NAVOLCHI 1st Review Meeting

November 27th 2012, Brussels

SEVENTH FRAMEWORK PROGRAMME

FP7-ICT-2011-7
GA 288869

Work Package 5 Presentation

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IMEC, Belgium

Nano Scale Disruptive Silicon-Plasmonic Platform for Chip-to-Chip Interconnection

www.navolchi.eu

Outline

1. WP Position in Project.
2. WP Objectives.
3. Milestones and Deliverables.
4. Status of Work: Achievements.
5. Resources: Budget and Manpower
6. Summary and Outlook.

Objectives

Overall Objective :

Design and implement optical and electrical interfaces for plasmonic interconnect

Specific Objectives:

- Coupling light between silicon back bone and plasmonic devices
- Beam Shaping grating couplers to direct light between chips
- Compact filters for noise suppression
- Specify and implement Dual Die Communication Module (DDCM)

Milestones and Deliverables

D5.1	DDCM specification document	5	ST	R	CO	6	04/2012
D5.2	DDCM with electrical PHY design and verification data base	5	ST	R	CO	12	10/2012
D5.3	Compact optical filters (2nm bandwidth, >30nm FSR) and first generation beam shapers	5	IMCV	R	CO	21	07/2013
D5.4	Generic DDCM compatible with plasmonic-based PHY specification document	5	ST	R	PU	24	10/2013
D5.5	Report on plasmonic waveguide couplers	5	IMCV	R	CO	24	10/2013

Milestones and Deliverables

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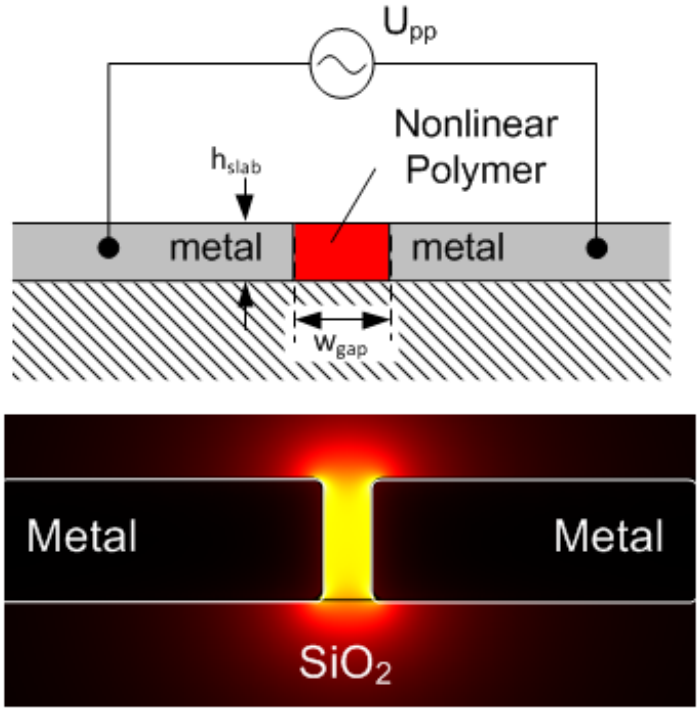
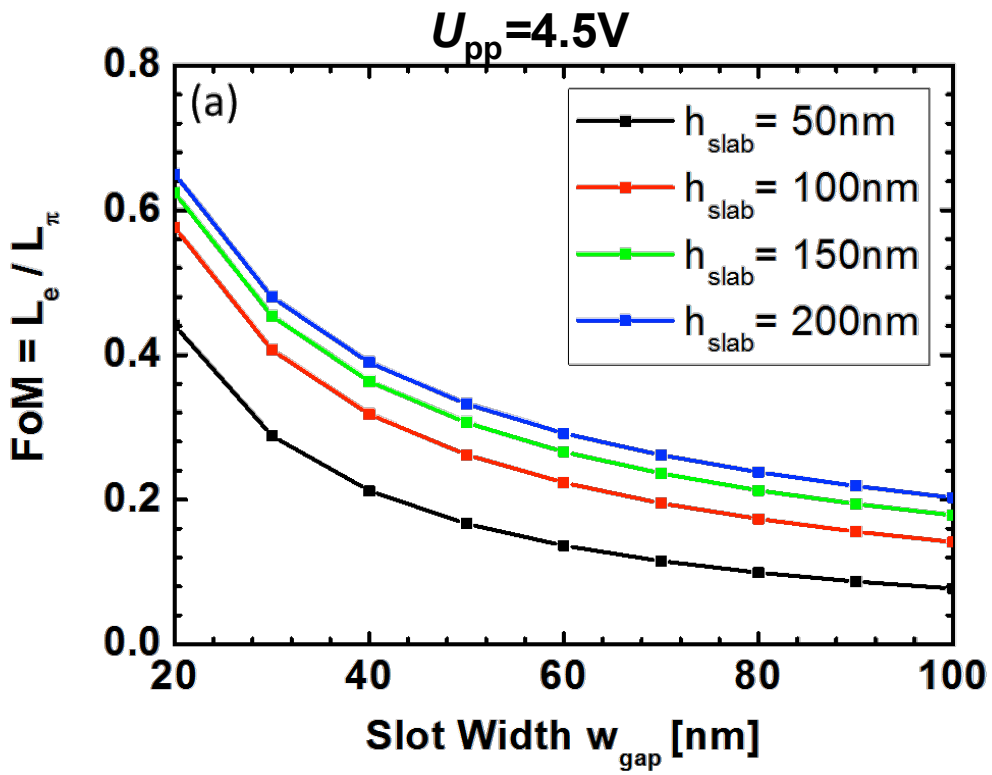
MS25	Decision on optimized plasmonic waveguide couplers	5	KIT	6	04/2012
MS26	Fabrication of plasmonic waveguide couplers with less than 3 dB coupling loss	5	KIT	12	10/2012
MS27	Design of first generation beam shapers and compact optical filters	5	IMCV	12	10/2012
MS28	DDCM with electrical PHY design and verification	5	ST	12	10/2012
MS29	Data codecs for power consumption reduction	5	ST	15	01/2013
MS30	Decision on plasmonic waveguide couplers with less than 3 dB coupling loss	5	KIT	15	01/2013
MS31	Fabrication of compact optical filters and first generation beam shapers	5	IMCV	18	04/2013
MS32	Data codecs for error detection and correction	5	ST	18	04/2013
MS33	Design of second generation beam shapers	5	IMCV	24	10/2013
MS34	Generic DDCM compatible with plasmonic-based PHY	5	ST	24	10/2013
MS35	Fabrication of compact optical filters and first generation beam shapers	5	IMCV	30	04/2014
MS36	DDCM evolution for NiP solutions	5	ST	30	04/2014

