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# PICs for data center interconnect

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# PICs for data center interconnect

Benjamin Wohlfeil

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# Company overview

# Our history

## Foundation of the company



## Going public

- FSE: ADV



## Going global

- Expansion in North America
- Revenue >USD 250 million



## Scaling the business

- >1800 employees
- Revenue >EUR 500 million
- Award-winning supply chain



1994

1999

2000

2006

2010

2013

2016

2020



## First product

- Metro WDM for enterprise DCI



## Adding Ethernet

- First fiber-based Ethernet services



## Portfolio expansion

- Optical+Ethernet
- Network automation



## Strategic acquisitions

- Synchronisation
- Software and virtualization

Open connectivity solutions for a connected world

# ADVA worldwide

## Our NUMBERS

>EUR 500 million revenue<sup>1</sup>

~1,800 employees<sup>2</sup>

## Our CUSTOMERS

Hundreds of carriers

Thousands of enterprises

## Our LEADERSHIP

#1 DCI<sup>3</sup> enterprise

#1 Ethernet access devices<sup>4</sup>

#2 Network synchronization<sup>5</sup>



1) Annual 2017 – analyst consensus; 2) Sep 30, 2017; 3) Data Center Interconnect – Source: Ovum; 4) IHS 2016; 5) ADVA internal estimates

