Trends in Optical Interconnects: Size, Power, Cost

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SLN-Workshop on Optical Interconnects, 2010-10-28
Outline

- GigOptix and the HX Line
- A new SFP+ solution
- Conclusions
GigOptix and the HX Line
GigOptix Markets

GigOptix addresses multiple applications across the global network

100G Mach Zehnder Modulator

Parallel VCSEL driver/TIA solution

High Power Broadband Amp

Low Power Multi-rate TIA

Satellite Communication

Airborne Communication

Core Routers

Core DWDM

Metro Routers

Metro

Submarine Networks

Enterprise & Datacenter

HX Line GigOptix-Helix

100G DP- QPSK Driver

10G MZM Drivers

40G DPSK Mach Zehnder Modulator

10G EML driver
Optical Communications Progression

Submarine Networks
Core DWDM
Metro
Access
Enterprise
Consumer FTTx
Chip

1980
100m

2005
10G

2000
2.5G

2010
100G

2015
1 T

Source: Management estimates based on OVUM052046, 047556, 047543, LC

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# Optical PMD Product Portfolio Overview

## Chart Details:
- **Legend:**
  - Available
  - 2010 Release
  - 2011 Release
  - Potential
    - * includes TIA
    - ** includes TIA/AGC

## Product Portfolio:

### 100G
- **Parallel TIA/LA:** HXR5204A, HXR4204A, HXR4112
- **Parallel VCSEL Driver:** HXT5204A, HXT4204A, HXT4112, HXT4012
- **TIA/LA:** GX3200*
- **Linear Amp:** GX3220**
- **EA Driver:** GX3222**
- **MZM Driver:** GX6220
- **MZM:** GX62450, GX62455, GX62255, GX6255, LX8900, LX8240

### 40G
- **Parallel TIA/LA:** HXR3412, HXR4104
- **Parallel VCSEL Driver:** HXT3412, HXT4104, HXT4004
- **TIA/LA:** GX3440, GX3240, GX3400
- **Linear Amp:** GX3122**
- **EA Driver:** GX6420
- **MZM Driver:** GX6261, GX6255, GX62255, LX8400, LX8401, LX8220, LX8230, LX8140

### 10G
- **Parallel TIA/LA:** HXR5501A, HXR3404
- **Parallel VCSEL Driver:** HXT5501A, HXT3404, HXT3101
- **TIA/LA:** GX3101B*, HXR4101A*, iT3010/11, iT3012/18
- **Linear Amp:** GX3110**
- **EA Driver:** GX6128, GX6120N, iT4036
- **MZM Driver:** iT6135, iT6134, GX6155, GX6159, GX6122
- **MZM:** GX6155, GX6122

### <10G
- **Parallel TIA/LA:** HXR1101, HXR3401*
- **Parallel VCSEL Driver:** HXR3101B*
- **Linear Amp:**
- **EA Driver:**
- **MZM Driver:**
- **MZM:**

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**Reach:** VSR 10cm-10m

**ULH < 1000Km**

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**Optical PMD Product Portfolio Overview**

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Parallel Optical Modules

De-facto standards (MSA‘s):

SNAP12 / CXP  QSFP  Other
Active Optical Cables (AOC)

Datacom Examples: QSFP, CXP

Consumer Example: HDMI/DVI

From: http://www.molex.com/cmc_upload/0/000/-15/805/DS_iPass_HSC_CXP.pdf

From: http://www.opticis.com/english/02_product/product01_01.htm#
10G History – MSA Evolution

Evolved towards smaller solutions
Fab-less Chip Vendor

GigOptix forms the supply-chain interface between „silicon“ world and „optical“ world.
A new SFP+ solution
The Smart OSA Concept

- GigOptix’ Smart OSA’s consist of one Silicon chip and one O/E chip
- All high speed and analog electronics is integrated, only standard digital interfaces
  - Simplified design
  - Improved RF performance
  - Lower power dissipation
  - Lower EMI

![Diagram of the Smart OSA Concept](image)
The HXT4101 / HXR4101 Chipset: Overview

- The chipset is made of:
  - The HXT4101A 14 Gb/s Compact VCSEL Driver
  - The HXR4101A 4.0 G / 14 Gb/s Dual-Band Limiting TIA

- Common Feature Set
  - Configuration via I2C, or selection of predefined modes via wirebonds
  - Lowest power dissipation vs performance
    - 100mW for consumer applications
    - 150mW 100m links
    - 250mW 300m links
  - Small Form Factor
    - Minimal external components required
    - Small die size: ~1mm x 1mm
  - Speed up to 14 Gb/s
  - On-chip A/D Converter for control and diagnostic read-outs
Example: Green SFP+ Module using Smart OSA’s

GigOptix™ SFP+ VSR (Very Short Reach) format will cover most frequently used reaches (up to 100m) in Datacenter/HPC while consuming merely 150mW. That is 4x lower power dissipation per plug than current SFP+ products.

GigOptix owns the chipset, the firmware and is deeply involved in the module design, CM selection, O/E selection, production setup and monitoring.
Low Power Consumption 10.3 Gbit/s Link

- HXT4101A Settings:
  - Driving Current:
    - Average = 25 (5.2 mA)
    - Modulation = 25 (5.2 mA_{pp})
  - Pulse Width Adjust = 2
  - Bandwidth Adjust = 0
  - Drive Tune Constant = 3
  - Emitter Follower Constant = 3

- HXR4101A Settings:
  - Signal detection & AGC disabled
  - Swing Size = 0
  - Emitter follower current = 0
  - Gain = 0
  - Output Degeneration = 3
  - TIA bandwidth = 0
  - EF current (output) = 1

Current consumption: 18.9 mA

Current consumption: 21.4 mA
# TOSA/ROSA Product map

<table>
<thead>
<tr>
<th></th>
<th>TOSA 5pin (HXT4101A in stand-alone mode)</th>
<th>TOSA 6pin (HXT4101A in I2C-controlled mode)</th>
<th>ROSA 5pin (HXR4101A in stand-alone mode)</th>
<th>ROSA 6pin (HXR4101A in I2C-controlled mode)</th>
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<tbody>
<tr>
<td>Datacom</td>
<td></td>
<td>X Smart OSA</td>
<td>X Conventional usage</td>
<td>X Smart OSA</td>
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<td>Consumer</td>
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<tr>
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<td>X 2)</td>
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<tr>
<td>Telecom</td>
<td></td>
<td></td>
<td>X</td>
<td>X long-wavelength SM I2C to set bit-slicing</td>
</tr>
</tbody>
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**Notes:**

1) Advanced consumer applications, e.g. to save power or wide temperature range

2) Avionics may need special TX subassemblies to cover very large temperature range while avoiding the use of a microcontroller
Conclusions

- GigOptix chip-sets enable ever more compact assemblies of optical interconnect solutions
- Smaller sized packages require more careful design
  - Cooperation with contract manufacturers
  - OSA products
- Lower power and cost reduction through reduction of interfaces / integration of functionality
- Create end-customer pull to accelerate time-to-market
SPOC!

**Size, Power, Cost**

The 5 year mission starts here ...