Main achievements

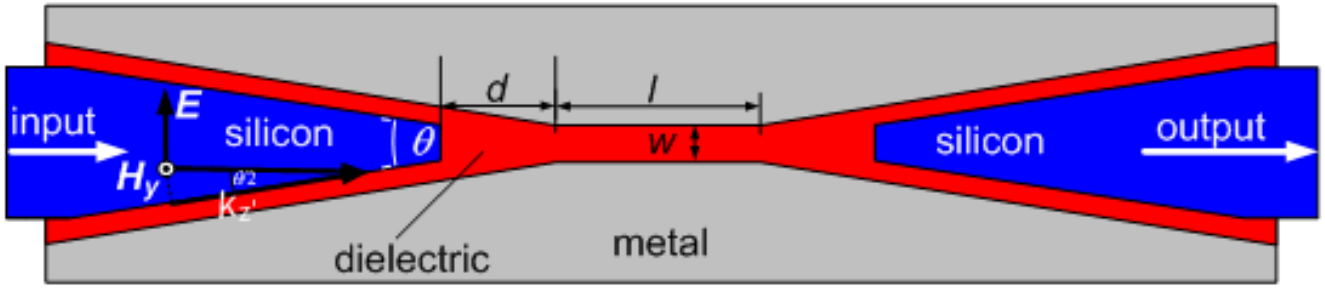
- DDCM functional specification completed (M5.2/D5.1)
- DDCM design activity completed (MS5.5/D5.2)
  - VHDL design completed
    - All features in place (STNoC support, virtual wires, Qos, credit-based flow control, PHY adapter, electrical PHY)
  - Verification environment in place for both VHDL and netlist
  - Full regression in place and passing
- DDCM design characterization completed
  - Area: around 300 Kgates
  - Speed: up to 450 MHz
  - PHY Tx crossing latency: 3.5 cycles at 450MHz
  - PHY Rx crossing latency: 0.5 cycles at 450MHz
  - Total crossing latency: 4 cycles at 450MHz i.e. 8.88ns
- Patent proposal about alternative optical link proposed by ST Support Technologies Group has been submitted and is currently under evaluation by ST patent committee