Network innovator – Speed for customers – Trusted partner

# Our broad customer base

## Service providers



## Enterprises



## Internet and cloud



## Government and education

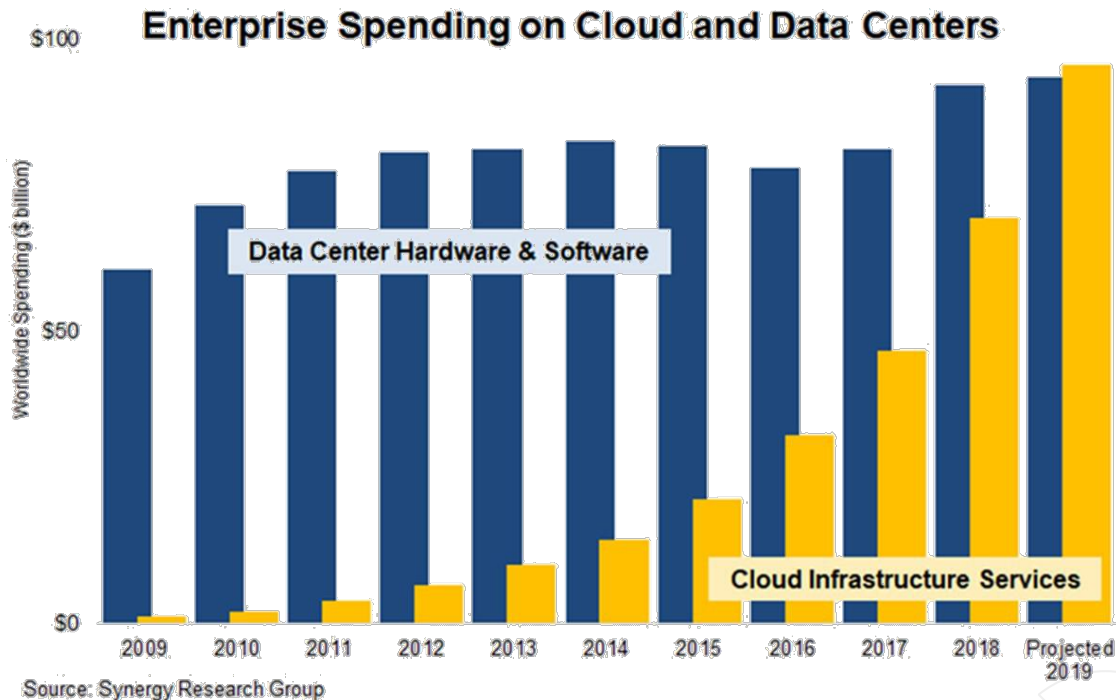


