SKYLANE OPTICS®
AN AMPHENOL COMPANY

BEYOND COMPUTING POWER:

THE IMPACT OF TRANSCEIVERS IN MODERN DATACENTER ARCHITECTURE

ROBERTH GURNELL
NORDIC SALES

05TH DECEMBER 2024 - STOCKHOLM

DATACENTER FORUM

Amphenol

ProLabs

- Founded in 2004
- Global presence: UK HQ; Offices throughout Europe/Asia/US
  Founded in 2004
- 22,000 square feet of warehousing
- One of the largest independent providers of compatible optical transceivers
- Products are compatible with over 90 OEM vendors and come with a lifetime warranty
- Reputation for competitive pricing, flexibility, quality and reliability
- Trusted supplier to long standing customers (service providers, distributors, resellers, integrators and end-users)
- Coding and testing lab located in UK

Halo

- Founded in 1999
- Largest & longest running independent optical supplier in North America.
- Over two and a half million coded transceivers/DACs shipped in 2017
- Over a decade of contract manufacturing experience
- Quality and reliability come first
- ISO 9001:2015 Certified & Six Sigma principles based operational “Data Traveler System”
- ISO Documented Lifetime Failure rate of <0.03%
  Failure rate <.02% over last calendar year
- 100% of all products are tested in the specific application at distance and threshold

SKYLANE OPTICS®

- Founded in 1998
- Headquartered in Belgium
- Warehouses in the EU and South America
- Over 670,000 products shipped in 2022
- More than 4 million transceivers in the field
- Over 25 years of inhouse production and testing experience
- Cutting-edge CFP2 technology
- All products certified and compliant with European regulations
- Strong optical & coding expertise, plus on-site support
- High focus on quality, 99,9% of all transceivers work perfectly during their lifecycle

SOLID OPTICS

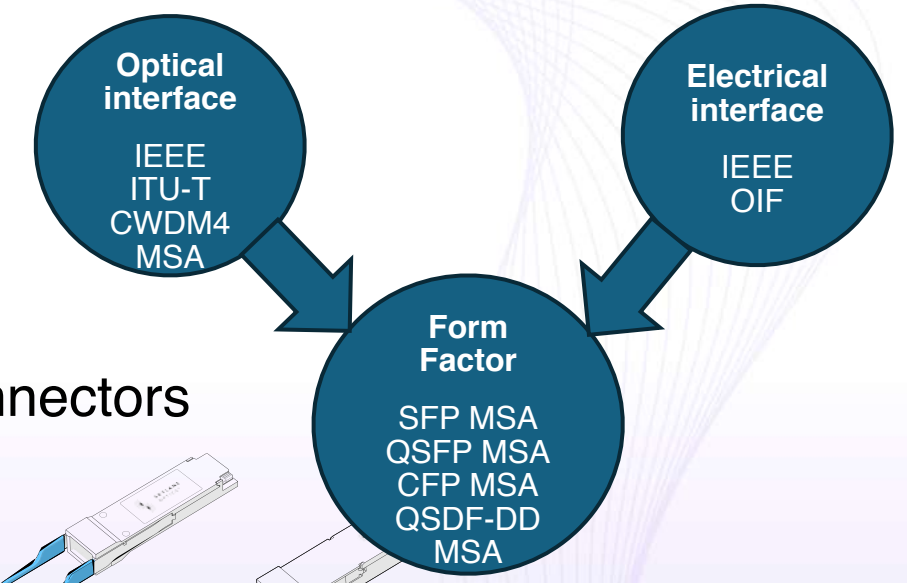
- Founded in 2006 (networking components) and 2007 (optical components).
- Global presence: offices in The Netherlands and the U.S.A.
- Customers across 90 different countries.
- Provider of compatible 3rd party transceivers, passive and active (EDFAMUX line) WDM solutions.
- Provider of refurbished networking equipment via group company Alturna Networks.
- 400,000 transceivers, and other optical solutions products shipped in 2021.
- 80,000 networking equipment (routers, switches, etc.) shipped in 2021.
- Coding & testing lab located in The Netherlands.
- Lifetime warranty.