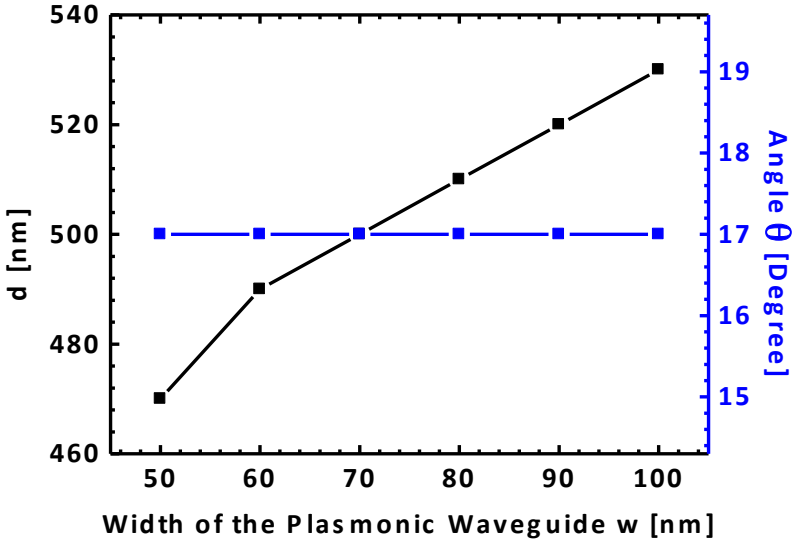
3D Design of the Phase Modulator

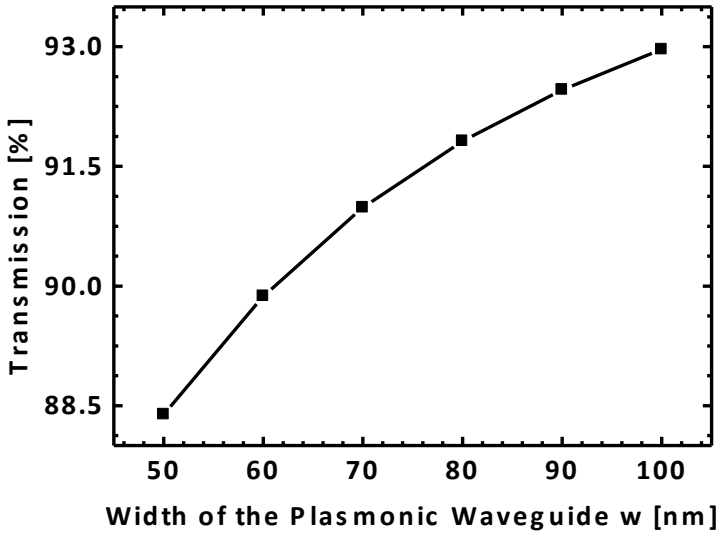




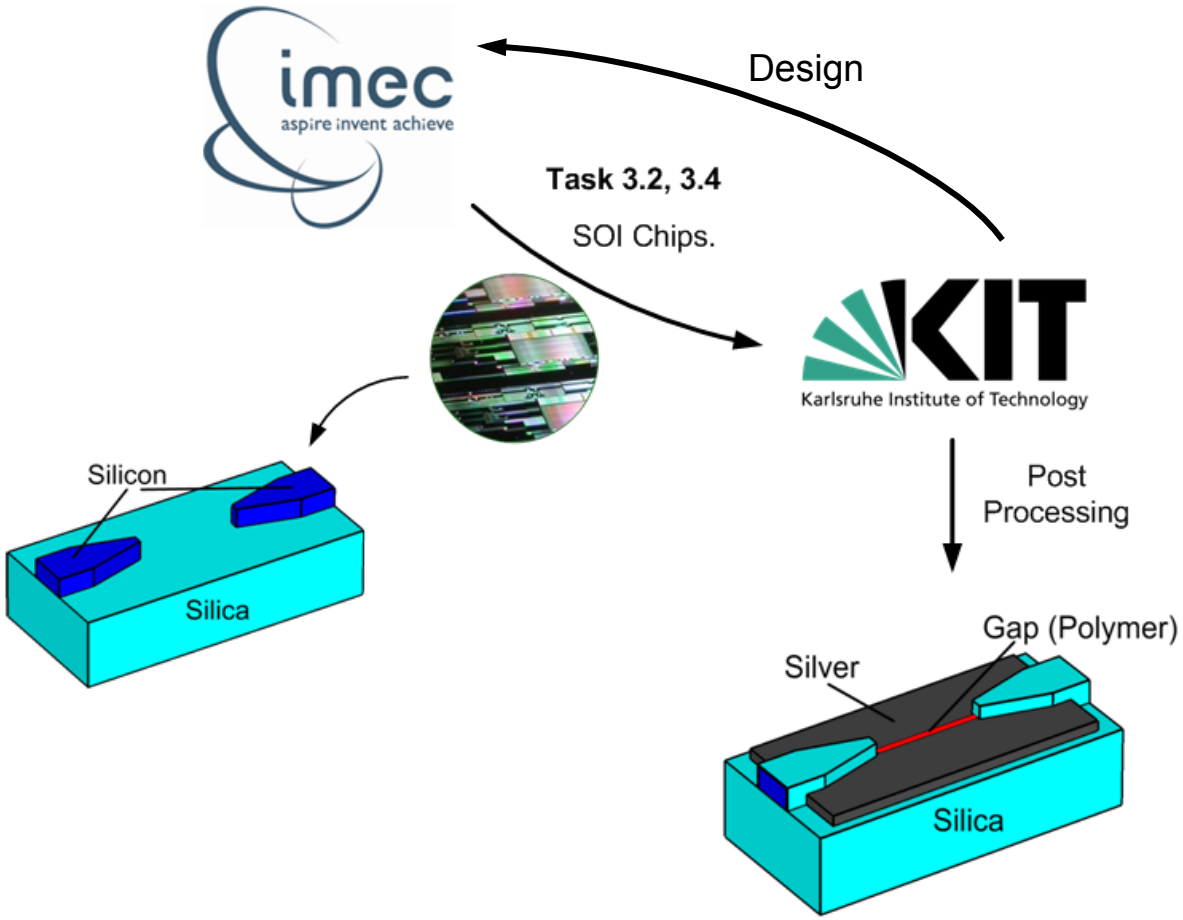
SPP Excitation in the Slot







Fabrication by KIT & IMEC



Fabrication by KIT & IMEC

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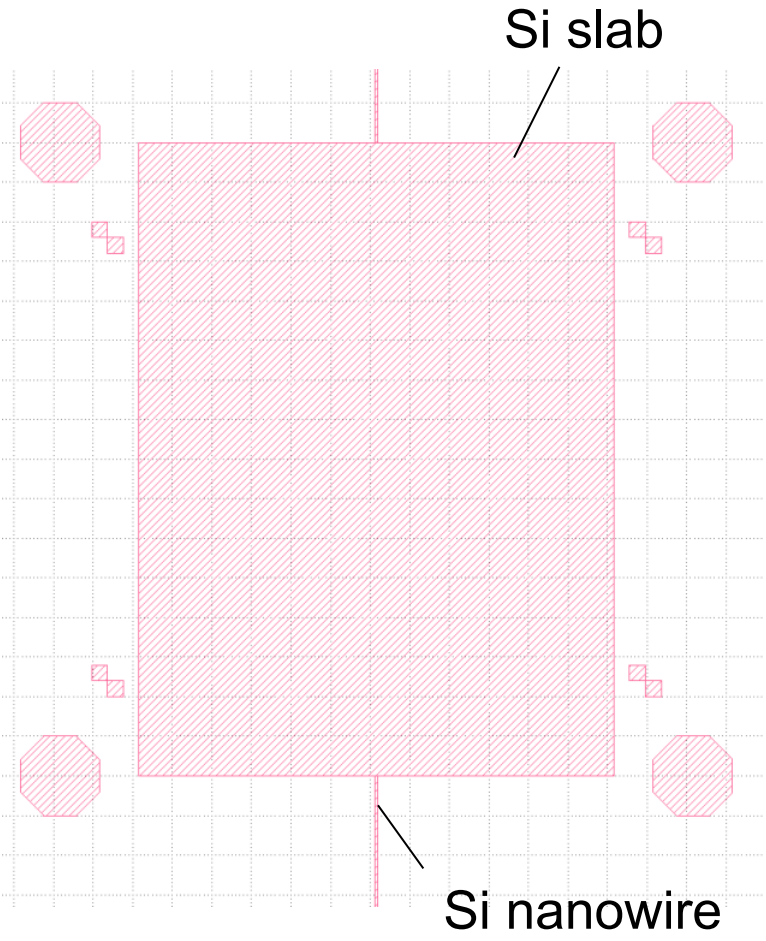
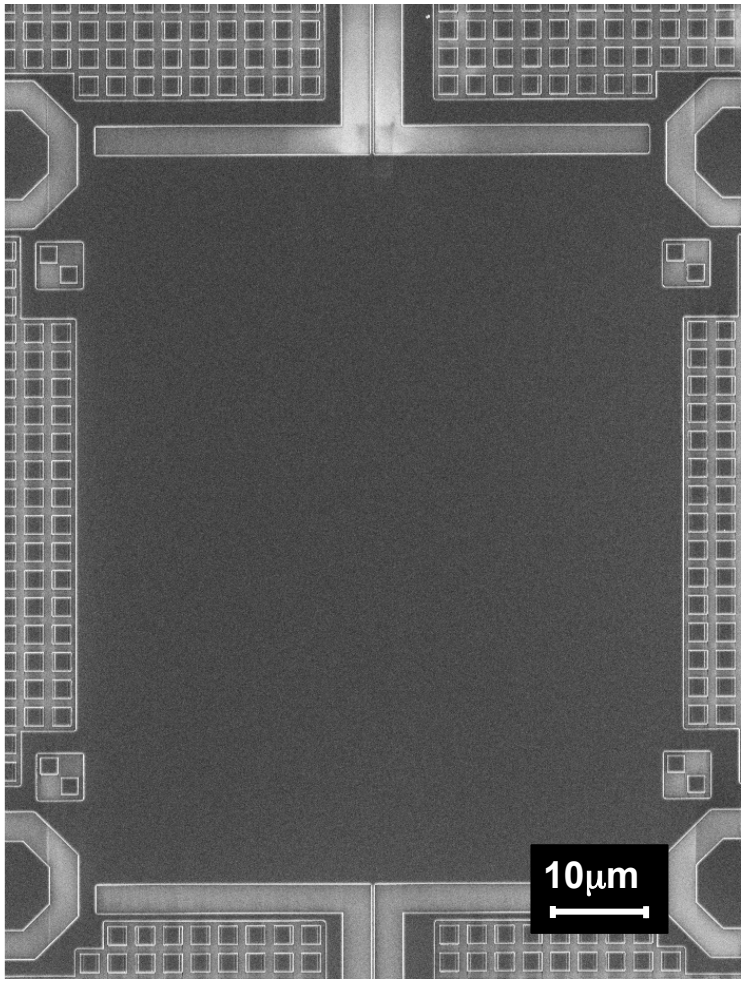
Design Layout



