# The case for shorter reach BiDi in RAN

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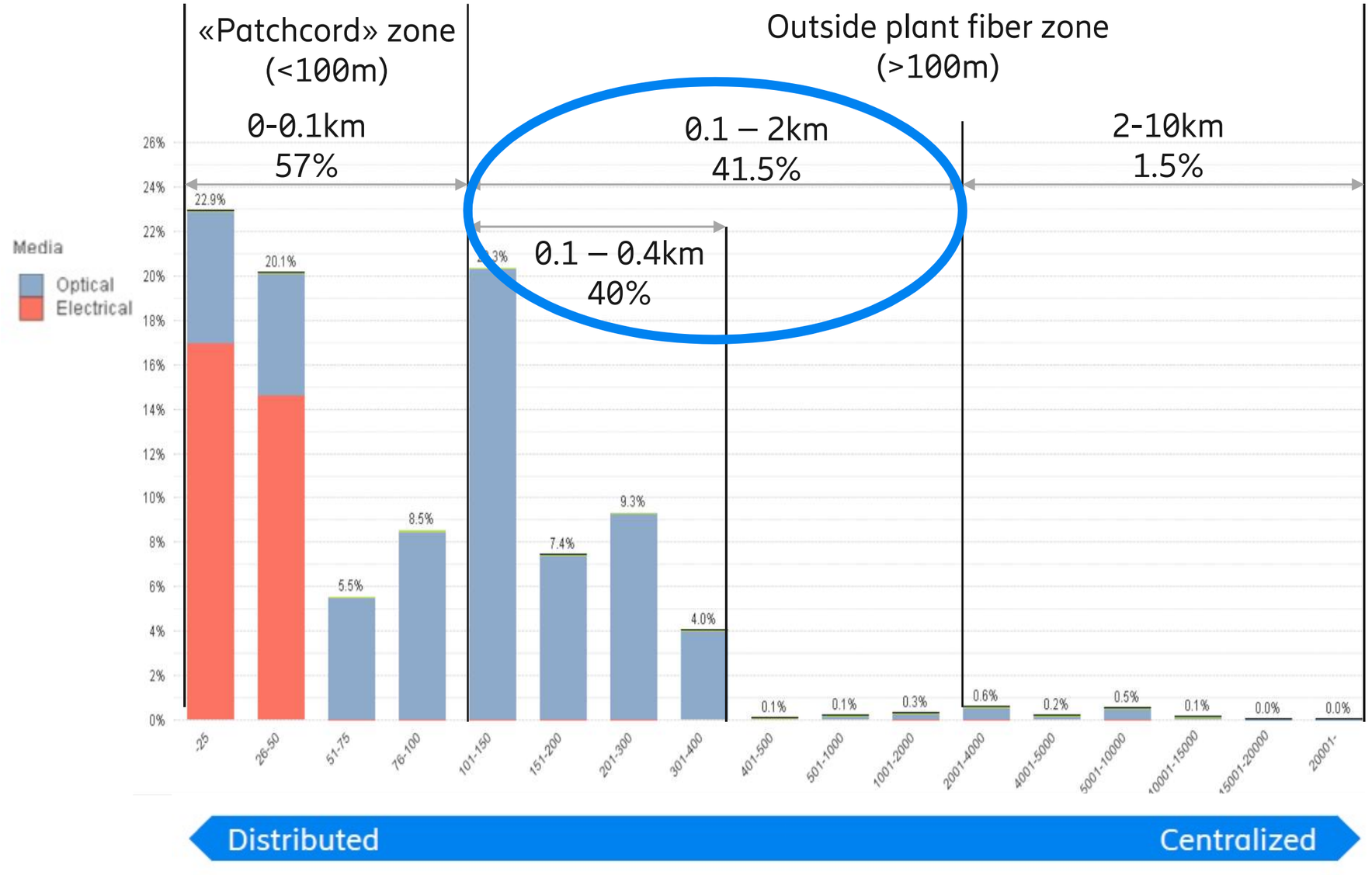
Jan 2020