Global success with open connectivity solutions



# Data centers

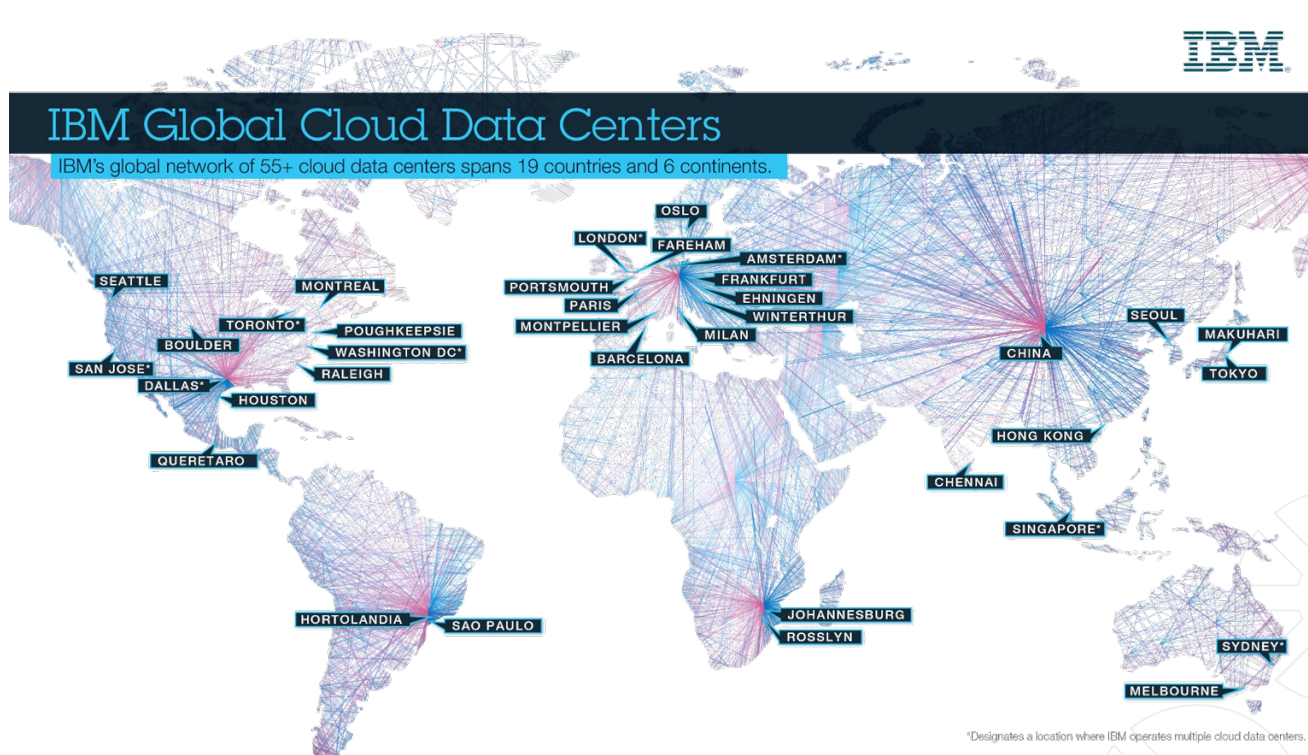
# Data center CAPEX growth



Large market – even with low share



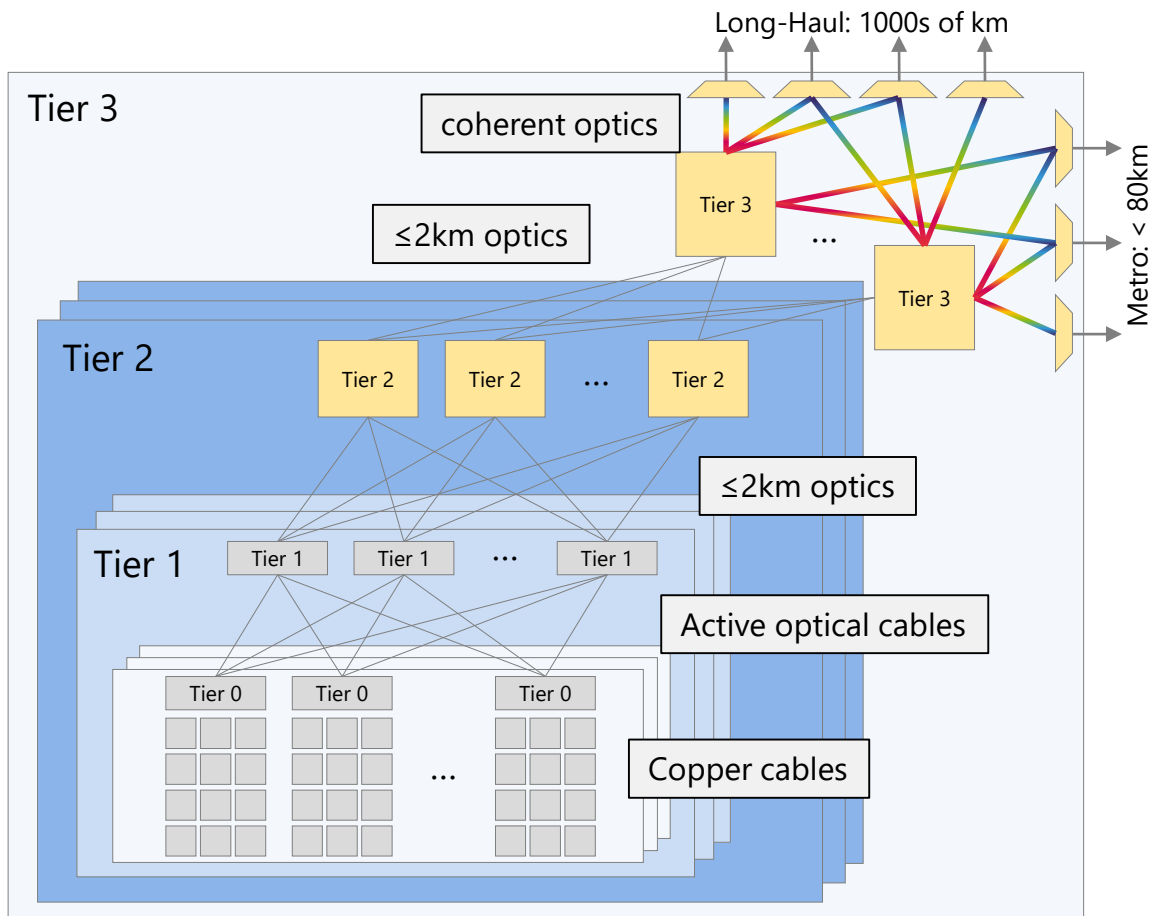
# Data centers world wide



# MS data center in