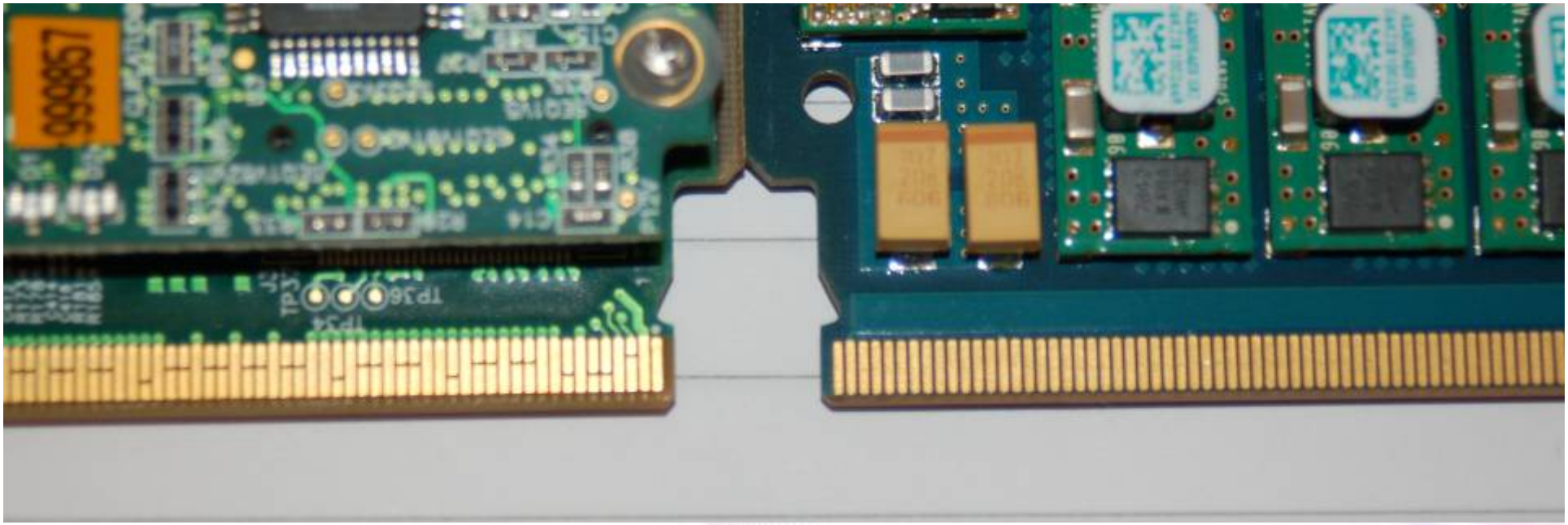
DSPs & some glue and comms



- AMC
- Can be used in ATCA and mTCA
- Quite generic

Note: testbed!

Life is full of problems ...



- Contact – or lack thereof
- In fact, for hot-swap, it should be the broken connectors (left).

An UE was developed as well

- Not really handheld
- But mobile
- A complete system
- Possible to test system mobile performance

sRIO experiences - testbeds

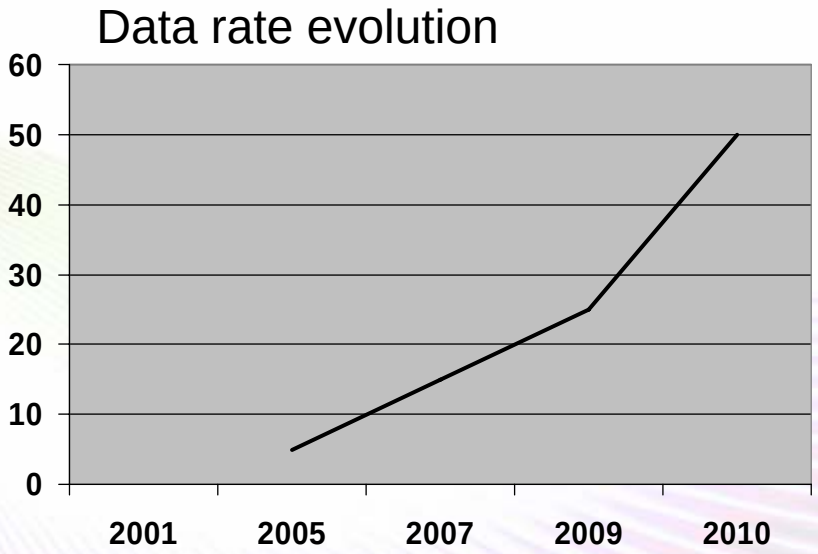
- More flexible than anticipated
- Easy to use
- Hot-swap works fine
- BB – radio interface sRIO based!
- Interoperability, as always

sRIO use in testbeds

- Every user set up his/her way of using a technology; a protocol
- We used e.g. a combination of SWRITE and NWRITE DOORBELL
- Maintenance write/read for system configuration and monitoring
- .... Interoperability?