# Fronthaul link length distribution (D-RAN)

## D-RAN only, ~ few millions of installed links




Historical ( ≤4G) data, courtesy of Ericsson

# Analysis of the three connectivity domains /1

## 0-100m

D-RAN sites, with DU's in close vicinity of the RU's

- — DU and RU on the same rooftop
- — DU at the bottom of the cell tower
- — «Fiber resources» are optical patch-cords

IEEE802.3 traditionally covers this space with duplex fiber short reach multimode interfaces

- — 10GBASE-SR, 25GBASE-SR, 50GBASE-SR, .., : VCSEL-based, perfect for indoor
- — Adapting them for outdoor use is not impossible, but adds challenges/cost

Mobile industry de-facto standard: duplex fiber, duplex fiber short reach single mode interfaces

- — Based on cheap laser sources (typically, Fabry-Perot DML )
- — On par cost-wise with the best multimode solutions for outdoor and supporting up to 2km-ish distances
- — With cost of transceivers constantly reducing , the cost of patch-cords is becoming more and more relevant in % terms

# Analysis of the three connectivity domains /2

## (0.5km/2km) - 10km

C-RAN deployments in relatively abundant fiber areas

- «Fiber resources» are dark fibers in an outside plant.
- xWDM systems can be overkill: BiDi transceivers sufficient for “wise” use of fiber.

**IEEE802.3 is going to cover this space with the BR10 10km BiDi single fiber interfaces being developed by this Task Force**

# Analysis of the three connectivity domains /3

## 100m- ( 0.5km/2km)

D-RAN sites, with DU's in relative vicinity of the RU's

- Radios on the rooftop of a building
- DU in the cellar of a building a few blocks away

«Small-scale» C-RANs

- macro densification with small cells in cities
- «baseband hotels» of limited size, and limited distances

In spite of the shorter reach, «fiber resources» may still be dark fibers in an outside plant

How IEEE802.3 currently covers this space

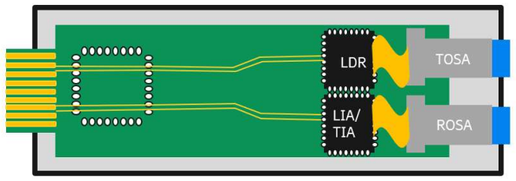
— For lower speeds: «LR» 10km duplex fiber ( 10GBASE-LR,25GBASE-LR, ...)
— 802.3cp in the process of adding  BR10 10km BiDi single fiber
— For high bit rates, «DR»/«FR» 500m/2km duplex fiber interfaces ( 200GBASE-FR4, 400GBASE-DR4/...FR4? )

**This space could be covered more effectively by cost-optimized short reach BiDi ( «BR10 lite» ?) interfaces**

# Every penny counts for mobile applications

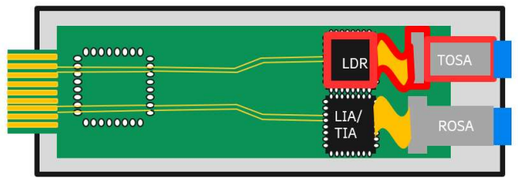
## Duplex fiber 10GBASE - LR «lite»

De-facto standard in use for years now by the wireless industry




10GBASE-LR (10km)
Tx: 10G DFB uncooled, 10G LDR
Rx: 10G PIN-TIA-LIA

IEEE standard

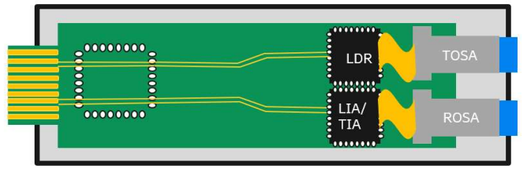



10GBASE-LR «lite» @ 10G (<2km)
Tx: 10G FP uncooled, 10G LDR
Rx: 10G PIN-TIA-LIA

Lower cost than a 10G DFB based implementation
Use a 10G FP, trade fiber loss for TDP