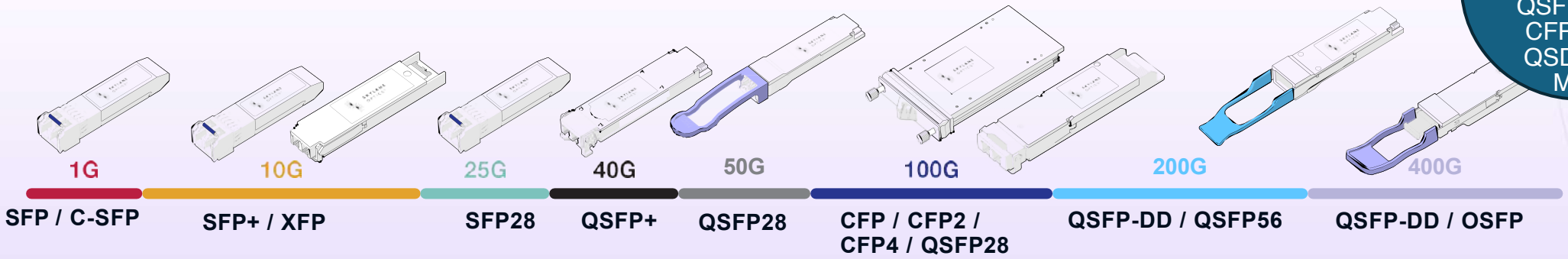
Skylane Optics

- **Amphenol Group**
  - 90.000 employees in the Amphenol Group.
  - 12.6 Billions USD in revenue in the Amphenol Group.
  - 2.1 Billion USD in Free Cash Flow.
- **Skylane Optics**
  - R&D and LAB facilities in EMEA and US.
  - Warehouses in EMEA and US and 95% of orders ship within 24 hours.
  - Uptime of 99,9% and documented <0.02% failure rate (zero DOA).
  - Each unit is coded and tested before shipment.
  - Lifetime warranty, Lab in Belgium for QA process with ESD/ Class 10K Clean Room.
  - Incoming and Outgoing Quality Control (IQC/OQC) and RMA handling processes, within 1-2 days.
  - Diverse supply chain to ensure supply continuity.
  - Risk reduction in supply chain via multiple CMs per Product in various regions.

Evolution of Transceivers

- Discreete optics vs Pluggable optics
- Form factors evolve as technology advances
- Standards on form factors and openess
- Tradeoff on Performance / Thermal capabilities / Fiber connectors





Cable & Fiber Patch

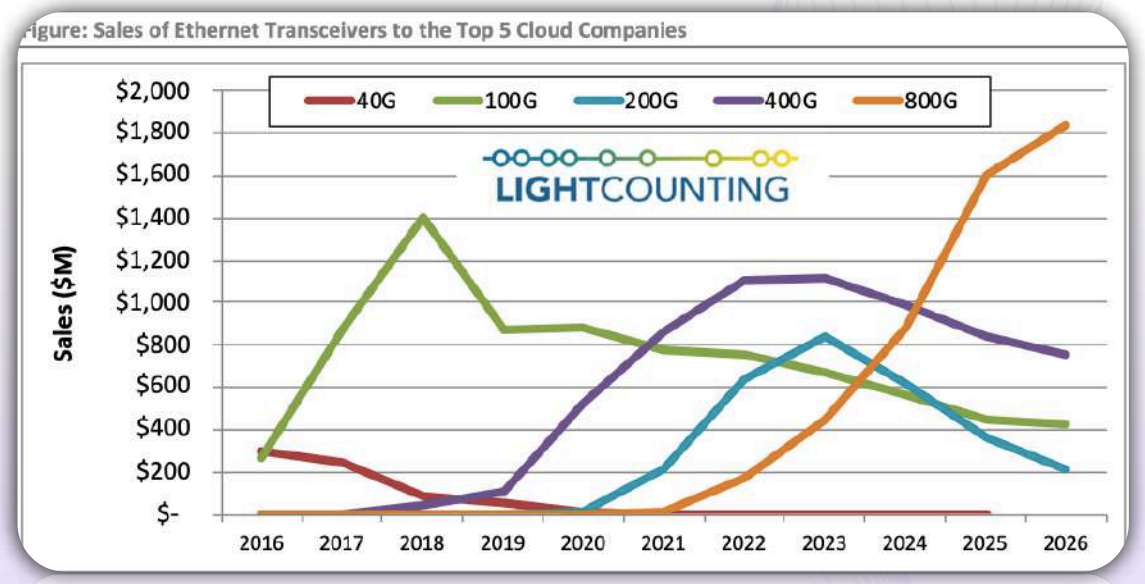
- **Direct Attach Cables (DAC) 1-10M**
  - DACs run a direct connector-to-connector electrical connection through a thick copper wire to avoid EM interference.
  - Active and passive variants. Typical distance of 1-10M