Quincy, WA



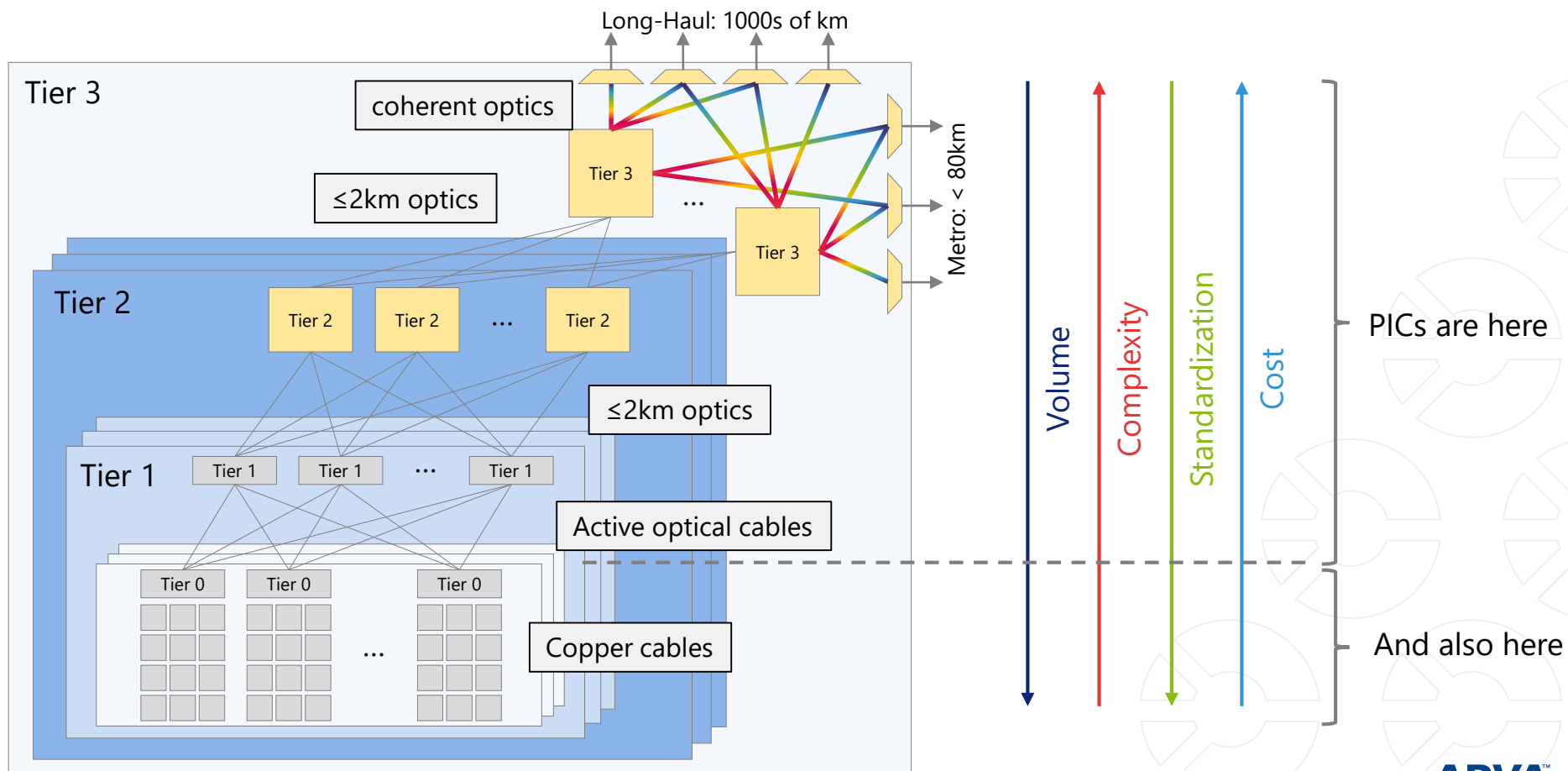
# Data center architecture



Tier 0 switches service a rack  
Tier 1 switches service a „row“  
(of racks)  
Tier 2 switches service a „Co-  
location“  
Tier 3 switches service a data-  
center