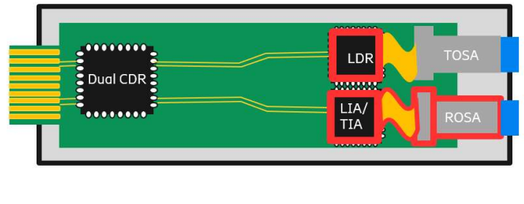
## Duplex fiber 25GBASE - LR «lite»

De-facto standard for duplex fiber being adopted by the wireless industry




10GBASE-LR (10km)
Tx: 10G DFB uncooled, 10G LDR
Rx: 10G PIN-TIA-LIA

IEEE standard




25GBASE-LR «lite» @ 25G (2km)
Tx: *the same* 10G DFB uncooled, 25G LDR
Rx: 25G PIN-TIA-LIA

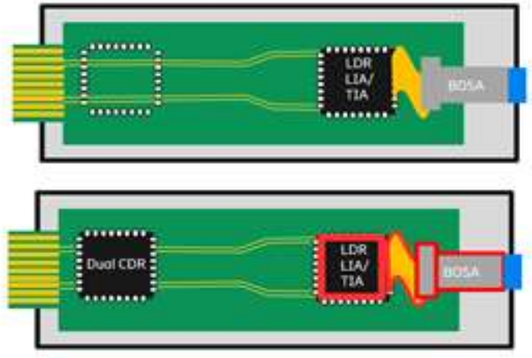
Lower cost than a 25G DFB based implementation
Use a 10G DFB, trade fiber loss for TDP

Three Vendors developing it, I-temp

Expected savings up to 25%
with respect to a 25G DFB-based implementation

Principle: trade some «fiber loss» for TDP allowing use of cheaper lasers

## 2km 25G, reuse of 10km 10G bidi technology




10km BiDi @ 10G, 1270nm/1330nm
Tx: 10G DFB uncooled, 10G LDR
Rx: 10G PIN-TIA-LIA

2km BiDi @ 25G
Tx: *the same* 10G DFB uncooled pair, 25G LDR
Rx: 25G PIN-TIA-LIA

# Tentative specs of 25G transceivers being developed

## we have the opportunity / necessity to harmonize them

### «Vendor 1»

λ1= 1270nm, λ2 =1330nm

| | |
|---|---|
| OMA Tx min = | -6.8dBm |
| ER min = | 3.0dB |
| TDP (max) = | 2.7dB |
| OMA Sens (max) = | -14.8 dBm |
| Link loss budget (*)= | 5.3dB |

### «Vendor 2»

λ1= 1270nm, λ2 =1330nm

| | |
|---|---|
| OMA Tx (min) = | -5.5dBm |
| ER (min) = | 3.5dB |
| TDP (max)= | 2.7dB |
| OMA Sens (max) = | -10.5dBm |
| Link loss budget (*) = | 2.3dB |

### «Vendor 3»

λ1= 1270nm, λ2 =1330nm

| | |
|---|---|
| OMA Tx (min) = | -4.0 dBm |
| ER (min) = | 3dB |
| TDP (max)= | 2.7dB |
| OMA Sens (max) = | -9.5dBm |
| Link loss budget (*) = | 2.8dB |

*(*) assumption, just considering OMA Tx min and TDP max values, without any specific (OMA Tx – TDP)max requirement*

# Take-aways

There may be space, for mobile applications, for cost/reach optimized BiDi («BR10 lite »?)

- Halving the number of fibers is always very important when dark fiber in outside plant must be used, regardless of the distance
- Every penny counts in mobile applications

The transceiver industry is already working on a «low hanging fruit», 25G 2km BiDi obtained by reusing technology from existing 10G 10km BiDi

- Opportunity for early interception of another «de-facto» mobile standard, turning it into an IEEE standard

In the traditional very short reach (0-100m) domain, the cost of patch-cords begins to matter

— If «duplex single mode transceivers + 2 single mode patch-cords» can be shown to break-even with «BiDi + 1 single mode patch-cord», perhaps a relevant portion of the mobile optical interconnects space (now covered by «de facto» standards) could be «won back to IEEE802.3 »