

High Speed Optics in Data Centers: Today & Tomorrow

Skylane Optics/Intronics

Kees de Waard



intrronics

Agenda

- Wie is Skylane Optics?
- DC overzicht & uitdagingen
- Optics voor DC
- Toekomst/conclusie
- Q&A?



Wie is Skylane Optics?



Belgisch Bedrijf



Team van 40+ medewerkers



20 jaar ervaring in de telecom sector



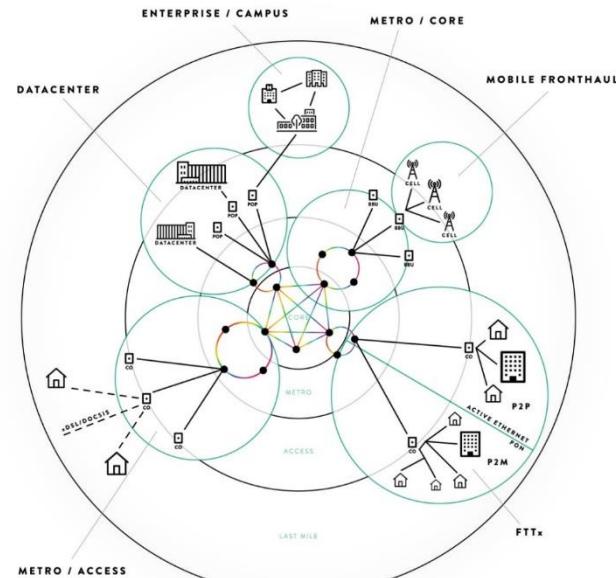
Compatible transceivers met ieder merk



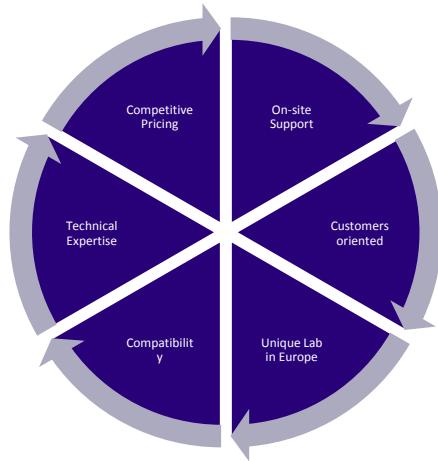
en meer...



Mijlpalen: Grote Tier Operators,
Data Centers en Integrators door europa
(Meer dan 30% van de FTTH markt in Zweden)



Skylane Value Proposition



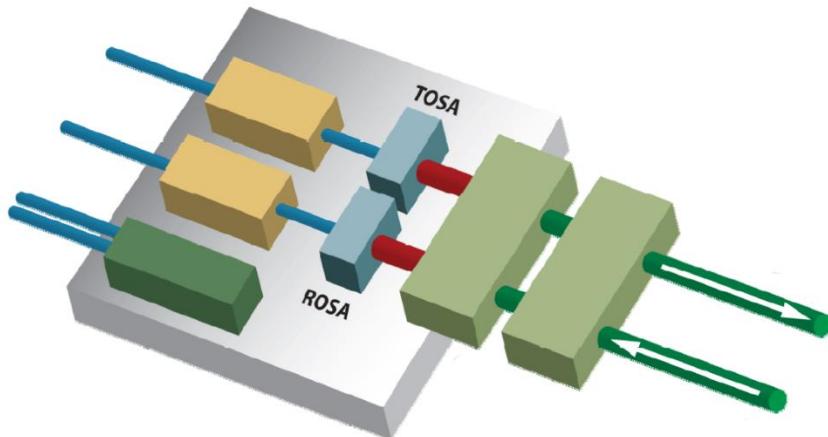
/ ALL SKYLANE OPTICS® TRANSCEIVERS ARE CERTIFIED AND COMPLIANT WITH EUROPEAN REGULATIONS



/ REFERENCE BODIES :



Transceiver: Basic Building Blocks



Transceiver

MSA

Optical Interface (IEEE, ITU, FC
Ass., Industry Alliances)
Protocol – Speed – Reach –
Type of Fiber