SOI chip Fabricated by IMEC



Fabrication by KIT & IMEC

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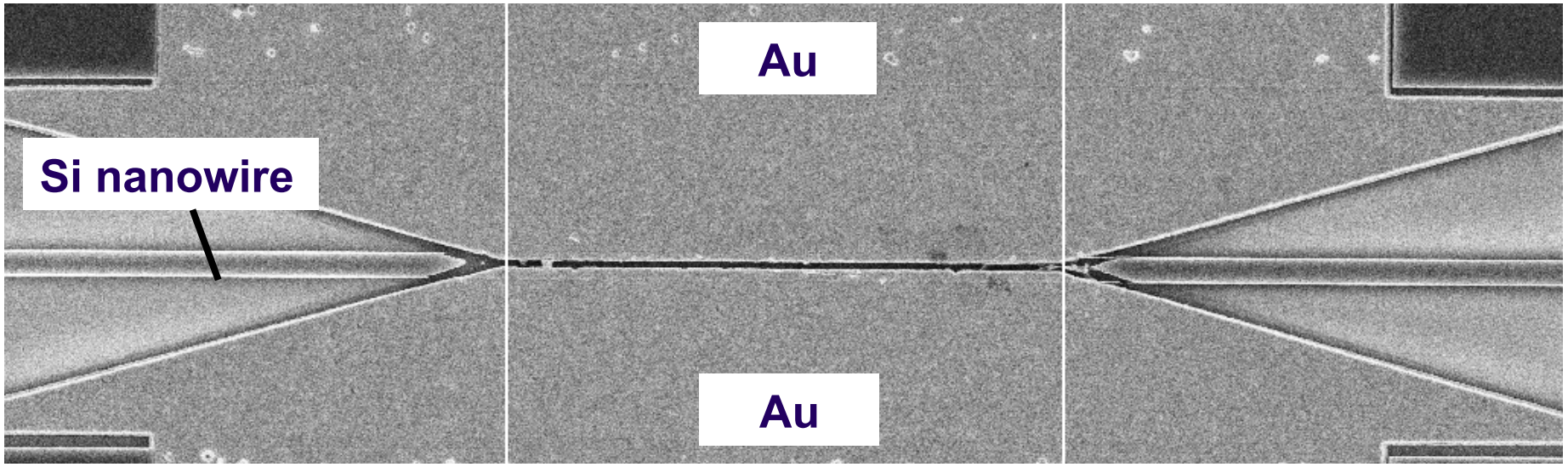
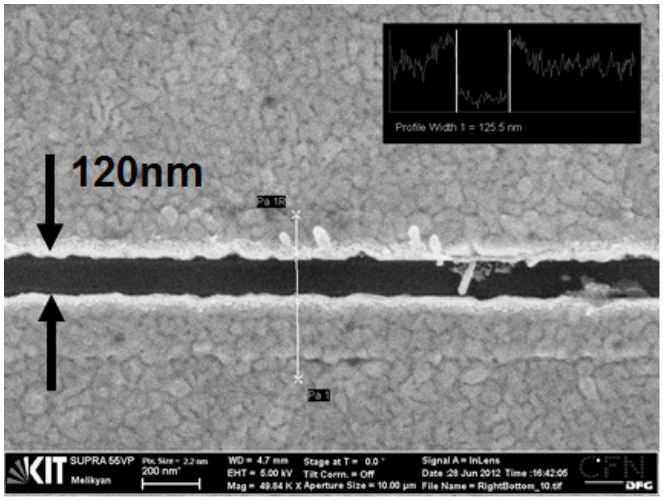
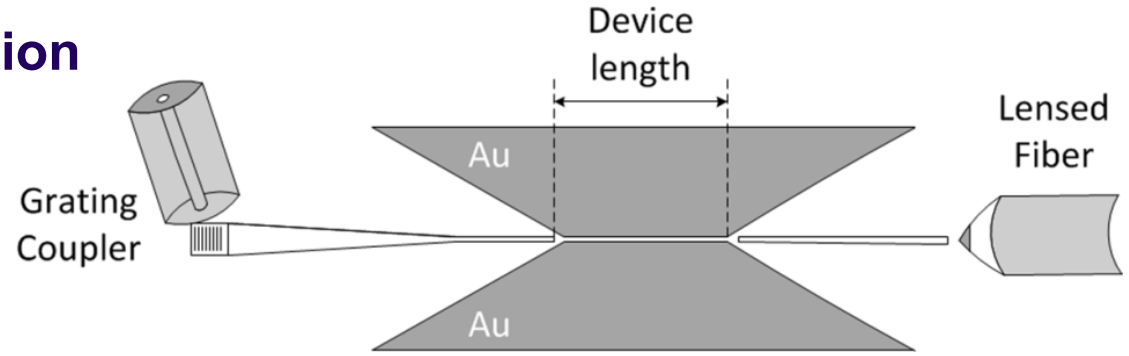
SEM image of the device