- **Active Optical Cables (AOC)**
  - AOCs use fixed fiber optic transceivers on a fiber cable for short reach connections typically 10-100m.
  - Plug and play assembly, reducing the complexity of a standard fiber optic install.
  - AOCs single 3.0mm cable diameter reduces the cable pile up in data center cable trays.

- DACs and AOCs offer many of the benefits of optical transceivers but with significant cost and power savings in short reach applications. The “plug and play” functionality of DACs and AOCs reduce the complexity and time to turn up new connections.

Market overview

- Total transceiver market assumed to be around 13 Billion in 2024 and doubling by 2030
- Large driver is datacenter infrastructure
- Substantial part of DC networking investments are in transceivers
- Density of DC switches increases resulting in surge of 800G technology for cloud computing



Datacenter Architectures

- Traditional DC – North south
  - Core, Aggregation, Access (Three tier architecture)
  - Client-server interactions, databases, web applications and storage to storage
  - Less latency intensive
  - Less bandwidth hungry
- AI/ML DC – East west
  - Leaf/Spine/Superspine
  - Focus on GPU to GPU
  - Higher requirement for low latency
  - Requires significantly higher bandwidth
- Example Nvlink / ConnectX (backplane and DAC usage)
- Infiniband vs Ethernet based transport

Application	Distance	Technology
Intra Rack	7m	DAC
Inter Rack (Leaf)	15m	AOC/QSFP/OSFP 100G-800G
Intra building (spine/ core)	100m	QSFP/OSFP 100G-800G
Inter building / DCI	2km->	QSFP-DD 100G-800G >1.6T Coherent

AI/ML Datacenter Architecture

Leaf/Spine/"SuperSpine"/DCI

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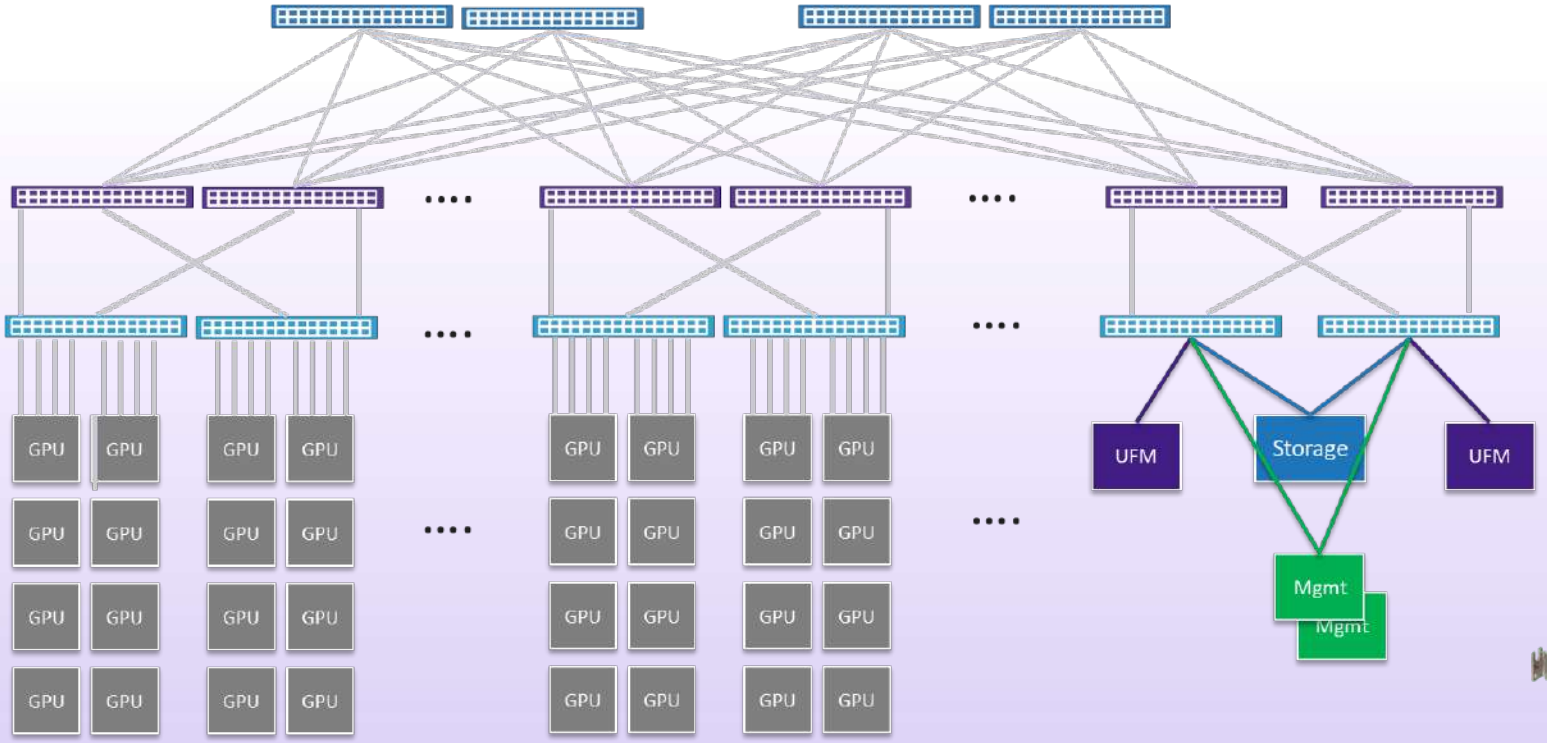
Nvidia
Mellanox
Arista
Juniper
Cisco
...
Ethernet
Infiniband
NDR/HDR