- Interface to long-haul network
- Also interface to metro network

# Data center architecture



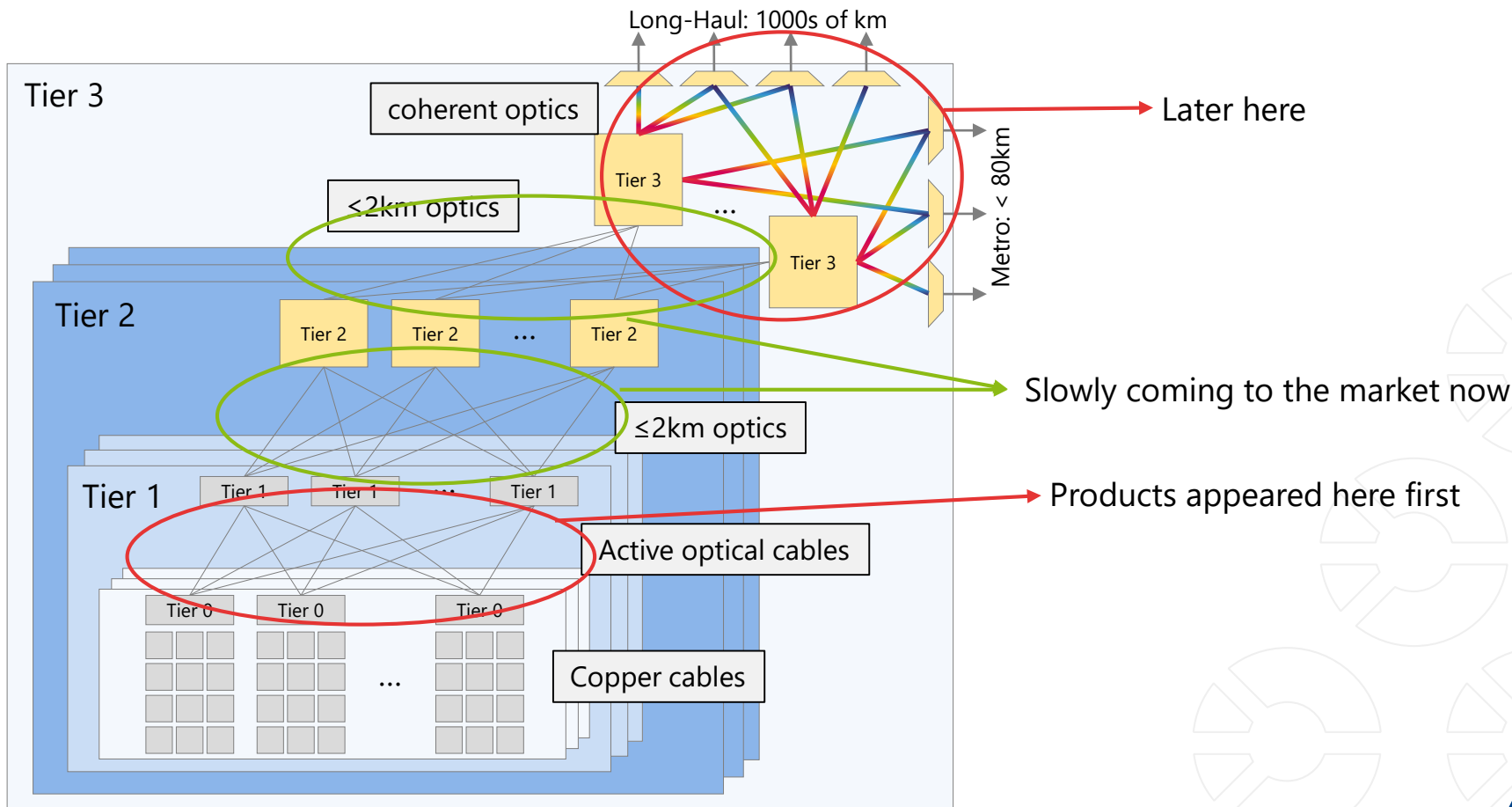


# Photonic integrated circuits

# Flavors of PICs

	Silicon	InP	SiN	SiO	Polymer	LiNbO3
Waveguides	++	++	+++	+++	+	+
Fiber coupling	-	+	++	++	+++	+
Modulators	+	++	---	---	+++/-	+++
Pol. converters	+++	+	-	-	-	-
Light sources	---	+++	---	---	---	---
Photo detectors	++	+++	-	-	-	-
Footprint	+++	++	-	-	--	---
Wafer size	+++	--	+	+	-	-
Yield	+++	+	++	++	+	-
Hybrid integration	++	-	+	+	+	--
Packaging	++	-	+	+	+	-

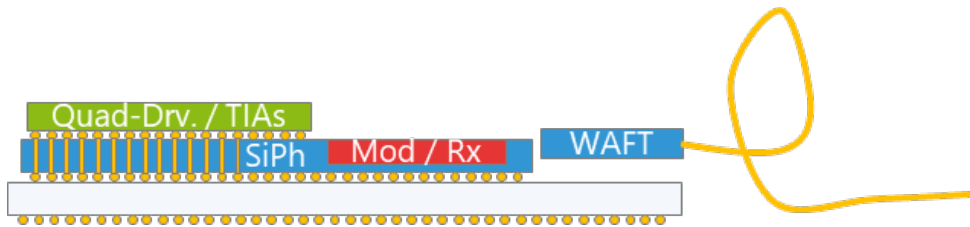
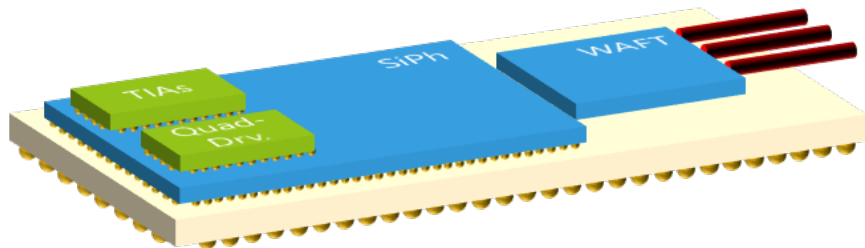
# Silicon photonics in DCI





# MASSTART

MASS manufacturing of TrAnsceiverS for Terabit/s era



- Single optical alignment step for multiple I/Os
- Flip-chip assembly of driver and TIA on PIC
- Solder reflow compatible assembly

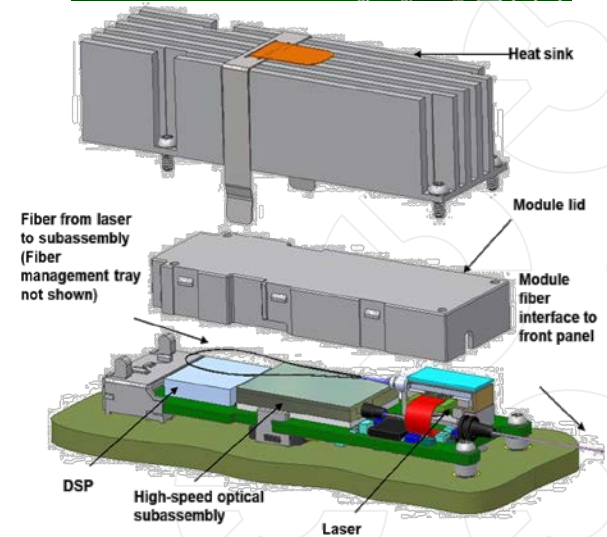
High-performance, low-cost assembly



# IC-TROSA

## Integrated Coherent Transmit Receive Optical Sub-Assembly

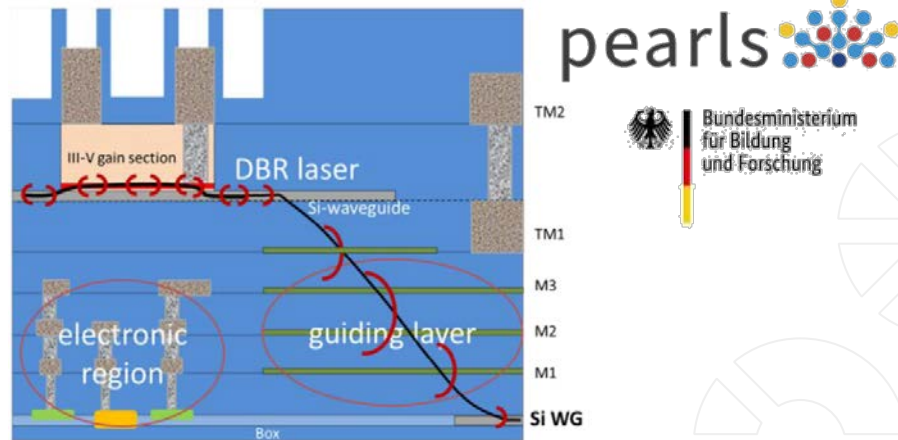
- Coherent optical engine for pluggables and line-cards
- Includes, modulator, receiver, driver, TIA and control electronics
- Solder reflow compatible
- BGA contacts for highest RF-performance
- 15 x 22.5 x 3.6mm (WxLxH) footprint
- OIF standard



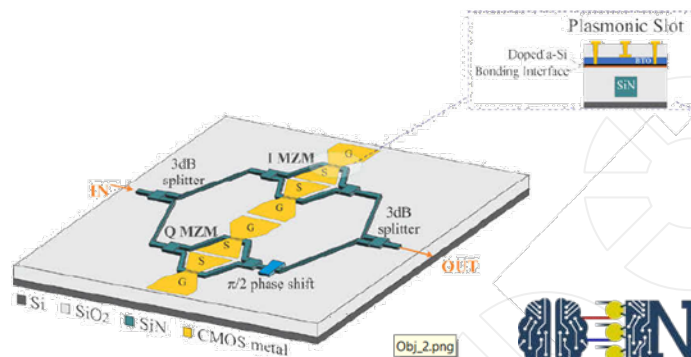
Source: ADVA

# What's next for PICs?

- Integration of lasers on silicon?
- (Monolithic) integration of electronics?



- New materials for higher speeds?



# Conclusion

- DCI is a viable market (even with market low share)
- PICs can be a high-end market
- Packaging remains highest cost factor



# Thank you

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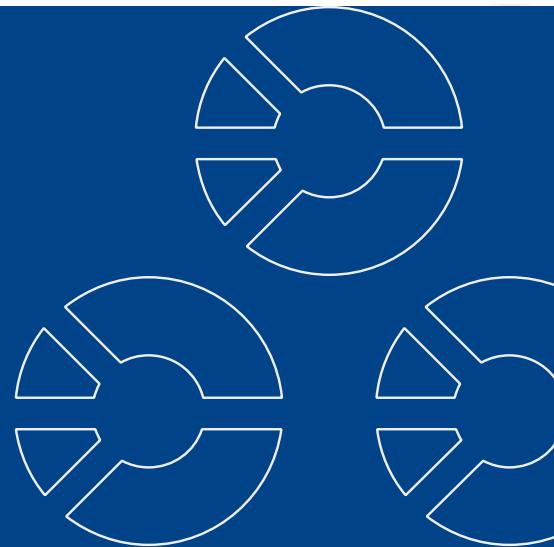


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