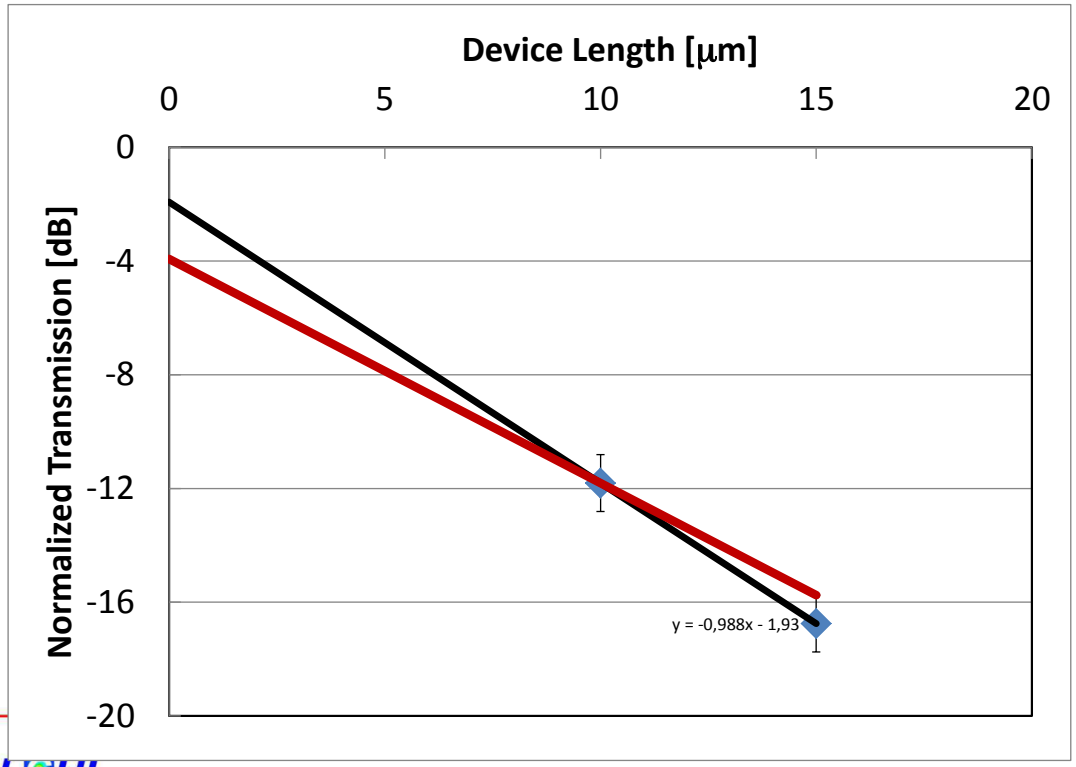


Optical Characterization

Light Coupling Configuration



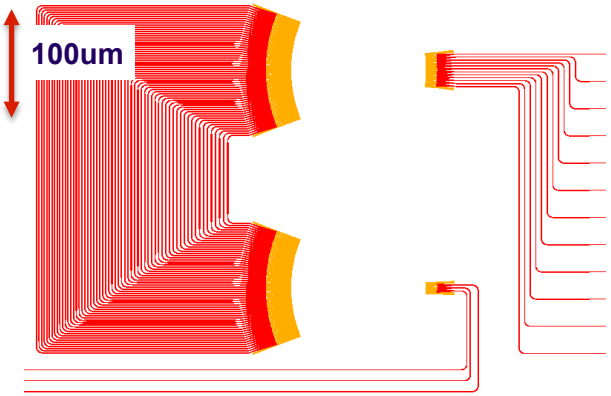
Cut-back measurement

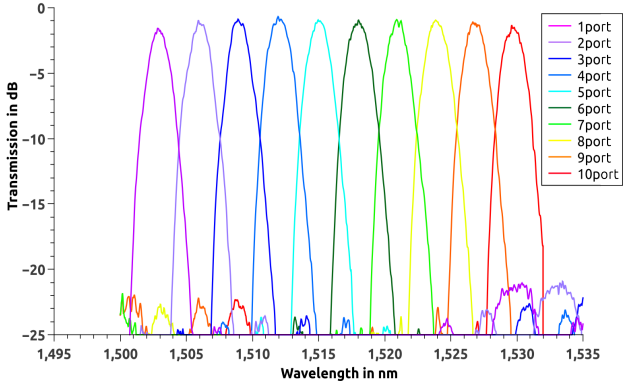


2dB coupling loss per tapered coupler!

Optical filters

- Objective: 1st gen: 3nm bandwidth, 10dB suppression, 30nm FSR



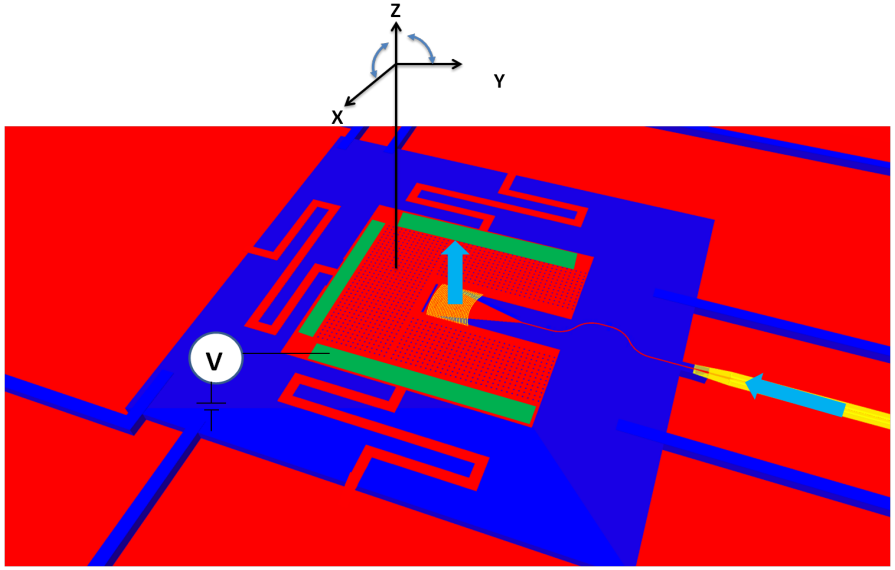


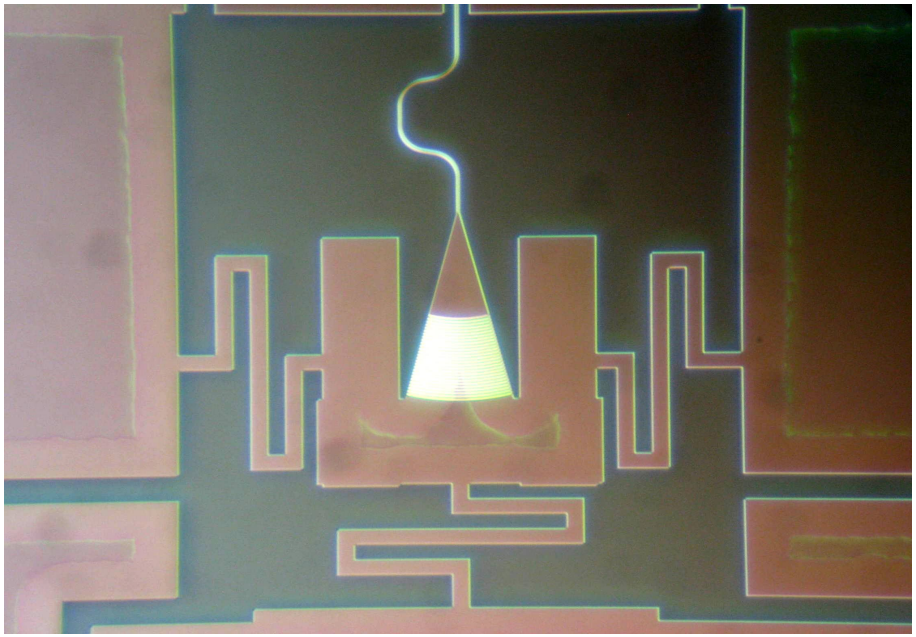
Device Details:
10x400 GHz AWG - size: 370x330 um2 - design FSR = 42 nm

