Enabling 21st Century Connectivity

First MXC™ Adopters meeting
March 11, 2014
Presenters

• Victor Krutul
  – Director Marketing, Intel® Corp

• Mike Hughes
  – Director, Product Management, US Conec
Agenda

• Goal of the MXC™ Adopters forum
• Why Intel® is involved
• MXC™ Supporters
• MXC™ Details
• Schedule
• Certification
• Call to Action
MXC™ Adopter’s Forum: Goals

1. Raise awareness of MXC™ technology
2. Provide information on MXC™ Marketing Collaterals
3. Accelerate deployment of MXC™ technology
4. Provide information on MXC™ Certification Program
5. Provide common forum for feedback
Why Is Intel® Involved?

Data Explosion*
“Every day we create 2.5 quintillion (10^{18}) bytes of data – so much that 90% of the world’s data today has been created in the last two years alone.”

- Intel® has a history of working with the Industry to improve people’s computing experience
  - USB, PCI Express, Infiniband, Ethernet . . .
- We heard from our customers (Data Center, HPC, Telco, Networking, Industrial) about the need for a new generation of optical connector
- We partnered with leaders in this Industry to help define & develop the technology
- Intel will continue to drive architectures and solutions with our customers that will use this MXC™ technology

* Source: IBM study on Storage http://www.storagenewsletter.com/rubriques/market-reportsresearch/ibm-cmo-study
MXC™ – Industry Innovators
## Relationship & Roles Of The Companies

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<th><strong>US Conec</strong></th>
<th><strong>Intel</strong></th>
<th><strong>Cables</strong></th>
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| • Designed, tooled and sells the MXC™ components to cable companies  
• Provides training, certification and logo to MXC™ adopters | • Makes and sells Intel® Silicon Photonics  
• Promotes MXC™ adoption applications like RSA, Top of Rack, ethernet, and high performance computing | • Developed and sells MXC™ cables and cable assemblies  
• Buys bag-of-parts (BOP) from US Conec |
Presenters

• Victor Krutul
  – Director Marketing, SPSG, Intel® Corp

• Mike Hughes
  – Director, Product Management, US Conec
What is Being Announced

• US Conec announced the availability MXC™ optical connector technology
• MXC™ cable components have been sampled to customers and will be available for production in Q2 2014
• US Conec also announced that it has established a MXC™ certification program
• Corning, Molex and TE Connectivity announced they will build and sell MXC™ based cable assemblies.
• First MXC™ Adopters meeting being held today
• Broad interest across cable companies, OEMs, ODMs & end users

Enabling 21st century connectivity
Outline For USC Discussion

• What is US Conec releasing?
• What is the application?
• Technology overview
  – MT/MPO background
  – Expanded Beam
  – PRIZM® MT Ferrule
  – Debris Insensitivity
  – MXC™ Connector Details
• Schedule
• Certification Program
What is US Conec releasing?

- **Initial MXC™ Plug and Receptacle design**
  - Designed for use with PRIZM® MT expanded beam ferrules
  - Training and Certification program with PRIZM® MT ferrules
  - US Conec will support MXC™ technology with historical business model
    - Training
    - Component (i.e., BOP) sales
    - Peripheral termination tools and equipment
  - Certification Program established
Why a New Connector Format?

In response to emerging data center equipment applications demanding a dense connector solution optimized for a direct card edge interface.

- Architectures with embedded optical devices
  - Silicon Photonic devices including Tx/Rx designs, future ASIC integration
  - Next generation miniature parallel VCSEL Tx/Rx devices
  - Multi-mode and Single-mode; Various wavelengths

- Basic Design Requirements
  1. Low Cost
     - Component cost
     - Processing/Termination cost
     - Installation and field cost
  2. Highly Reliable – Debris Insensitive
  3. High Density
     - Less faceplate area
     - Less PCB area
IBM PERCS P7 line cards first to implement PRIZM technology, along with ultra high density MTP interconnects.

This application begged for a higher density, equipment optimized connector!
Optical performance is based on:

- Fiber alignment (axial & angular based on ferrule & guide pin)
  - True position of fiber-holes in the ferrule relative to alignment pin holes
  - Tolerance of the alignment stainless steel pins
  - Diameter tolerance of fiber holes and alignment pin holes
- Fiber tip contact (endface geometry + connector spring force)
- Fiber tip cleanliness & quality

**Eliminated/Reduced Using Lensed Ferrules**

**Connector Component Quality**

**Endface Quality**

**Fiber Tip Quality**
Expanded Beam Interconnects

- Larger beam cross section results in less impact of debris
- Alignment tolerances at the mating plane of expanded beam interconnectors are reduced
- Collimated light results in forgiving alignment in z-axis
  - Less spring force required
  - Lenses provide very consistent loss
- Stable return loss governed by lens geometry