Future demands on sRIO

- Higher data rates
  (3 -> 6 -> 10 -> ..)
- 2x – for cost & efficiency
- Virtual Channels (VC),
  Virtual output Que (VoQ)
- Interoperability
  what is realistic?
- Ethernet interworking
- Traffic Management -extensions



Summary

- sRIO has been a key component in developing a multitude of advanced testbeds
- Facilitating re-use of hw and sw
- sRIO more flexible and easy to use than expected
- Wishlist: 2X, 6Gbit/s -> 10 Gbit/s
- Interoperability

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Some experiences from actually using sRIO

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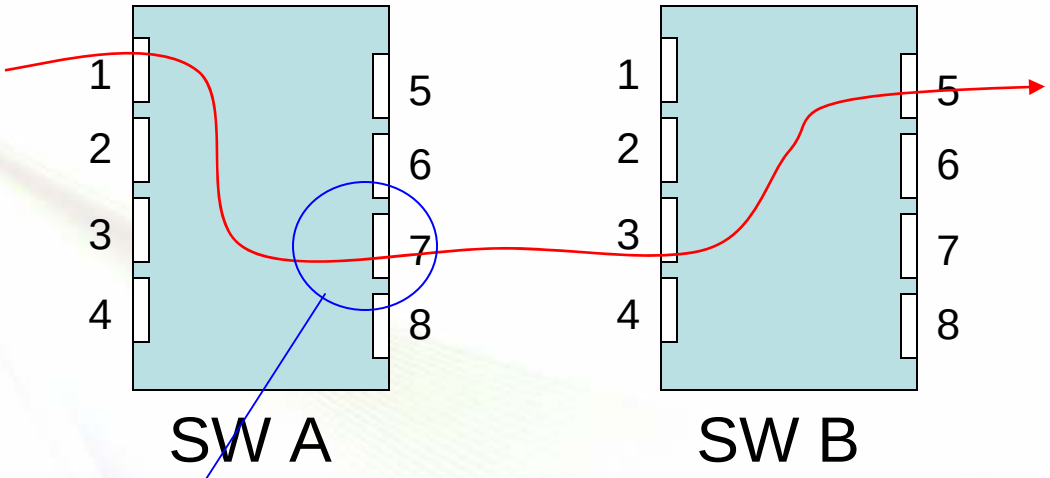
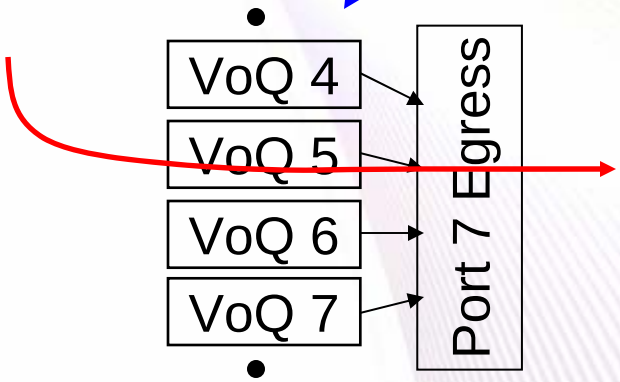
Backup

VoQ Looks Forward

DestID	Port	VoQ

Switches require two stage table entries





Flow Control Arbitration

- Extends the existing Type 7 congestion management packet functionality defined for flow level control
- Allows endpoints to manage and arbitrate for resource Segmentation and Reassembly (SAR) contexts at a PDU level
- Prevents traffic from being admitted to the fabric if there are no receiving end resources
- Endpoint wishing to transmit data sends Request message for single or multiple PDUs
- Receiving device allocates (Xon) or de-allocates (Xoff)
- Allows pipeline of request and TX Release message to de-allocate resources

Traffic Management

- Allows endpoints to coordinate traffic flows between class and stream based queues
- Uses the extended header type 9 packet format
  - Offers finer granularity control than type 7
- Receiving device sends messages to the transmitting device to throttle traffic
- Supports On/Off, Rate based, and Credit based schemes

Encapsulation

Standard has three parts:

- Advertising participation in messaging scheme
  - Capabilites such as conveyance, mailbox ID, StreamID, COS
- Session Management Protocol
  - Discovering how to communicate
  - Identify protocols available and attributes about the protocols
- Encapsulation Format

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