Measurement details:
Insertion Loss: -.90dB non_uniformity: 0.8 dB
Crosstalk: 22 dB
1dB Bandwidth: 1.01 nm - 3dB Bandwidth: 1.75 nm - 10dB Bandwidth: 3.19 nm

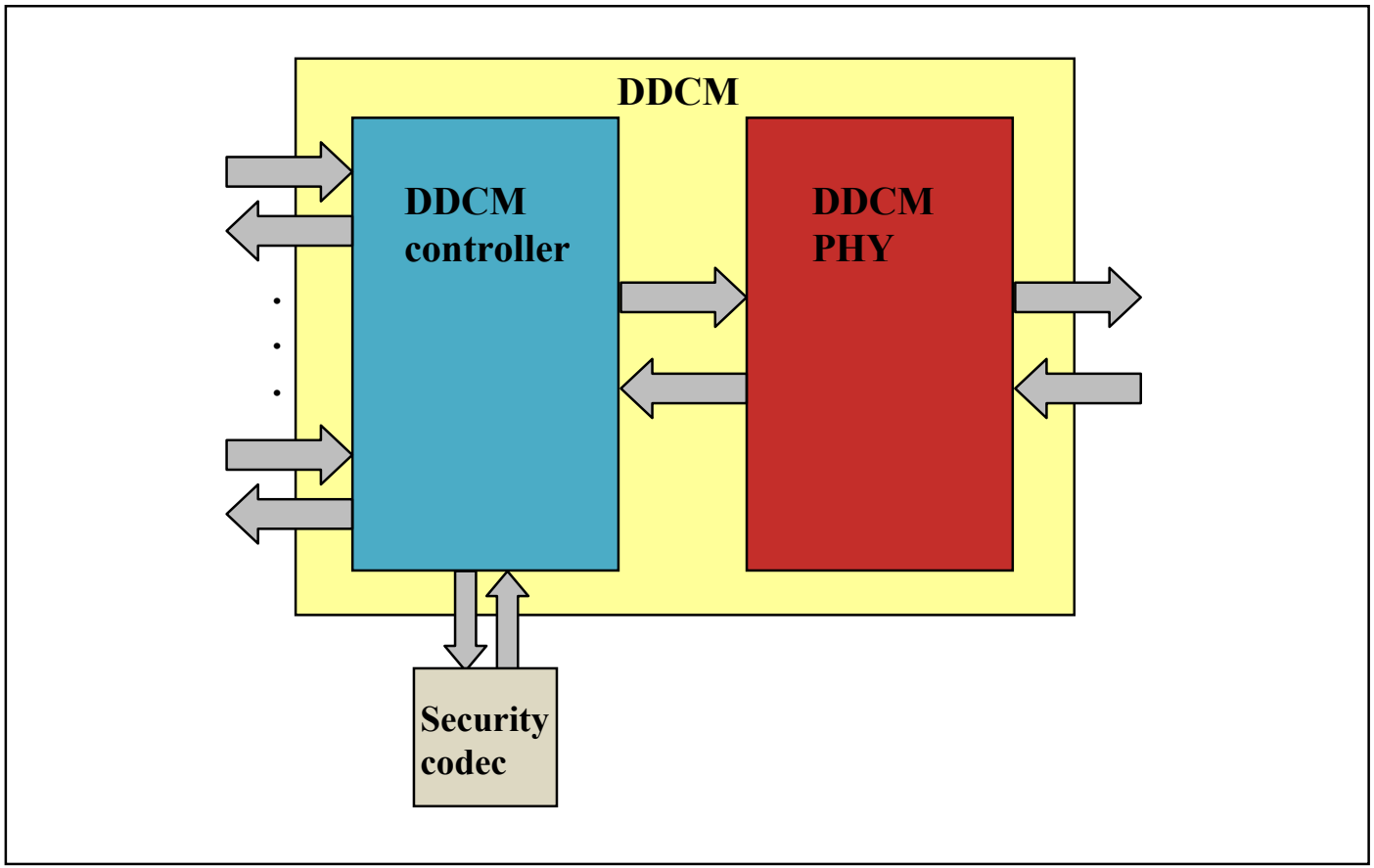