Fiber: core size: 50 micron

lens

Expanded beam: 180+ micron
PRIZM® MT MM: Ferrule Inside MXC™

- No Polish termination
- Same outer footprint as traditional MT
- Mating force required ~3N vs. 10-23N physical contact MPO
- Up to 16 fibers per row
- Up to 4 rows
- Supports 850nm and 1310nm applications

![Components diagram with labels](image)

- Epoxy windows
- Optical Stop Plane
- Fiber Lead-in area
- Precision micro holes
- 50 micron lens recess balances lens protection with cleanability

Hermaphroditic, post and hole alignment features
PRIZM® MT Ferrules Utilize Termination Process Commercialized For PRIZM® LT

A low-cost, no-polish termination procedure:
1. Cleave-only fiber array inserted into ferrule
2. UV or Thermal cure
3. Connector housing installed
4. Final optical testing
No Dust Worries

10x Better Dust Immunity

Recessed Integrated Lens for expanded beam

Fiber cladding

180 micron EB Diameter

50 micron Core Diameter

Z impact of debris = loss of physical contact for traditional ferrules
Simplified Component Structure

- Reduced complexity plug BOP
- One piece receptacle becomes part of the internal Tx/Rx to bulkhead jumper
- Traditional ‘adapter’ eliminated
MXC™: Equipment Interface

MTP® Cables are made to be strain relieved on two sides.

Smaller, MXC™ format are made to be ruggedized on the external cable only.

Space savings with MXC for card edge applications:
- 59% PCB area
- 40% faceplate area
- 132 MXC™ receptacles fit into a 19” 1U panel
ARC MXC™ Connector IL Performance

- 3360 IL measurements of MXC™ to MXC™ mating
- IL measurements of 1x8F and 2x8F combination
- Average IL is 0.37dB & Max IL is 0.7dB @ 99.5%
- Comparable to standard MTP IL performance
Coming Soon in 2014: Expanded MXC™ Platform

MXC™ Connector Platform – BOP available Q2 2014
1. Ganged Bulkhead
2. Ganged / Single Blind Mate

Benefits
- Ultra dense, Multi-ferrule variants
- Lower PCB space consumption
- Lower Cost Links
- Fewer, simplified components
- Multi-sourced cable assemblies
- With and without EMI protection
- With and without shutters for eye safety
MXC™ & PRIZM® MT Certification Program

To ensure quality cable assemblies are making it into market place, US Conec has established a formal training and certification program for PRIZM MT ferrules and MXC connectors

**Program Summary:**

- Company must attend formal, on-site training class (Hickory, NC) for PRIZM® MT ferrule (estimate 2 days) and MXC™ connector (estimate 1 day), as appropriate
- Terminate products using US Conec established procedures and documentation.
- Submit product samples to US Conec for evaluation prior to commercial sales and at regular intervals thereafter
  - Alternative equipment, processes, and/or material may be acceptable
  - 2 Information to be shared under NDA
- US Conec will conduct environmental and mechanical testing on the submitted samples
  - Certification for the products submitted will be granted upon successful completion of the testing

Certified Partners will be able to openly pursue MXC™ cable business
Schedule

• OFC 2014: MXC™ samples now available
• Q2: Low volume production
• Q3: Formal certification training begins at US Conec
• Q4: Volume production
Summary

• US Conec is now producing and sampling production grade MM PRIZM® MT ferrules and MXC® front panel connectors for next generation, embedded optic architectures

• The new connector technology is optimized for point to point, equipment card interface applications

• The MXC connector was designed for use with PRIZM® MT, multi-fiber, expanded beam ferrules
  – Lower cost due to component reduction
  – Elimination of polishing and endface geometry
  – Simplified connector component designs
  – Factory and field time savings due to the tolerance to debris

• The technology is compatible with next generation silicon photonic and VCSEL based link designs at various wavelengths.

• Future Variants for ganged insertion and blind mate will be available in the 2\textsuperscript{nd} half of 2014

• US Conec has established a cable certification program
Call to Action

- Become familiar with MXC™ technology
- Request your samples from US Conec
- Request information from US Conec on certified MXC™ assembly providers
- Consider designing MXC™ technologies into your future data center products

Enabling 21st Century Connectivity
For More information

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Photonics Advantages

Copper wires reaching physical limits
• ~10 Gbps or higher becoming challenging
• Distance/speed tradeoff costing more in energy

Alternative: Transmit data over optical fiber
• Much further reach at any given speed
• Multiple signals can travel on one fiber
• Thin & light = easy cable management

Challenge: Costs