Switching

Nodes

	200G	400G	800G
Super Spine/ Core Spine Leaf	QSFP56 SR4	OSFP SR4 QSFP-DD SR4 QSFP-DD SR8 OSFP DR4 QSFP-DD DR4	OSFP 2XSR4 OSFP 2XDR4
GPU UFM Storage MGMT	QSFP56 SR2 QSFP56 AOC QSFP56 DAC SFP56 SR	OSFP-RHS SR4 QSFP56 SR4 QSFP-DD AOC QSPF56 AOC QSFP56 SR2 QSFP28 DR1	OSFP-RHS SR4 OSFP DAC QSFP-DD SR4 QSFP112 SR4

DATACENTER FORUM

Impact on your AI/ML when things fail

- Transceivers enable rapid communication between datacenter components, facilitating the transmission of large datasets for AI processing.
- Following are some impacts on failing low quality transceivers
  - Disrupt data flow between servers and storage systems, causing delays in AI model training and inference.
  - Increase the risk of data packet loss or corruption, resulting in incomplete datasets and flawed AI models.
  - Loss of data integrity in GPU-to-GPU communication, slowing down processing times.
  - Slower processing affects overall AI application performance and may impact real-time decision-making.
  - Increased maintenance costs arise from the need for new processes for proactive hardware maintenance

Quality Factors

- Signal Integrity – Critical in GPU to GPU computing
- Form factor – Time to deploy and meeting density requirements
- Thermal Performance – Higher demand on cooling and Networking equipment compatibility
- Reliability (MTBF) and Longevity – Impact hands on and predictability of investment as well as uptime
- Interoperability and Flexibility – MSA / Multiplatform / Modularity

Power Savings and Efficiency

- Surge in power needed per RU due to density
- Full rack of switching would require alone 20kW of power only for transceivers
- Using energy efficient design and pluggable optics will reduce the TCO
- Balance between AOC/DAC/Transceivers is key

