Inside-the-box Optical Links

High Speed Interconnect Solutions for harsh environments
Data links: need for speed

- Digitalization of video, communication and radar signals has been a groundswell trend for decades as data converters, sensors and signal processors become faster
- High-speed links are requested more and more to combine data coming from distributed equipment and provide users with enhanced information
- Used in looped real time systems, the need for high speed is going down to Board-to-Board and device-to-device links to ensure a minimum latency
Optical link breakdown

- **Data rate** depends on:
  - Transmitter and receiver speed
  - Fiber BW
  - Link budget (Tx power, Rx sensitivity, fiber and disconnect loss)

Key parameters for dense and harsh environments:
- Size: density
- Power consumption
- Robustness (vibrations, temperature, shocks)
Opto-electronic converters: small & robust

**Size and density**
- From 1 to 12 channels per device
- From 0, 1 to 12 Gbps per channel
- Single fiber or ribbon fiber interface

- 100 mW/ channel
- Tx optical power stabilized over -40/+95 °C
- Technology has been flying since 2007 (ARINC 804 compliant)
Opto-electronic converters

- Free-space Tx/Rx link can be set between 2 boards, adding direct point-to-point connectivity without loading the backplane board.
Fibers: routing and shuffling

- Fibers must be able to link mid/edge-board components to front/rear panels through a tight path that may cross sharp, hot edges and many components
- Need for thin, strong and agile fiber routes
Optical contacts & connectors

• Multi-channel contacts for high density and single-channel contacts for easy shuffling
  • Handling fibers by packs of 12 or through an individual route depends on the box architecture
  • Both solutions are needed in the optical link toolbox and must be mixable along the link

Single channel transceiver equipped with Luxcis ARINC801 contact in 38999 connector

Multi-channel transceiver equipped with Q-MTitan ARINC846 contact in 38999 connector
Complex optical path

Multi-channel transceiver

Mid-board multi-channel disconnect

Front panel multi-channel disconnect

Multi-channel optical link: retain a 12-fiber ribbon line from transceiver to front panel

Multi-channel transceiver

Board edge multi-channel disconnect

Mid-board multi-channel disconnect

Fanout to single fibers

Multi-channel optical link: fan out the fibers at front panel

Front panel

Back plane
Trends for tomorrow

• More speed in smaller size
• Expanding optical links inside the box will require more:
  • Data rate: 28 Gbps, 56 Gbps per channel
  • Density: contacts handling 24, 36, 48 fibers in one disconnect (as far as link budget is kept good enough)
  • Complex shuffling components

• Expansion of optical links inside the box will require less:
  • Component footprints
  • Installation time
  • Optical link TCO
Embedded optical links

- Optical links are fully available to use inside high-speed data processing units
  - Thanks to a well-furnished toolbox, including single-channel and multi-channel components, complex link architectures can be easily set
  - A high number of fibers can be handled in tiny enclosures, leading to huge embedded data streams
  - A full range of ruggedized optical interconnects and transceivers is available for embedded systems operating in harsh environments. Most of them are already qualified for aviation standards

- The end-to-end link has to be designed as a whole to optimize density and TCO versus functionality
  - Choice of single or multi-channel package
  - Shuffling parts to achieve complex point-to-point links
Thank You