Optical beam steerers

- Shifted focus to steerable gratings

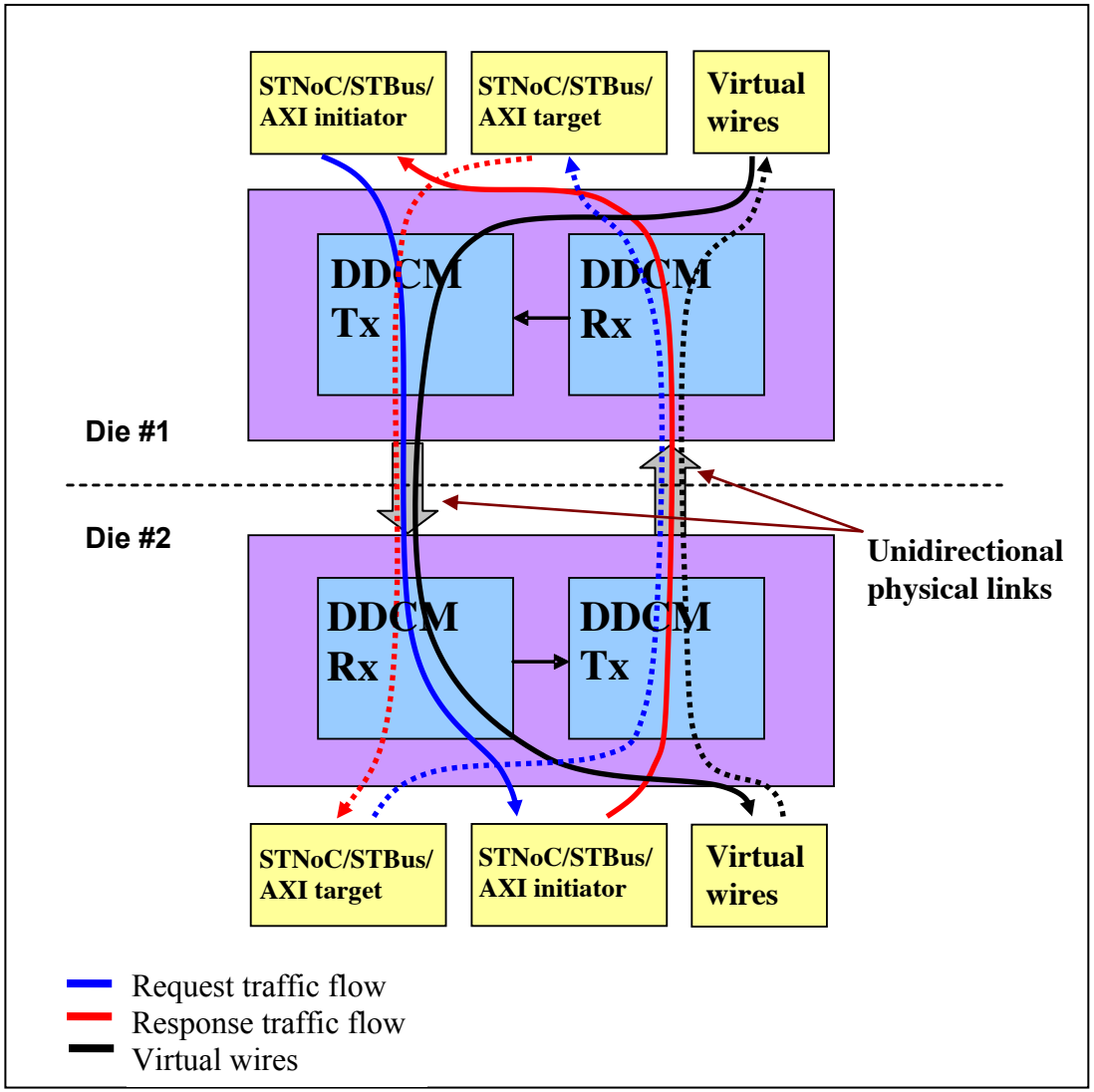




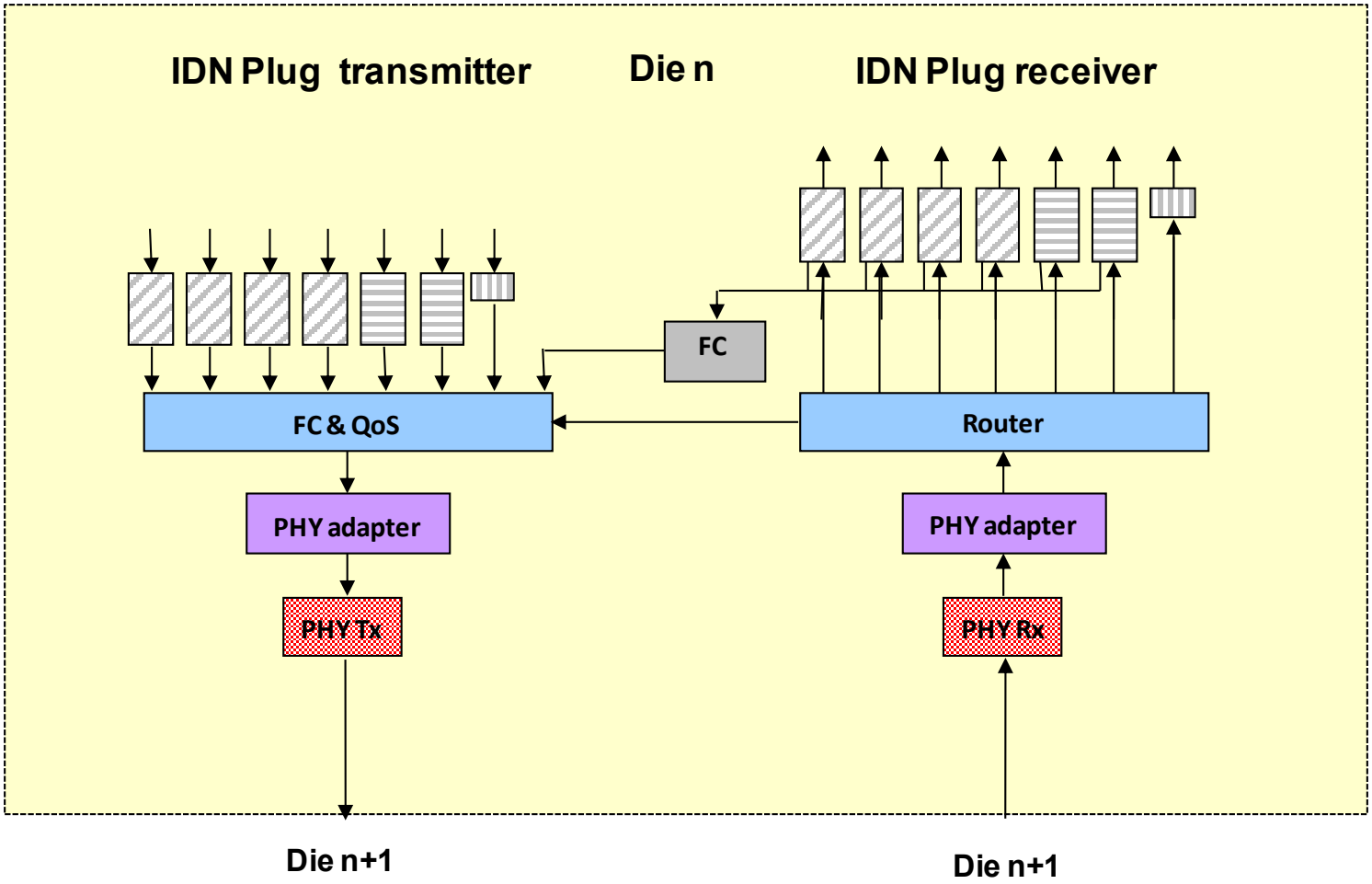
Main achievements (cont'd)