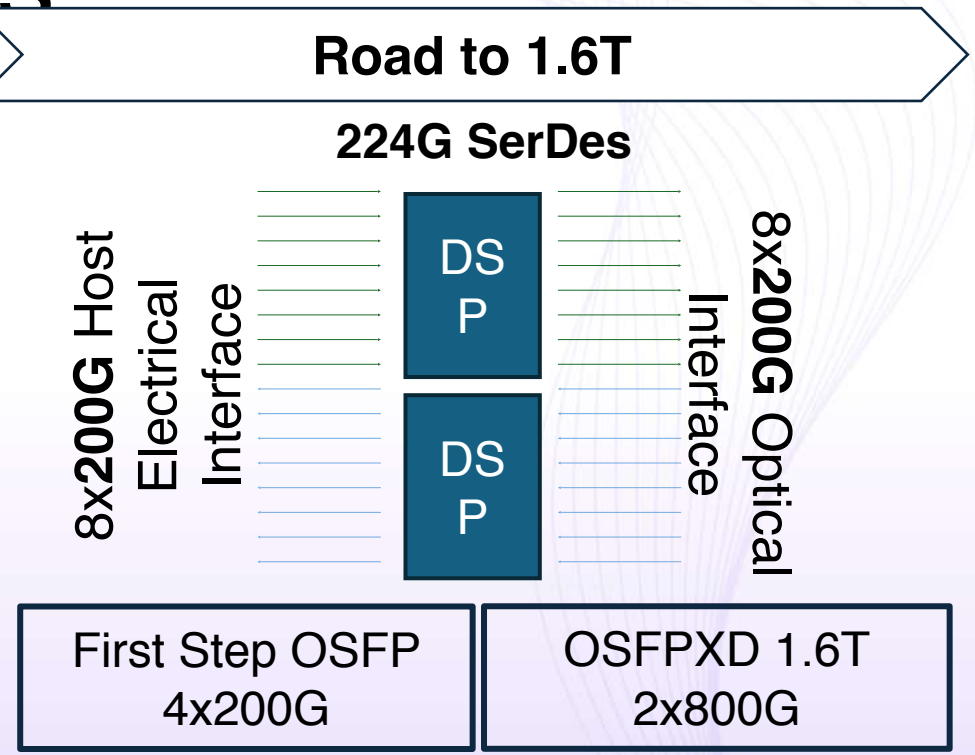
Form Factor	Modules per 1RU	Total Capacity	Module Power	Watt per 100Gbit	Power assigned for Transcevers
CFP 100G	4	400G	25W	25W	100W
CFP2 100G	8	800G	12W	12W	100W
CFP4 100G	32	3.2T	6W	6W	200W
QSFP 200G	32	6.4T	5W	2.5W	160W
QSFP-DD 400G	32	12.8T	16W	4W	512W
OSFP/QSFP-DD 800G	32	25.6T	15-18W	2W	576W

Qualification Process

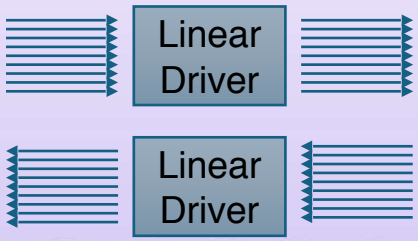
- CM's – (US, Thailand, Vietnam, China, Malaysia)
- Risk reduction in supply chain via multiple CMs per Product in various regions
- Quality qualification (IKEA test)
- Thermal qualification
- Interoperability testing and coding
- Leading to uptime better than 99.9% and documented sub 0.02% failure rate (zero DOA).
- Ensuring Lifetime warranty

Technology advancements

- Emerging Technologies still needs high speed optical interconnects. NVL72 – Nvidia Blackwell architecture is no exception.
- Coherent optics (DSP developments for DCI) – OpenROADM
- OSFP developments 800G ->1.6T (PAM4)
- LPO - DSP removed from module will be part of the Host Platform
- Technology advancements to reduced latency



Linear Drive Optics (LPO)



- Removes DSP - Processing moved to host – Tomahawk 5
- Reduce power consumption up to 10W
- Reduce latency ~ 90ns

Value proposition using third party optics

- Dissagregation ensure openess and technology advancements
- TCO savings
  - Reduced support costs and lifetime warranty (% on IB)
  - Long-term savings on operational costs / less downtime
  - Power savings – new technology made available faster
  - No vendor lock-in
  - OEM costs (could possibly be same CM)
- Risk reduction in supply chain (multiple CM's)
- Multiplatform support

Conclusion

- Transceivers plays a very strategic role of connectivity in AI/ML infrastructure
- Third party optics provides future-proofing for scalability and technological advancements
- Interoperability and flexibility is key
- Vendor assessments and certifications ensure quality and reliability
- Prioritize quality in procurement decisions

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THANK YOU