Mechanical Interface

Electrical Interface

DDM

Ethernet

SONET/SDH

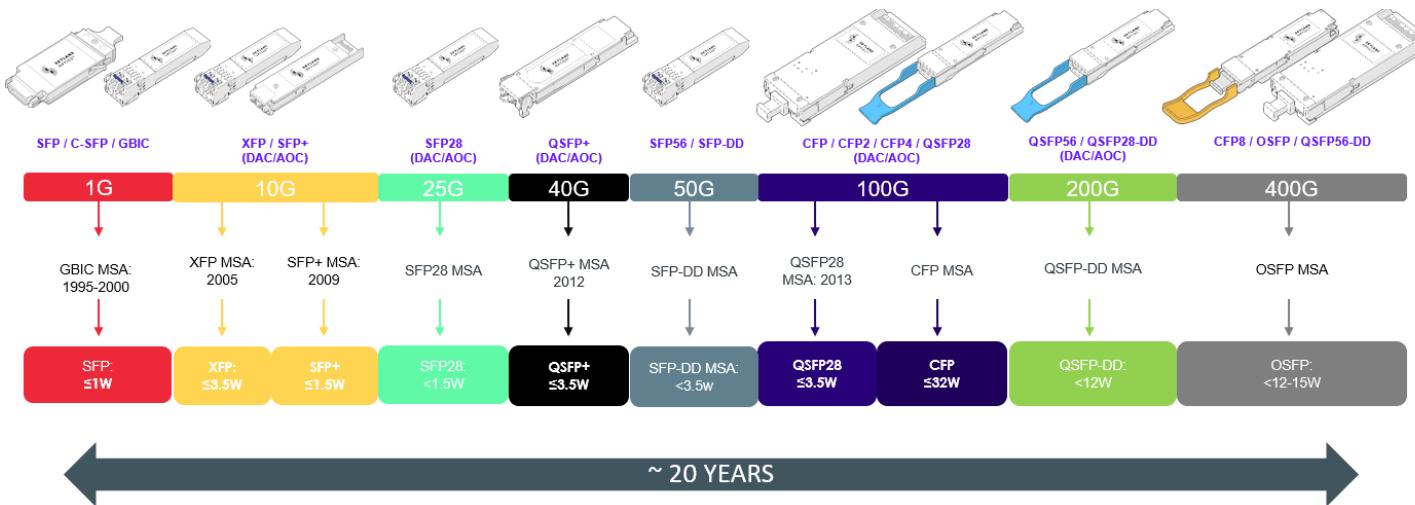
Fiber Channel

CPR1/OBSAI

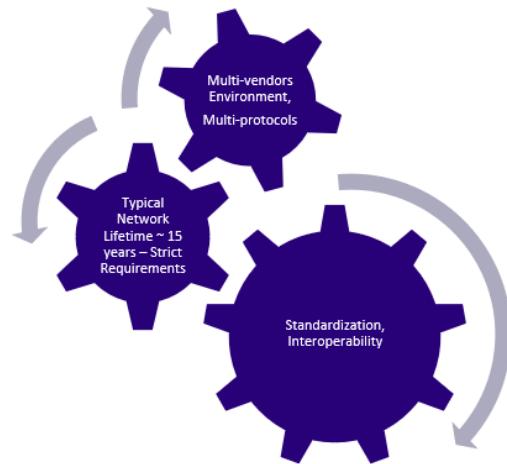
Transceiver Form Factors – Overzicht

UITDAGING: Fixed & proprietary interfaces, weinig flexibiliteit, hoge kosten
OPLOSSING: Pluggability & Standardisatie

Portfolio



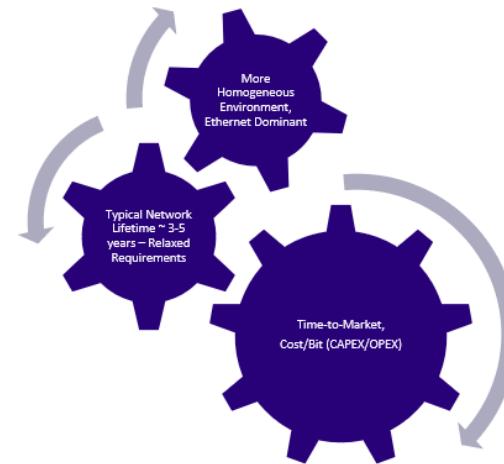
Industry Paradigm Shift



PAST



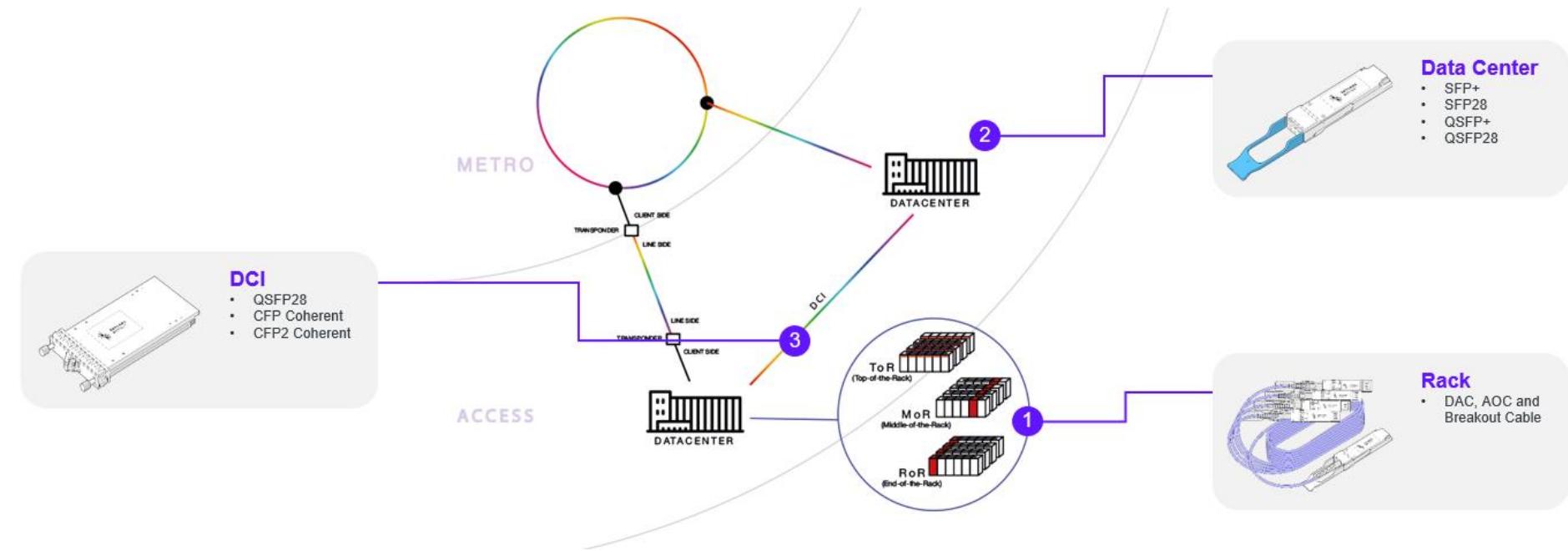
Industry driven by
Telecom Legacy
Operators &
Standardization