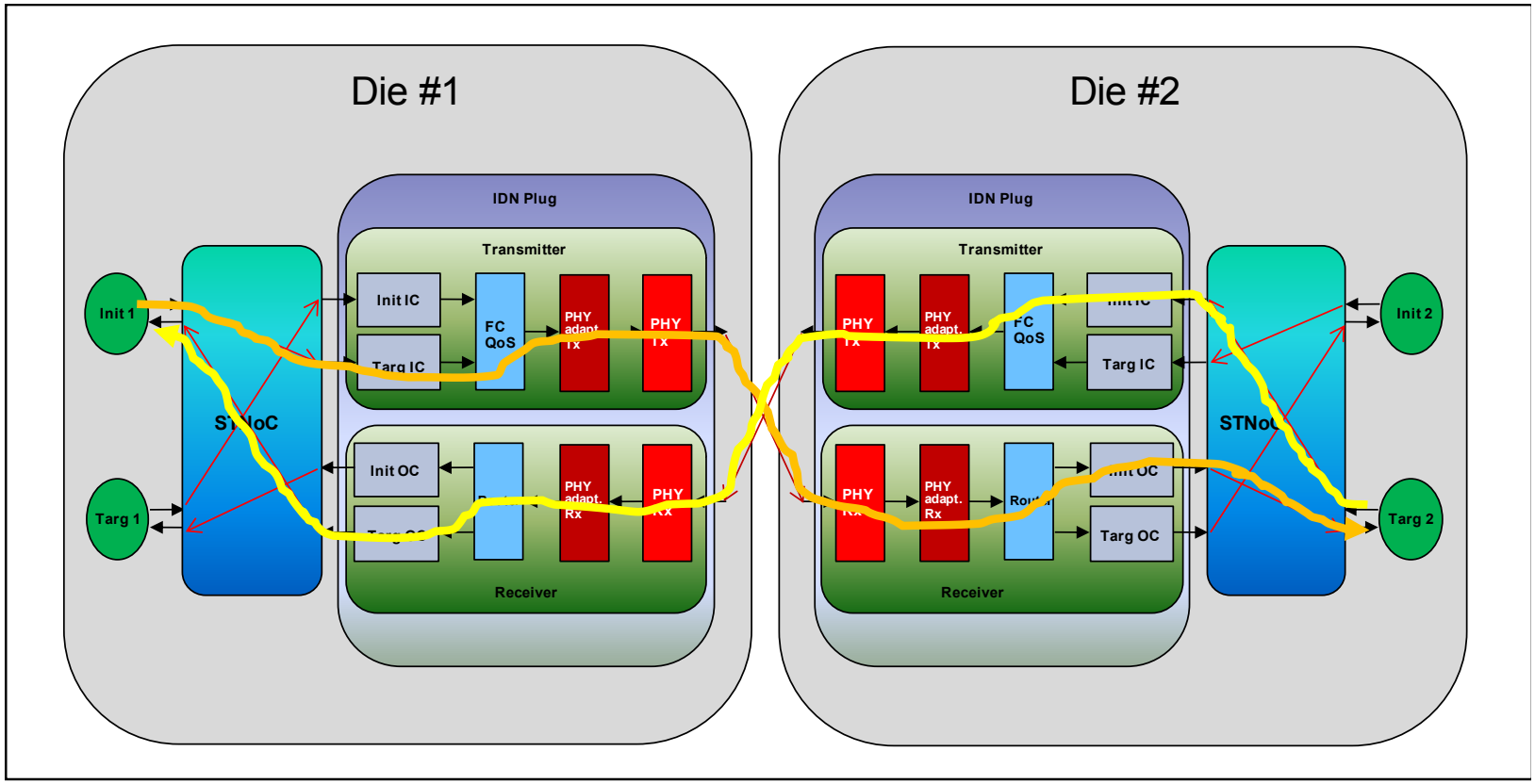
Main achievements (cont'd)



Main achievements (cont'd)



Main achievements (cont'd)



Resources

Outlook

KIT:

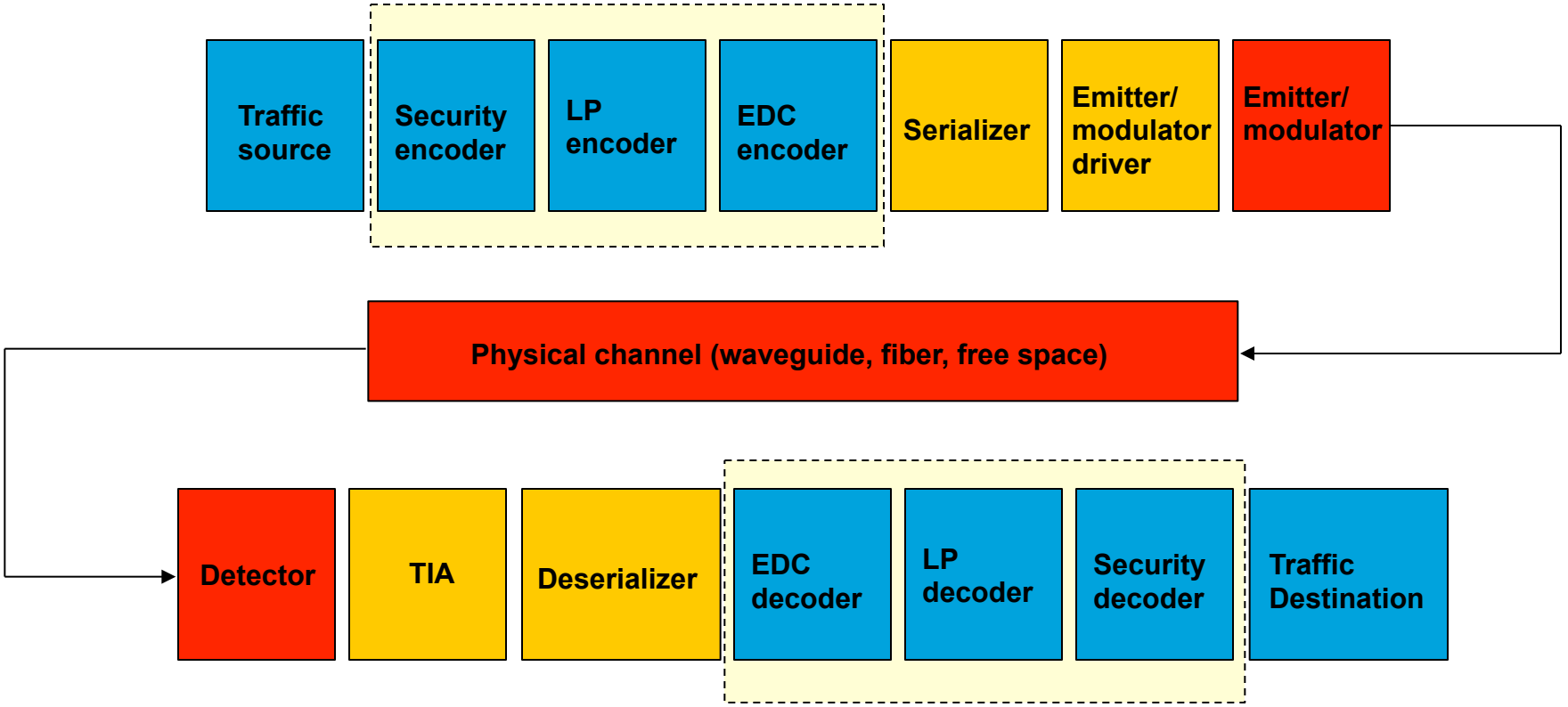
1. Further optimization of the process
2. Next post-processing is being carried out by KIT
3. New cut-back measurement

IMEC

1. Further optimize beam steerers
2. Waiting for input consortium on final design filters

Outlook ST

- Digital
- Analog
- Photonic



WP X Summary (Short Version for Coordinator Talk)

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Objectives:

Achievements: