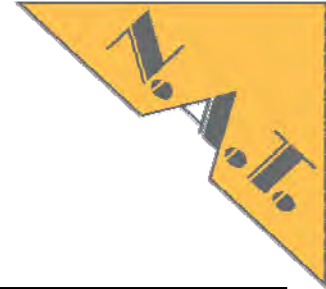


Heiko Körte  
Director Sales & Marketing

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Session 102

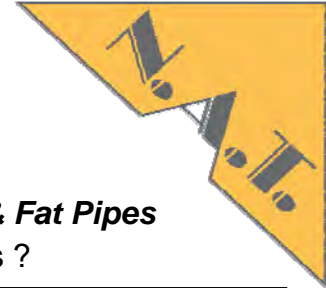
***μTCA*** in practise:

**Applications and Fat Pipes – future of fat pipes ?**

xTCA summit, October 28<sup>th</sup>, 2009

Convention Center, Santa Clara, CA

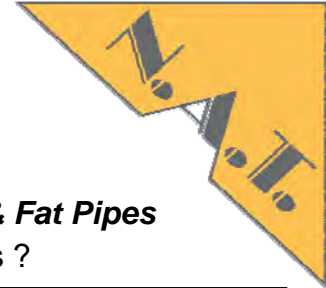
# Motivation



***μTCA*** *in practise: Apps & Fat Pipes*  
future of fat pipes ?

- "Fat Pipes"
  - What is a "fat pipe" ?
  - Which "fat pipes" are defined ?
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- Combining "fat pipes"
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  - What is the impact on my system architecture ?
- Solutions available in the future

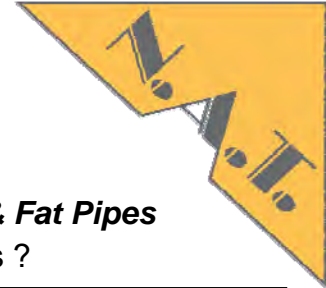
# Agenda



***μTCA*** *in practise: Apps & Fat Pipes*  
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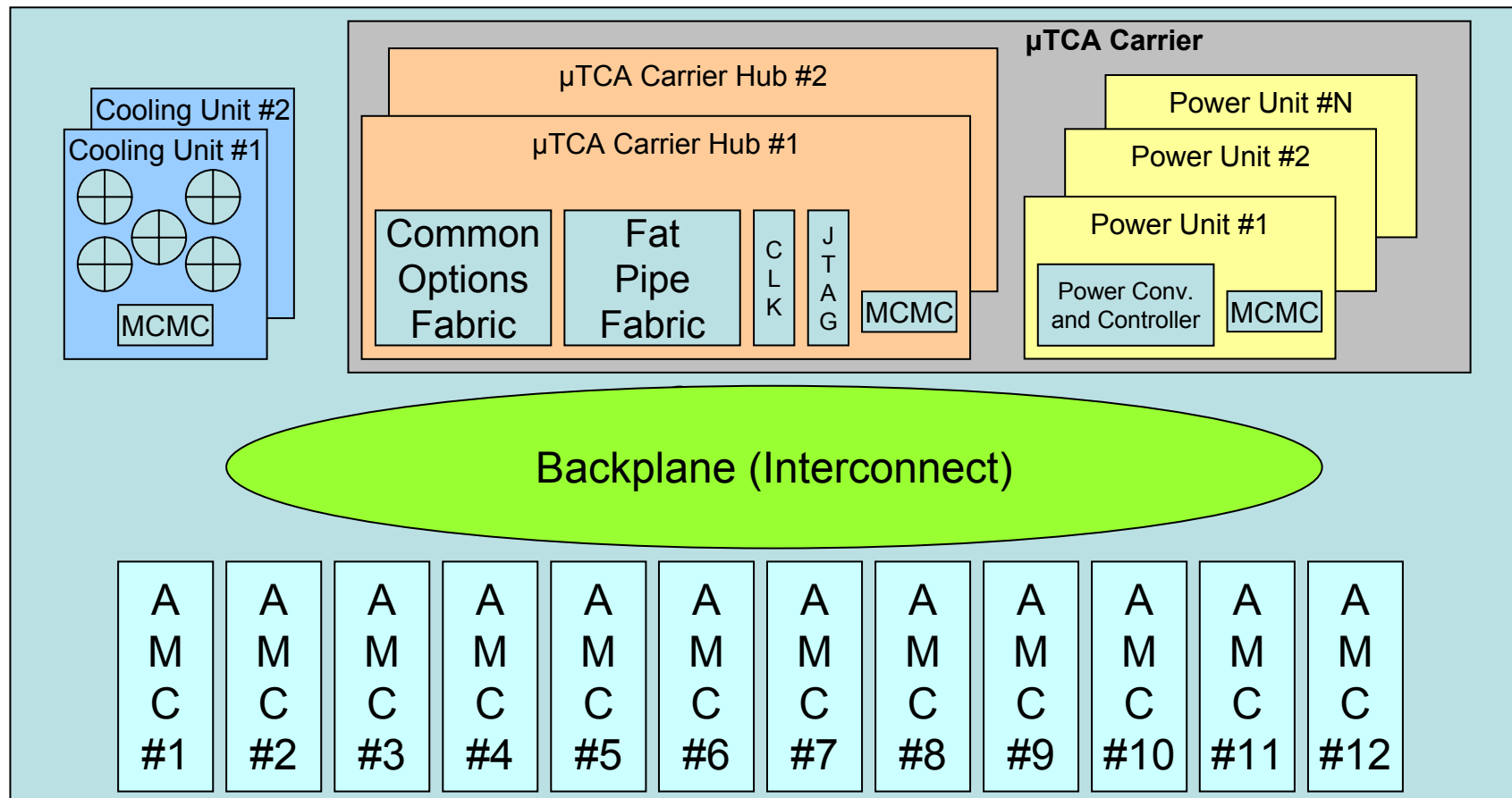
# What is a "Fat Pipe"?