PRESENT



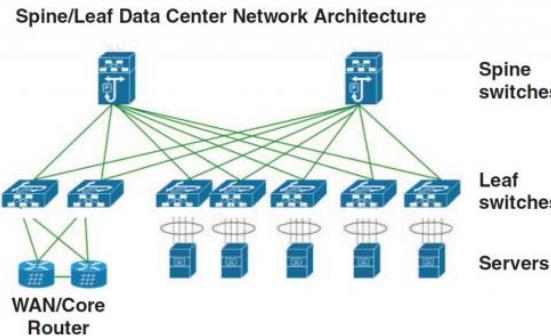
Datacenter Infrastructuur overzicht



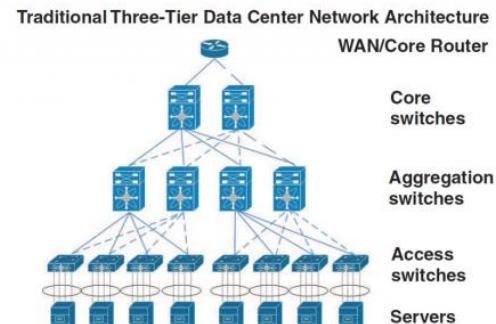
DC Topologie

DOEL: Verbinden van storage, servers, switches & routers

Spine-Leaf



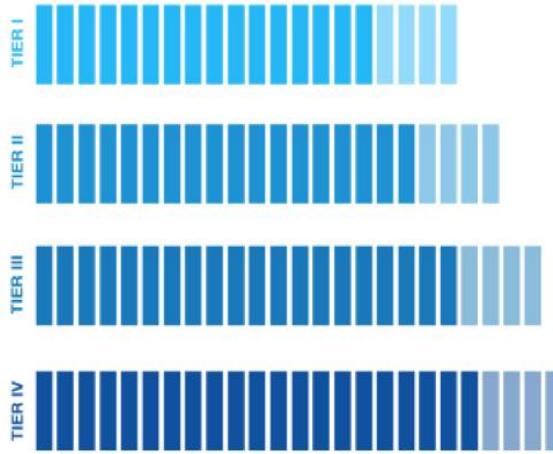
Traditional 3-Tier



Spine-Leaf Benefits:

- Two layers structure
- Favors East-West rather than North-South traffic
- Minimizes & Uniformizes Latency
- Less traffic bottlenecks

DC metrics: Availability



Availability: 99.67%
28.8h of interruptions / year
No redundancy

Availability: 99.75%
22h of interruptions / year
Partial redundancy

Availability: 99.982%
1.6h of interruptions / year
N+1 Redundancy

Availability: 99.995%
0.8h of interruptions / year
2N+1 Redundancy



Source: OVH

- De “Uptime Institute” classificeert DCs in 4 niveaus die samenhangen met de hoeveelheid apparatuur die benodigd is om DC redundancy te garanderen
- Beperkingen van infrastructuur (PS, Cooling, Active NE, Networking...)

DC metrics: Omvang & service model



Size: Kast, serverruimte, kleine, medium & grote DCs (van kast < 10 m² tot meer dan 5000 m² voor grote DC's)



Service model:

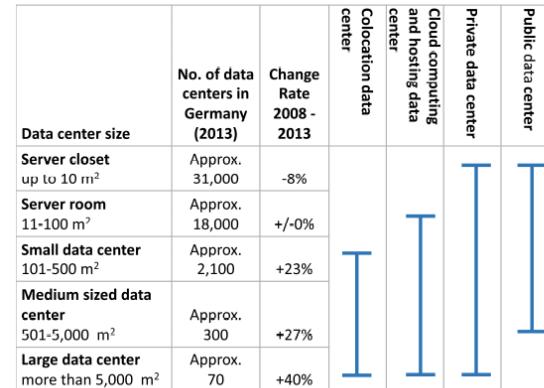
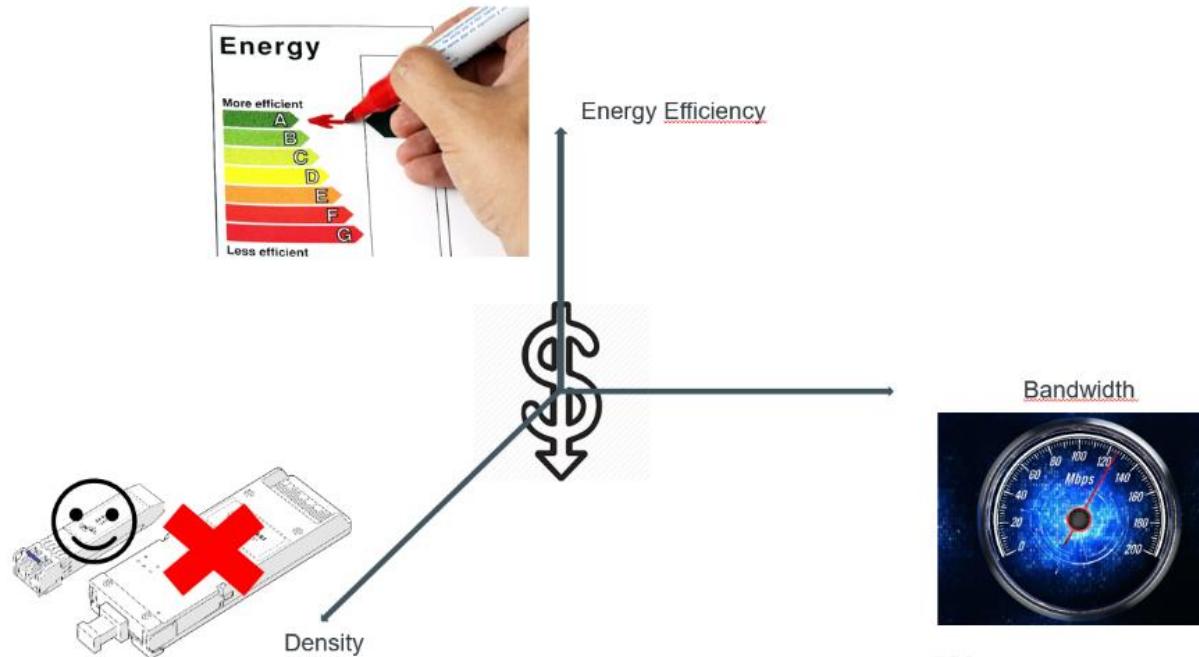


Fig. 2. Typology of data centers (overview) (Source: Borderstep)

Belangrijkste uitdagingen

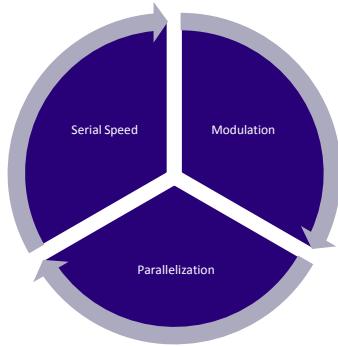


Benodigde optics

	Parallel (MPO)	Duplex (LC)	Zwart = Traditionele oplossingen Rood = Recente oplossingen
Multimode	Dominant in DC Short Reach (~ 100 m) Lower cost optics Complex fiber management More expensive fiber New type of MM fiber needed (OM5...)	SWDM4	
Singlemode	PSM4	Only used for long reach (2-10 km) More expensive optics Simpler fiber management Future proof fiber High data rate ready Example: Facebook only uses SM now	

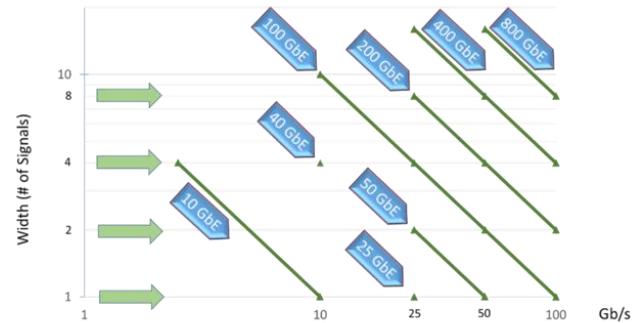
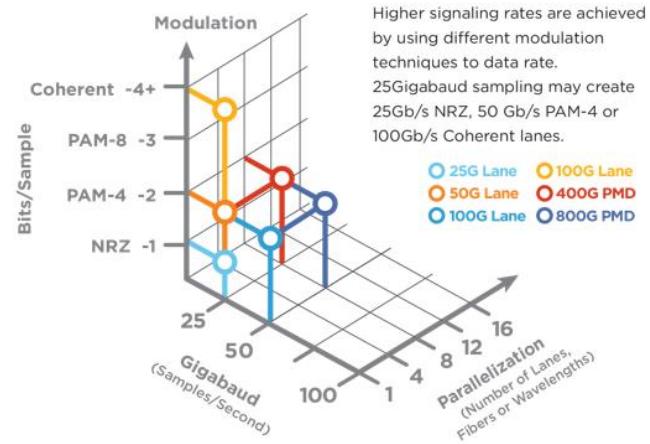
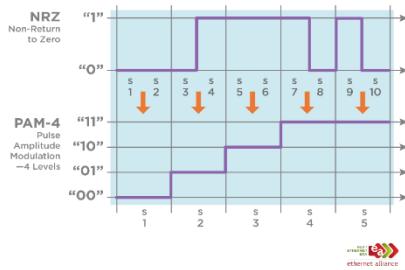
- Eisen aan optics: Hoogste bandbreedte, kleinste formfactor, energieverbruik
- Meest gebruikte formfactors: SFP, SFP+ & SFP28, QSFP+ & QSFP28

Hogere bandbreedte door andere modulatie

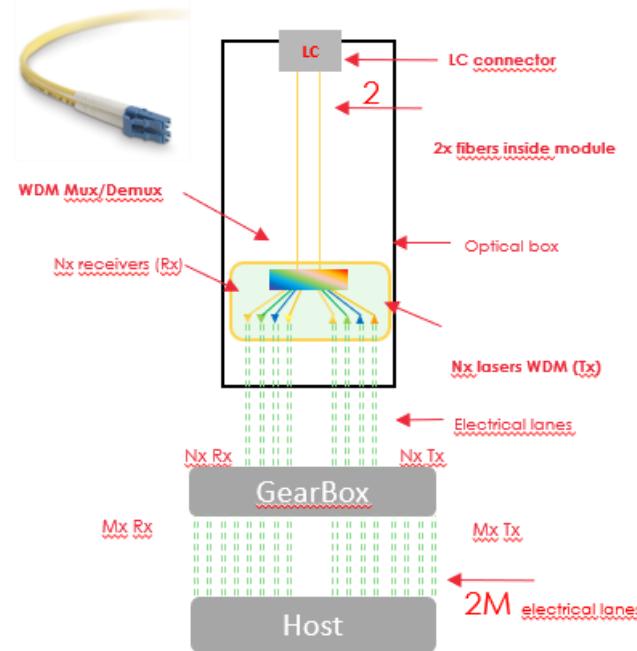
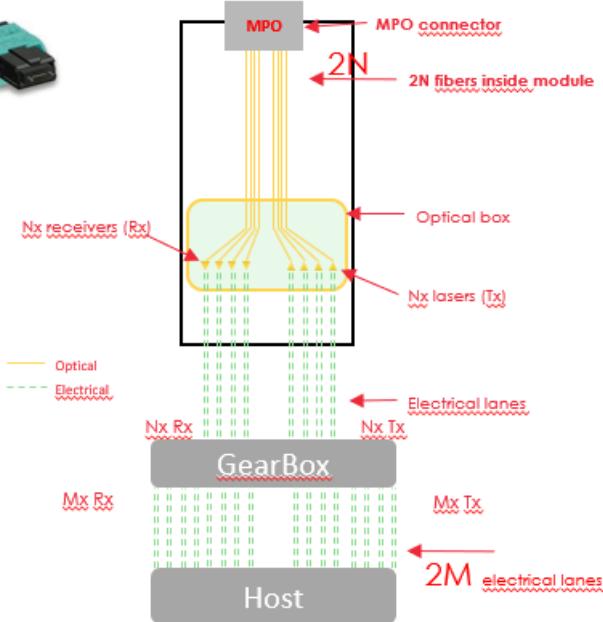


SIGNALING METHODS

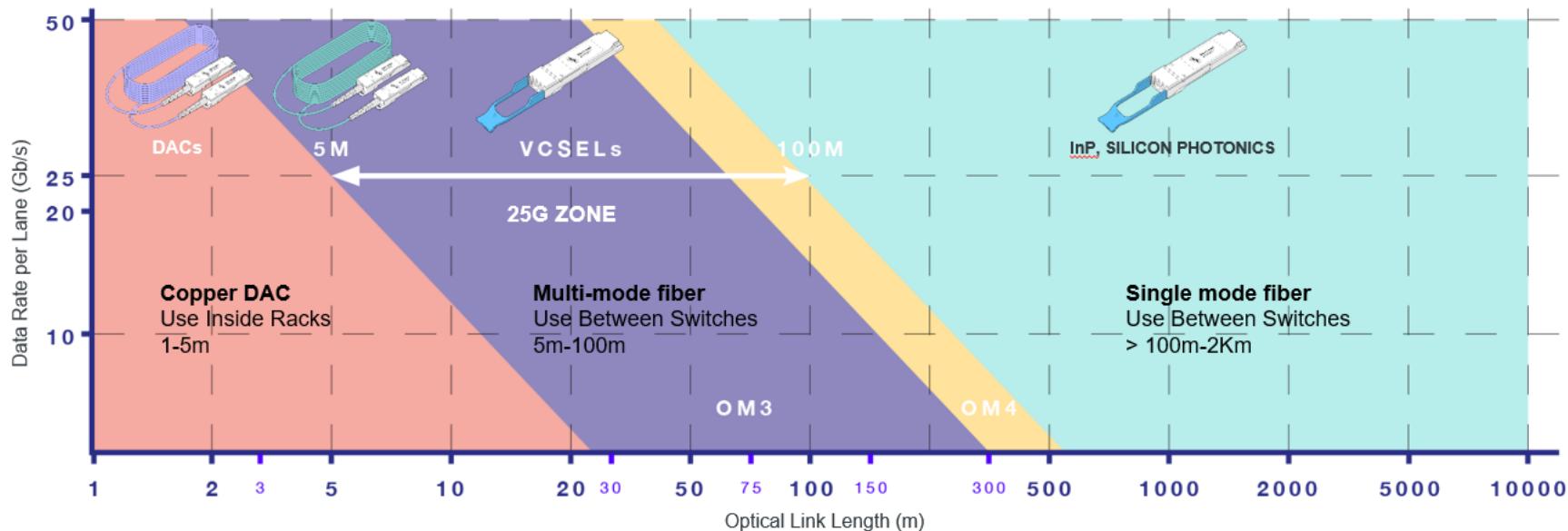
Most high speed Ethernet signaling has been Non Return to Zero (NRZ), but Pulse Amplitude Modulation 4 Level (PAM-4) signaling delivers twice as many bits per sample.



Parallel Optics Varianten: MPO vs LC



Optics Technologie Toolbox



- Direct Attach Copper**
- Zero power
 - Distance: 3m

- Active Optical Cables**
- VCSEL 100m
 - Distance: 3-20m

- SR4 VCSEL Transceivers**
- Up to 100m
 - MultiMode Fiber
 - Structured cabling

- Silicon Photonics Transceivers**
- Up to 2Km
 - SingleMode Fiber
 - PSM4 or WDM4 in parallel

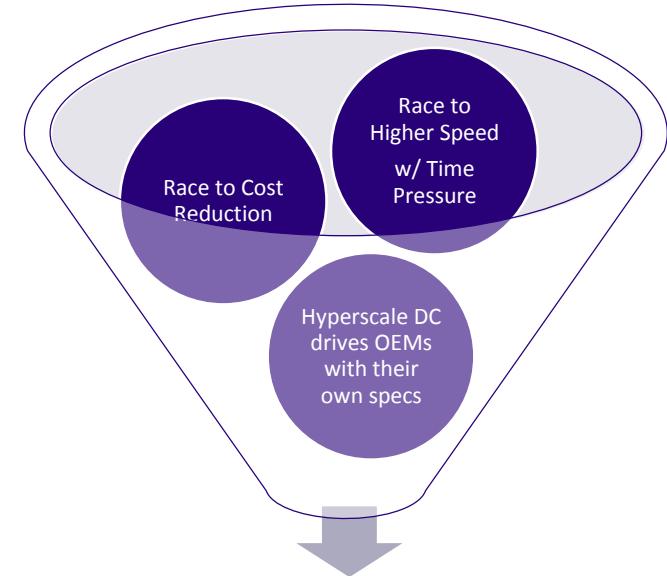
100G Jungle... Nu onder controle

100G	Parallel (MPO)	Duplex (LC)
Multimode	SR4 & 4x25G-SR (70/100m) SR4 FEC-Less (30/40m) eSR4 (200/300m) SR10 (100m)	SWDM4 (75/100m; 150m on OM5)
Single Mode	PSM4 (500m)	CWDM4 (2 km) CLR4 (2 km) LR4 Lite (2 km) 100GLambda-FR (2 km) LR4/ eCWDM4 (10 km) 100GLambda-LR (10 km) 4WDM-10 (10 km) 4WDM-20 (20 km) eLR4 (20 km) 4WDM-40 (40 km) ER4Lite (40 km) ER4 (40 km)

Zwart = Standaard IEEE Interfaces

ROOD = Industry alliances en proprietary interfaces

Multimode afstanden voor OM3/OM4; Singlemode afstanden voor SMF28

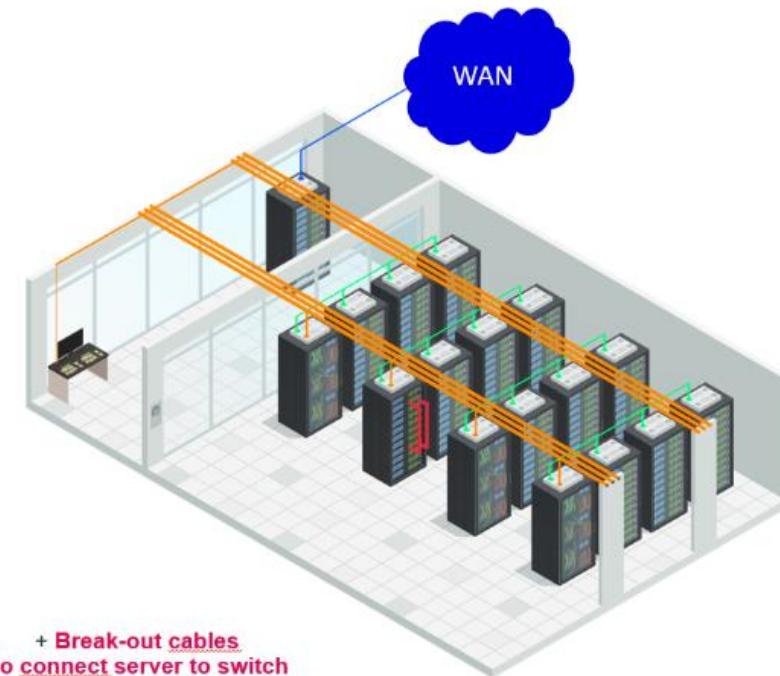
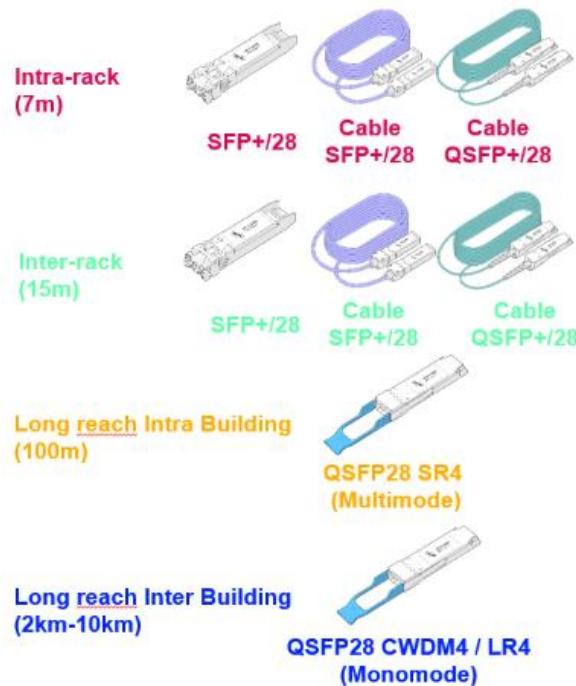


Standardisatie loopt achter;

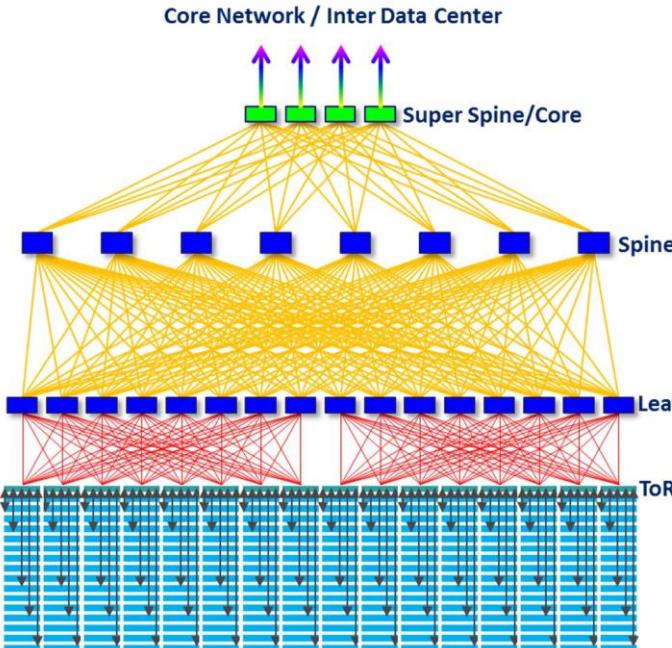
Veel verschillende varianten op de markt;
 Interoperability tussen varianten is een zorg

Markt kiest wie wint of verliest

Optics toepassingen



Veel gebruikte optics (Spine & LEAF topology)

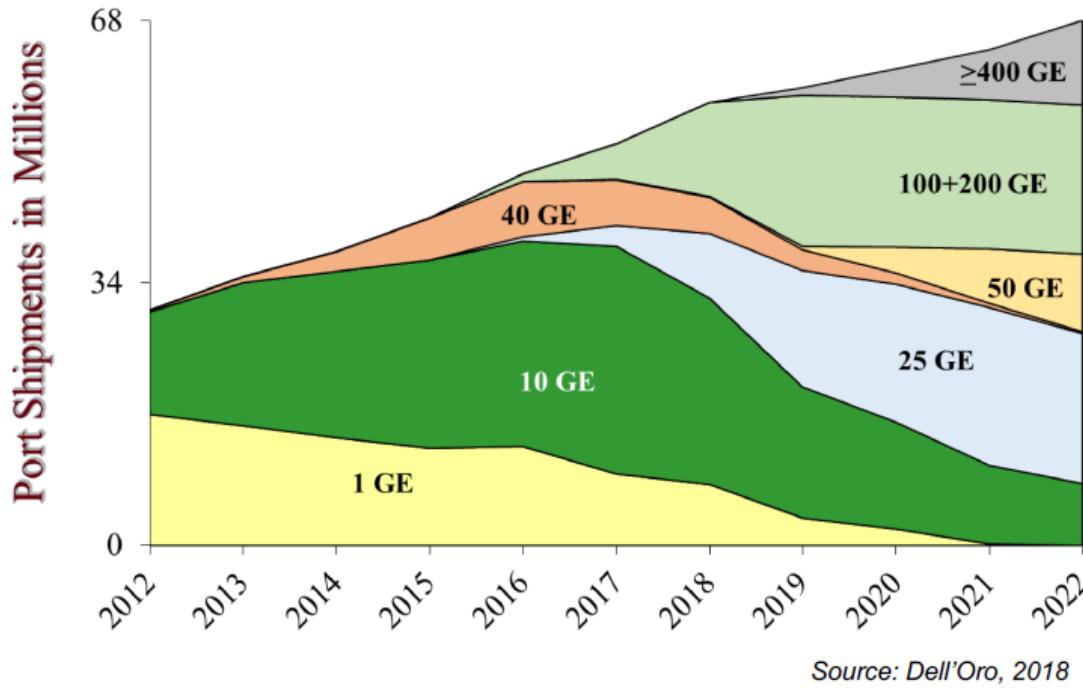


	Today	Today	Coming soon	Next? (> 2 years)
Inter-Datacenter 20km-metro	10/ 40G	10/40G DWDM	100/200G DWDM - coherent	200/400G DWDM - coherent
Spine-Core 500m-2km	10G SMF	40G SMF	100G SMF	200/400G SMF
Leaf-Spine 300m-2km	10G MMF or SMF	40G MMF or SMF	100G SMF	200/400G SMF
ToR-Leaf 100m-500m	10G MMF or SMF	40G MMF or SMF	100G MMF or SMF	200/400G MMF or SMF
Server-Top-of-Rack (ToR) 1m-30m	1G Cu	10G Cu or FO	25G Cu or FO	50G Cu or FO
				50G/100G Cu or FO

SMF: Singlemode Fiber; MMF: Multimode Fiber FO: Fiber Optic

Source: Oclaro

Voorspelde DC Ethernet Poort Shipments



Source: Dell'Oro, 2018

1RU Ethernet Switch Roadmap

First Deployed	Electrical I/O (Bit rate/lane)	Switching Bandwidth	TOR/Leaf Switch Configuration (1RU/24 ports)	
2010	10G	1.28T	 32xQSFP+ (40G)	
2015	25G	3.2T	 32xQSFP28 (100G)	3.2Tb/s switches gebaseerd op 100G QSFP28 modules worden nu gebruikt in datacenters.
2019	50G	6.4T	 32 ports of 200G	Als gevolg van meerdere switching IC's die verwacht worden zal de markt in de toekomst gefragmenteerd zijn. Given the multiple switching ICs expected to be available, the market is likely to be fragmented in the future.
2020	50G	12.8T	 32 ports of 400G	

Sterke toename in vraag naar bandbreedte vraagt om technologieën en standaarden om in de toekomst 12.8T switches mogelijk te maken.

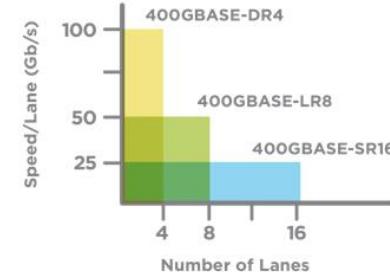
200G/400G de nieuwe Jungle...?

400G	Parallel (MPO)	Duplex (LC)
Multimode	SR16 (100m) SR8 & 8x50G-SR (70/100m) SR4.2 (70/100/150m)	TBD
Single Mode	DR4 (500 m)	FR8/ FR4/ CWDM8 (2km) LR8 / LR4 (10 km) ER8 (40 km) ZR (80 km, coherent)

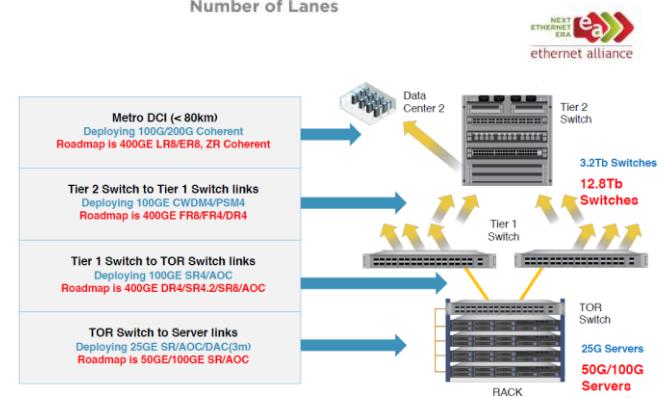
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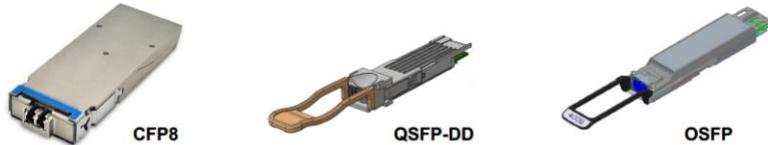
Multimode afstanden voor OM3/OM4; Singlemode afstanden voor SMF28



After the data rate/lane is chosen, the number of lanes in a link determines the speed. This chart shows how 4, 8 or 16 lanes can be used to generate 400GbE links.



Form Factors Explosie

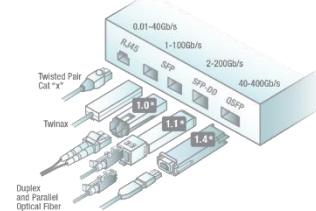


Dimensions (mm)	CFP8	QSFP-DD	OSFP
Width	40	18.35	22.58
Length (overall)	102	89.4	100.4
Thickness	9.5	8.5	13
Thermal Capability	12-18W	< 12W*	12-15W

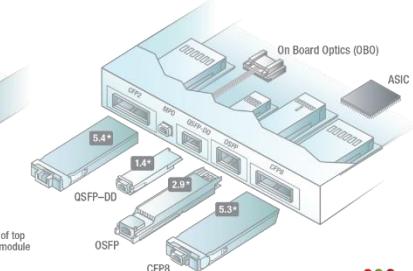
*Estimated

FORM FACTORS

1-4 Lane Interfaces



4-16 Lane Interfaces



*Square inches of top surface of the module

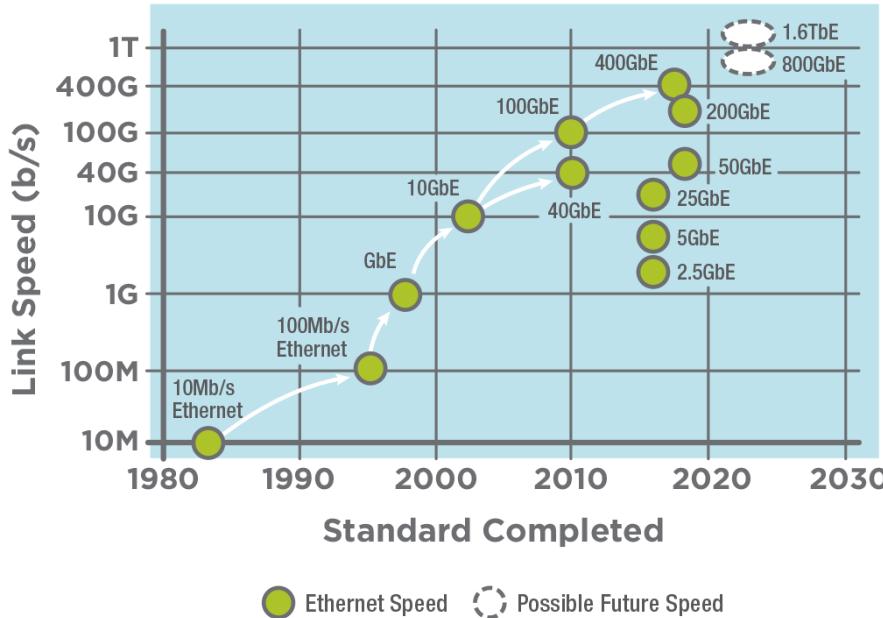


Trends in DC Optics

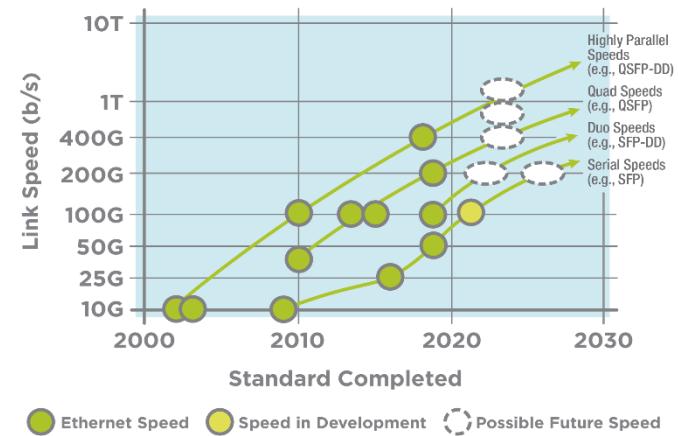
- Continu groei in bandbreedte per module
 - 400G: QSFP-DD/OSFP
 - 800G: Form factor ? 8x100G-PAM4?
 - Is pluggability nog noodzakelijk? BOA/OBO?
- Toegenomen gebruik van optics in server naar TOR switch links
- Lage latency optics voor niche toepassingen
- Volwassenheid van kern technologieën
 - High-speed VCSELs voor short reach (100m)
 - Silicon photonics (500 m tot 2 km)
 - DML/EML: 10 km en meer
- Opkomende coherent optics voor DCI (40+ km, power consumptie/kosten afweging)

Ethernet Alliance Roadmap

ETHERNET SPEEDS



TO TERABIT SPEEDS



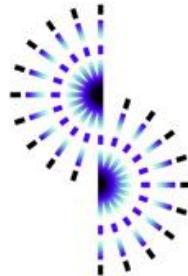
Conclusie

- In de toekomst zullen veel verschillende formfactors en interfaces strijden om wie de uiteindelijke standaard zal worden. Dit zal voor het 200G/400G+ landschap leiden tot fragmentatie.

Dank voor uw aandacht!

Vragen?

Bezoek ons op de Intronics stand **nummer 13**



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