Location in a  $\mu$ TCA System



$\mu$ TCA in practise: Apps & Fat Pipes  
future of fat pipes ?

- Components of a  $\mu$ TCA shelf

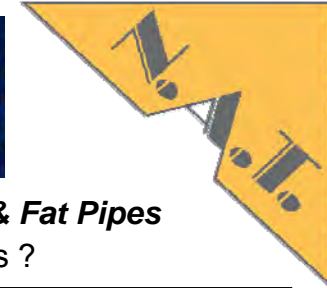


# What is a "Fat Pipe"?

## Serial Data Transmission



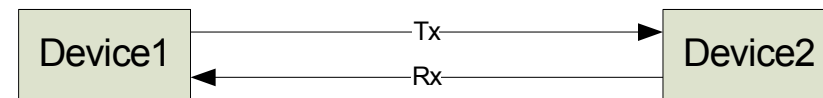
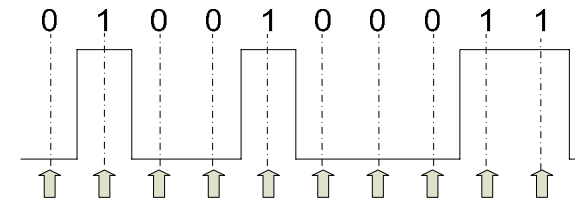
**µTCA** in practise: Apps & Fat Pipes  
future of fat pipes ?



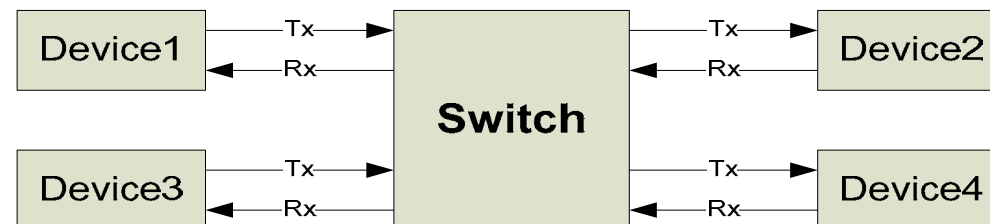
- Bits are transmitted one after the other over single data line
- Every data byte (8bit) is transformed to 10bit symbol that contains enough transitions

### → 8B/10B Coding

- Clock is recovered from serial stream
- Bidirectional transmission via dedicated Tx and Rx lines
  - One Tx/Rx pair is called "Lane"



- Multiple Devices interconnect realized with **Switches**



# What is a "Fat Pipe"?

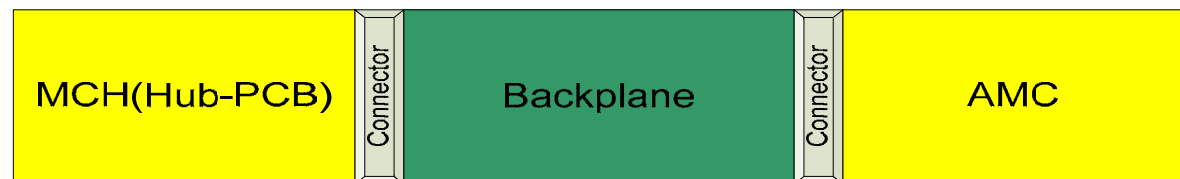
## Serial Data Transmission



**μTCA** in practise: Apps & Fat Pipes  
future of fat pipes ?

- Very high frequencies: > 1Ghz
  - No per-cycle-relation to other signal needed
  - point-to-point connections only
- Differential Signaling
  - Better immunity to disturbances and interferences
- Bandwidth is determined/limited by:
  - Maximum frequency depends on chip technology and interconnect quality
  - Example: Harting MCH/AMC plugs and backplane connectors are specified with 6,125GHz
  - Multiple Lanes are used in parallel to increase bandwidth

- The whole signal path is important!



slide 7

# Agenda



***μTCA*** *in practise: Apps & Fat Pipes*  
future of fat pipes ?

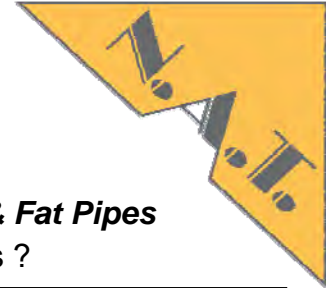
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# Definition of "Fat Pipes"

## Overview



**μTCA** in practise: Apps & Fat Pipes  
future of fat pipes ?



- Defined in PICMG AMC.x series (the "Fabrics"):
  - AMC.0 – Base Specification
  - AMC.1 – PCI Express (PCIe)
  - AMC.2 – Ethernet (1GbE and 10GbE/XAUI)
  - AMC.3 – Storage (SAS/SATA)
  - AMC.4 – Serial Rapid I/O (SRIO)

# Definition of "Fat Pipes"

## PCIe – Programmer's Darling



**μTCA** in practise: Apps & Fat Pipes  
future of fat pipes ?



- 2,5Gbit/s raw bit frequency
  - After 8B/10B decoding 2Gbit/s transmission speed
  - Results in ~250MByte/s effective data rate per lane
  - Within μTCA: up to 4 lanes in parallel → ~1GByte/s
- Centralized architecture
  - Host required (upstream port)
  - Difficult to set up redundant systems (non-transparent upstream port)
- Software compatible to PCI
  - Comfortable for Programmer: Simple memory mapped accesses
- (Hardware-) Integrated:
  - Protocol Error Detection, Correction and Reporting
  - Flow Control and Quality-of-Service (Prioritization)

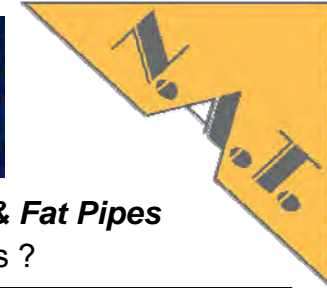


# Definition of "Fat Pipes"

## 1GbE – the well-known Ethernet



**μTCA** in practise: Apps & Fat Pipes  
future of fat pipes ?



- One lane with 1.25Gbit/s → 1Gbit/s after 8b/10b decoding per direction
- Decentralized communication model
  - easy to build up redundant systems
  - each device has unique MAC-address
- Suited for data exchange beyond the system barriers
  - no Data reorganization needed for direct connect to LANs
  - example: standard PC can be integrated in μTCA setup
- Data integrity is ensured by higher layer protocols  
=> high amount of computing resources required

# Definition of "Fat Pipes"

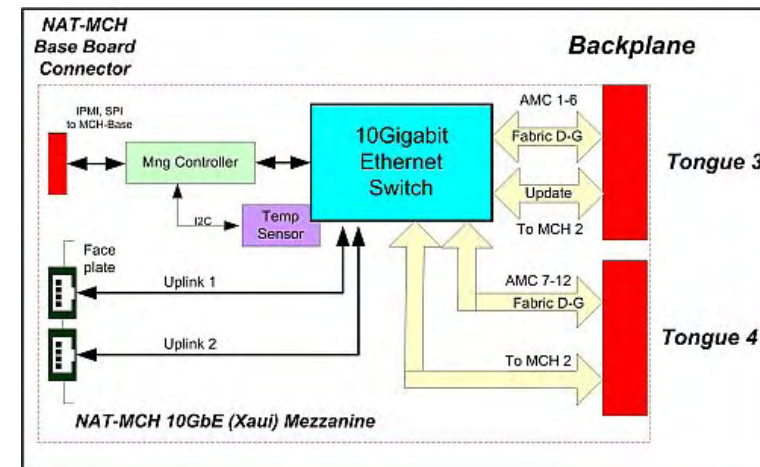
## 10GbE – Ethernet with turbo



**µTCA** in practise: Apps & Fat Pipes  
future of fat pipes ?



- 4 lanes at 3.125Gbit/s per lane per direction
  - resulting in 2.5Gbit/s per lane per direction after 8b/10b decoding => 10Gbit/s per direction in total
- 20 port XAUI switch from Fulcrum Microsystems (FM2220) on XAUI hub mezzanine
- Basic Features:
  - port speed selectable per port:
    - XAUI (10GbE) or
    - 2.5GbE or
    - 1GbE
  - 2 uplink ports on faceplate
    - 10GBase-CX4



slide 12

# Definition of "Fat Pipes"

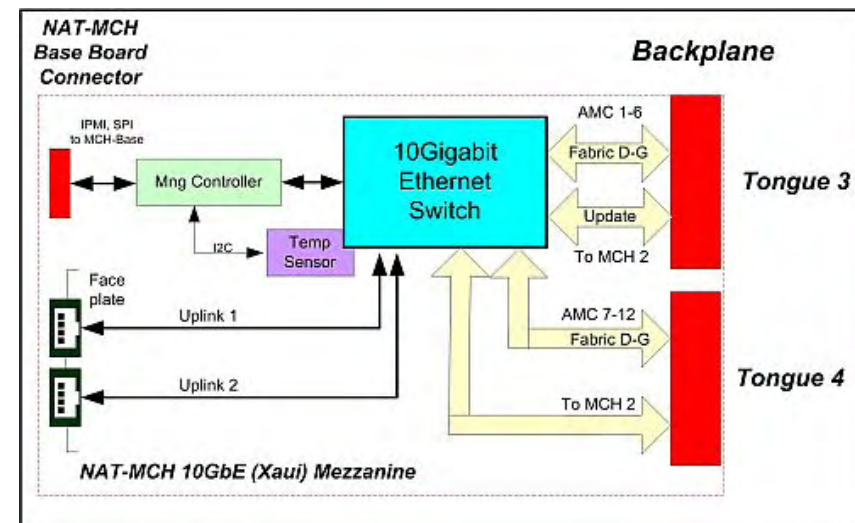
## 10GbE – Ethernet with turbo



**μTCA** in practise: Apps & Fat Pipes  
future of fat pipes ?



- Security Features:
  - MAC address security
  - port access control
- Layer2 Bridging Features:
  - spanning tree
  - VPN priority
  - link aggregation
  - duplex flow control
  - traffic shaping



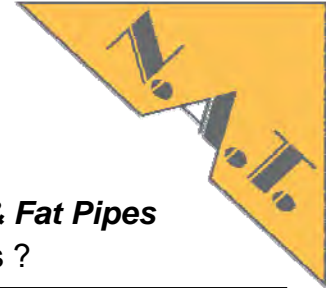
slide 13

# Definition of "Fat Pipes"

## SRIO – combining advantages



**µTCA** in practise: Apps & Fat Pipes  
future of fat pipes ?



- x1 or x4 SRIO with configurable speed per port:
  - 1.25Gbps per direction
  - 2.5Gbps per direction
  - 3.125Gbps per direction
- 👉 Link partners must be set to same speed!
  - > max. 10Gbps per direction after 8b/10b decoding
- Decentralized communication model
  - > No host required
    - Peer-to-Peer communication
    - Easy to build up redundant systems
- Memory mapped access possible
- Hardware data integrity

# Definition of "Fat Pipes"

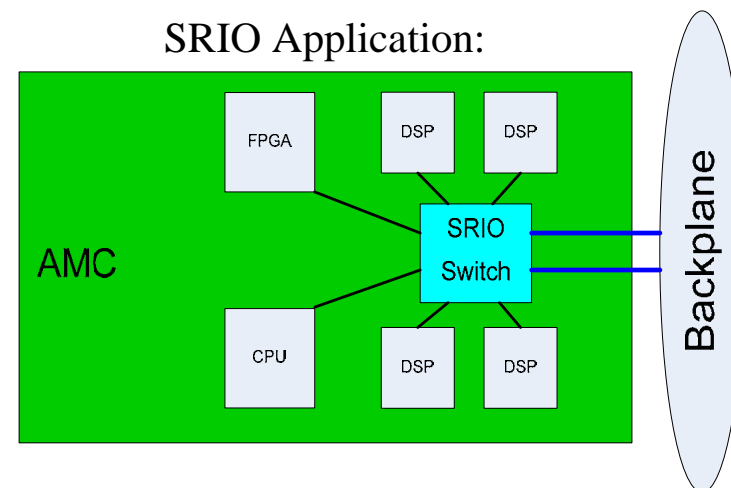
SRIO – combining advantages



*μTCA* in practise: Apps & Fat Pipes  
future of fat pipes ?

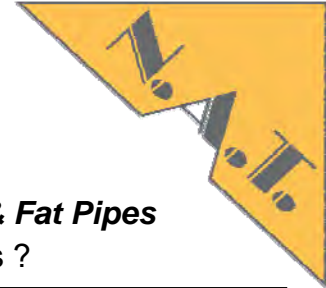


- still not well recognized ("Is this new ?")
- growing silicon ecosystem (CPUs, DSPs, FPGAs)
- high-speed chip-to-chip and/or board-to-board connection
  - no protocol conversion needed
- Features of Tundra TSI578:
  - very low port-to-port latency (min. 112ns)
  - hardware multicast
  - packet prioritization



slide 15

# Agenda

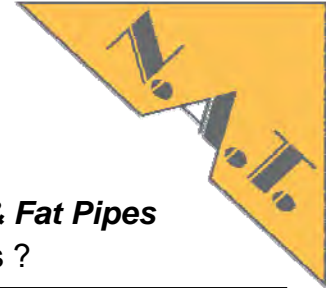


***μTCA*** *in practise: Apps & Fat Pipes*  
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# Which "Fat Pipes" ?

## fabric comparison and applications



**μTCA** in practise: Apps & Fat Pipes  
future of fat pipes ?

Protocol	PCIe	10 GbE	SRIO
<b>Advantage</b>	<ul style="list-style-type: none"> <li>Memory mapped access</li> <li>Software compatible to PCI</li> </ul>	<ul style="list-style-type: none"> <li>Not only for system internal connectivity</li> <li>Data is ready for connect direct to LAN</li> </ul>	<ul style="list-style-type: none"> <li>Hardware data integrity</li> <li>Memory mapped access</li> </ul>
<b>Disadvantage</b>	<ul style="list-style-type: none"> <li>Host needed</li> </ul>	<ul style="list-style-type: none"> <li>High Software Overhead</li> </ul>	<ul style="list-style-type: none"> <li>???</li> </ul>
<b>Typical Application</b>	<ul style="list-style-type: none"> <li>Processing Blade</li> <li>Next generation Industrial PC</li> </ul>	<ul style="list-style-type: none"> <li>Media Gateway Network Convergence</li> </ul>	<ul style="list-style-type: none"> <li>Distributed Data processing or Data Acquisition</li> </ul>

# Which "Fat Pipes" ?

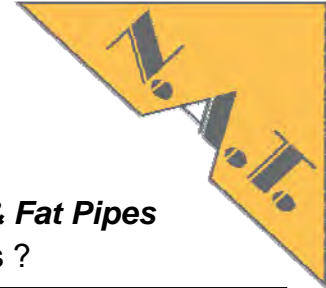
## fabric comparison and applications



**µTCA** in practise: Apps & Fat Pipes  
future of fat pipes ?

Protocol	PCIe	10 GbE	SRIO
<b>Used in</b>	<ul style="list-style-type: none"> <li>Automation</li> <li>Medical</li> <li>Defense</li> <li>(Tele-)coms</li> </ul>	<ul style="list-style-type: none"> <li>Defense</li> <li>Telecom</li> </ul>	<ul style="list-style-type: none"> <li>Automation</li> <li>Medical</li> <li>Defense</li> <li>Telecoms</li> </ul>
<b>Formfactors</b>	<ul style="list-style-type: none"> <li>19" 1-5U</li> <li>Table Top</li> </ul>	<ul style="list-style-type: none"> <li>19" 1-5U</li> </ul>	<ul style="list-style-type: none"> <li>19" 1-5U</li> <li>Table Top</li> </ul>
<b>Specialities</b>	<ul style="list-style-type: none"> <li>Redundancy</li> <li>Clustering</li> </ul>	<ul style="list-style-type: none"> <li>Redundancy</li> <li>Trunking</li> </ul>	<ul style="list-style-type: none"> <li>Redundancy</li> <li>Inter-system links</li> </ul>

# Motivation



***μTCA*** in practise: Apps & Fat Pipes  
future of fat pipes ?

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# Combining "Fat Pipes"

Are there any standards ?



**μTCA** in practise: Apps & Fat Pipes  
future of fat pipes ?



- There definitely are standards:

-> defined by PICMG:

- AMC.0: AMC base specification
- AMC.1: PCIe
- AMC.2: Ethernet (1GbE and 10GbE)
- AMC.3: Storage (SAS/SATA)
- AMC.4: SRIO
- MTCA.0: uTCA base specification



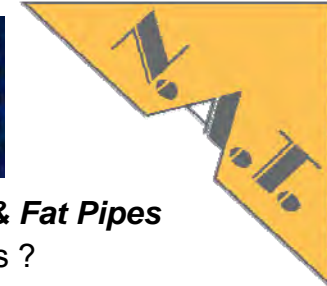
- PICMG: PCI Industrial Manufacturers Group

*"PICMG is a consortium of companies who collaboratively develop open specifications for high performance telecommunications and industrial computing applications."*

-> [www.picmg.org](http://www.picmg.org)

# Combining "Fat Pipes"

## PICMG AMC-to-MCH port mapping



**μTCA** in practise: Apps & Fat Pipes  
future of fat pipes ?

Con.	Region	Port	Function	1x MCH	2x MCH
Basic Side	Clock	TCKLA	Telecom Clock A	CLK1	1-CLK1
		TCLKB	Telecom Clock B	CLK2	1+2-CLK2
		FCLK	Fabric Clock or redundant TCLKA	CLK3	2-CLK1
	Common Options	0	1GbE	1-A	1-A
		1	redundant 1GbE		2-A
		2	SAS/SATA	1-B	1-B
		3	redundant SAS/SATA		2-B
	Fat Pipe	4	PCIe or 10GbE or SRIO	1-D	1-D
		5	PCIe or 10GbE or SRIO	1-E	1-E
		6	PCIe or 10GbE or SRIO	1-F	1-F
		7	PCIe or 10GbE or SRIO	1-G	1-G
Extended Side	Extended Fat Pipe	8	1GbE or 10GbE or SRIO		2-D
		9	1GbE or 10GbE or SRIO		2-E
		10	1GbE or 10GbE or SRIO		2-F
		11	1GbE or 10GbE or SRIO		2-G
	Extended Options	12			
		13			
		14			
		15			
		TCLKC+D	Telecom Clocks C+D		
		17			
		18			
		19			
20					

### AMC to MCH port mapping according to PICMG

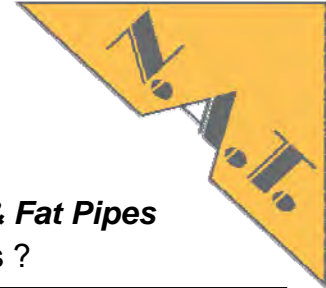


# Combining "Fat Pipes"

Are there any other standards ?



**μTCA** in practise: Apps & Fat Pipes  
future of fat pipes ?



- based on the PICMG definitions there are other requests from industrial users

- SCOPE Alliance:

*"SCOPE is an association of Network Equipment Providers aimed at accelerating the deployment of Carrier Grade Base Platforms for service provider applications."*

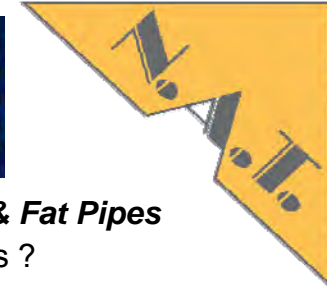
*„SCOPE's mission is to enable and promote the availability of open carrier grade base platforms based on Commercial Off The Shelf (COTS) hardware / software and free open source software building blocks, and to promote interoperability to better serve Service Providers and consumers."*

-> [www.scope-alliance.org](http://www.scope-alliance.org)



# Combining "Fat Pipes"

## SCOPE AMC-to-MCH port mapping



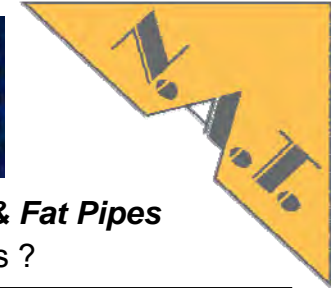
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		FCLK	Fabric Clock or redundant TCKLA	CLK3	1-CLK3
	Common Options	0	1GbE	1-A	1-A
		1	redundant 1GbE		2-A
		2	SAS/SATA		
		3	redundant SAS/SATA		
	Fat Pipe	4	Point-2-Point, e.g. PCIe		
		5	Point-2-Point, e.g. PCIe		
		6	Point-2-Point, e.g. PCIe		
7		Point-2-Point, e.g. PCIe			
Extended Side	Extended Fat Pipe	8	1GbE or 10GbE or SRIO	1-D	1-D
		9	1GbE or 10GbE or SRIO	1-E	1-E
		10	1GbE or 10GbE or SRIO	1-F	1-F
		11	1GbE or 10GbE or SRIO	1-G	1-G
	Extended Options	12	APS or Point-2-Point or rearIO		
		13	Point-2-Point or rearIO		
		14	Point-2-Point or rearIO		
		15	Point-2-Point or rearIO		
		TCLKC+D	Telecom Clocks C+D		2-CLK1+2
		17	1GbE or 10GbE or SRIO		2-G
18	1GbE or 10GbE or SRIO		2-F		
19	1GbE or 10GbE or SRIO		2-E		
20	1GbE or 10GbE or SRIO		2-D		

## AMC to MCH port mapping according to SCOPE



# Motivation



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future of fat pipes ?

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# Combining "Fat Pipes"

## PICMG vs. SCOPE

### impact on system architecture

---



**μTCA** *in practise: Apps & Fat Pipes*  
future of fat pipes ?



- Problem:
  - SCOPE has a different port mapping than PICMG
- Question: does the SCOPE approach specially designed components?

Potentially affected components:

- MCH
- AMCs
- backplane



# Combining "Fat Pipes"

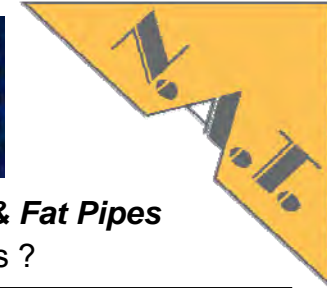
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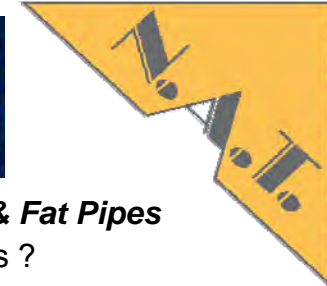
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PICMG vs. SCOPE  
 impact on AMCs



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		9	1GbE or 10GbE or SRIO	1GbE or 10GbE or SRIO
		10	1GbE or 10GbE or SRIO	1GbE or 10GbE or SRIO
		11	1GbE or 10GbE or SRIO	1GbE or 10GbE or SRIO
		12		APS or Point-2-Point or rearIO
	Extended Options	13		Point-2-Point or rearIO
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		15		Point-2-Point or rearIO
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19		1GbE or 10GbE or SRIO		
20		1GbE or 10GbE or SRIO		

PICMG

OK

# Combining "Fat Pipes"

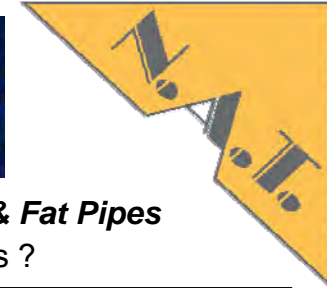
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# Combining "Fat Pipes"

## PICMG vs. SCOPE

### impact on system architecture



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future of fat pipes ?

- Problem:  
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- ✓ MCH
- ✓ AMCs
- ✓ Backplane

- Answer: yes, it does !

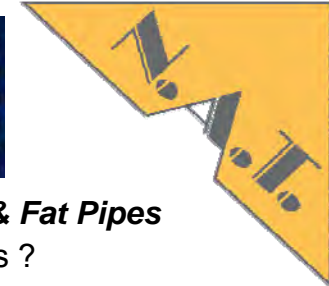
# Agenda



***μTCA*** *in practise: Apps & Fat Pipes*  
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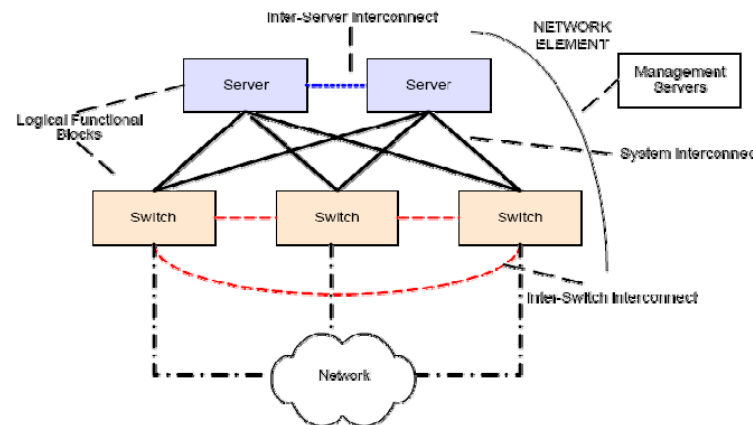
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  - What "fat pipe" to use for my application ?
- Combining "fat pipes"
  - Are there any standard definitions ?
  - What is the impact on my system architecture ?
- Solutions available in the future

# Solutions in the future



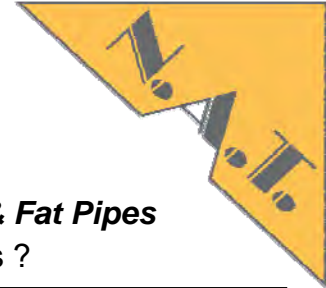
**μTCA** in practise: Apps & Fat Pipes  
future of fat pipes ?

- SCOPE is representing an important momentum in the market:
  - New standards in communication systems:
  - driven by big **tele**communication **com**panies (**TelCo**) and IC Manufactures
  - reflect the structure/challenges of next generation networks:



- However: SCOPE users are not the only ones !

# Solutions in the future

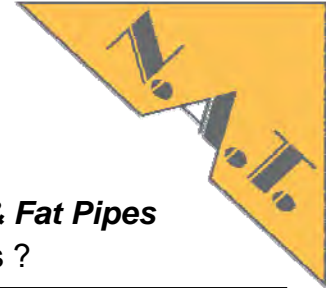


**μTCA** in practise: Apps & Fat Pipes  
future of fat pipes ?

- Consequences:
  - AMCs:
    - vendors with SCOPE customers will support both
    - vendors with mainly non-SCOPE customers will support PICMG only
  - backplanes:
    - vendors will have two product lines
  - MCH:
    - a PICMG standard compliant MCH will support both
    - MCH will provide switches with „inter-fabric“ routing:
      - PCIe – SRIO
      - XAUI - SRIO



# Summary

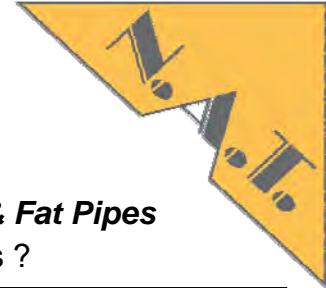


***μTCA*** in practise: Apps & Fat Pipes  
future of fat pipes ?

- "Fat Pipes"
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# Round Up

The last slide ...

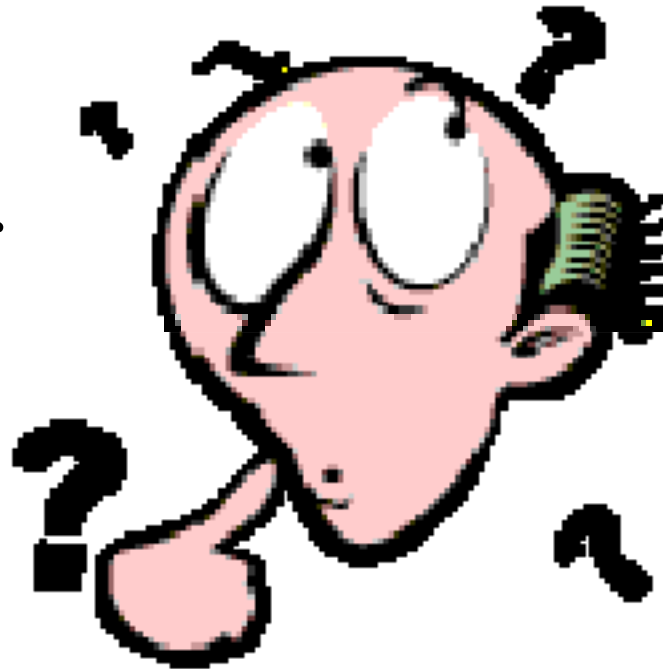


***μTCA*** in practise: Apps & Fat Pipes  
future of fat pipes ?

## This was it ...

I know, you have heard what I said ...

**... but ...**



... I am not sure if this was what I meant ...