Unified Mobile Backhaul

- 3G & 4G RAN Topology Evolution

Operators face tough Requirements in Mobile Data Networks…
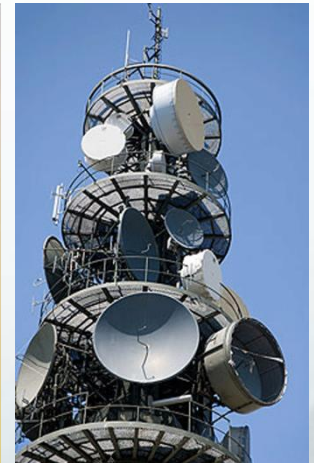
- 3G & 4G mobile Data Explosion ⇨ *high Capacity* + *evolving RAN Topology*

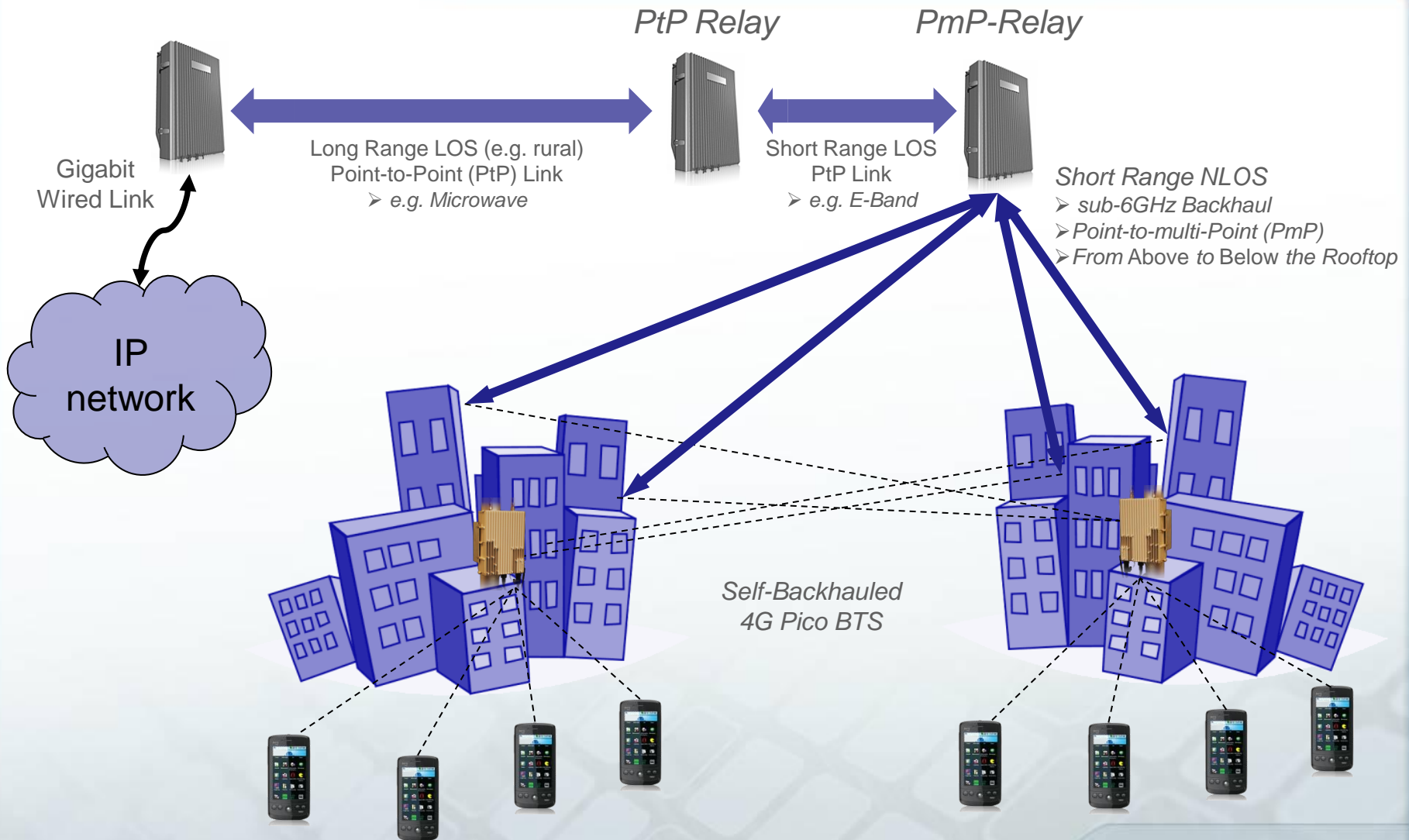- 4G RAN adds use of "Small Cells" ⇨ *Compact Pico- & Microcell Backhaul*

Mobile Backhaul Capacity Explosion

Small Cell Backhaul Required

Requires Backhaul Topology Evolution

Evolving 4G Network Topology
Illustration

DesignArt Networks

PtP Relay

PmP-Relay

Gigabit
Wired Link

Long Range LOS (e.g. rural)
Point-to-Point (PtP) Link
➤ *e.g. Microwave*

Short Range LOS
PtP Link
➤ *e.g. E-Band*

Short Range NLOS
➤ *sub-6GHz Backhaul*
➤ *Point-to-multi-Point (PmP)*
➤ *From* Above *to* Below *the Rooftop*

IP
network

*Self-Backhauled
4G Pico BTS*

DesignArt Networks

Multi-Band	➢ Increased need for installation flexibility:
	   → *Microwave backhaul bands already densely deployed !*
	   → *Not all bands support all requirements (e.g. NLOS)*

Gigabit+ Throughput	➢ Increased Demand in Capacity → *Need Solution that delivers GE Capacity across all bands*
Spectral Efficiency	➢ Limited Spectrum in candidate backhaul bands → *Need to maximize capacity from spectrum across all bands*

Evolved Topologies	➢ New "Small Cell" Deployment Paradigm
	   → *Increased BTS density, requires new deployment sites*
	   → *Small cell backhaul equipment must be very compact*

NLOS Support	➢ New "Metrozone" Backhaul Topology
	   → *"Below the rooftop" Deployment Model*
	   → *Requires NLOS solution for small cell aggregation*

4G Wireless Backhaul Options

Multi-Band

Gigabit+ Throughput

Spectral Efficiency

Evolved Topologies

NLOS Support

➤ NLOS sub-6GHz
- \+ *Robust NLOS Performance*
- \+ *Very high Spectral Efficiency*
- \+ *Optimized for TDD (FDD optional)*
- \+ *Point-to-Multipoint Topology for Pico & Microcell Backhaul Aggregation*
- \- *Licensed Spectrum leads to narrow Channels (un-licensed optional)*

➤ Microwave 6-42 GHz
- \+ *Optimized for LOS and long Range (several km)*
- \+ *High Spectral Efficiency*
- \- *Does Not support NLOS*

➤ 60 GHz / E-Band
- \+ *Unused and available low-cost Spectrum*
- \+ *Wide Channels (up to 1GHz)*
- \- *Poor Spectral Efficiency*
- \- *Requires clean LOS*
- \- *Short range*

⇨ **4G RAN Evolution leads to an evolving Backhaul Architecture, using all of the Alternatives above!**

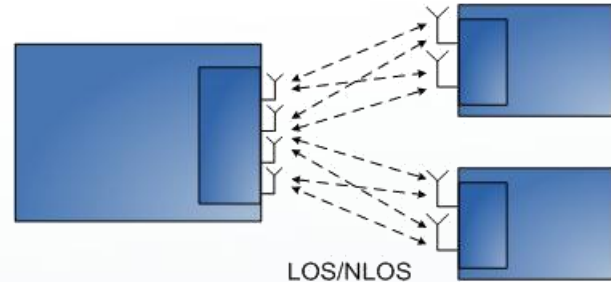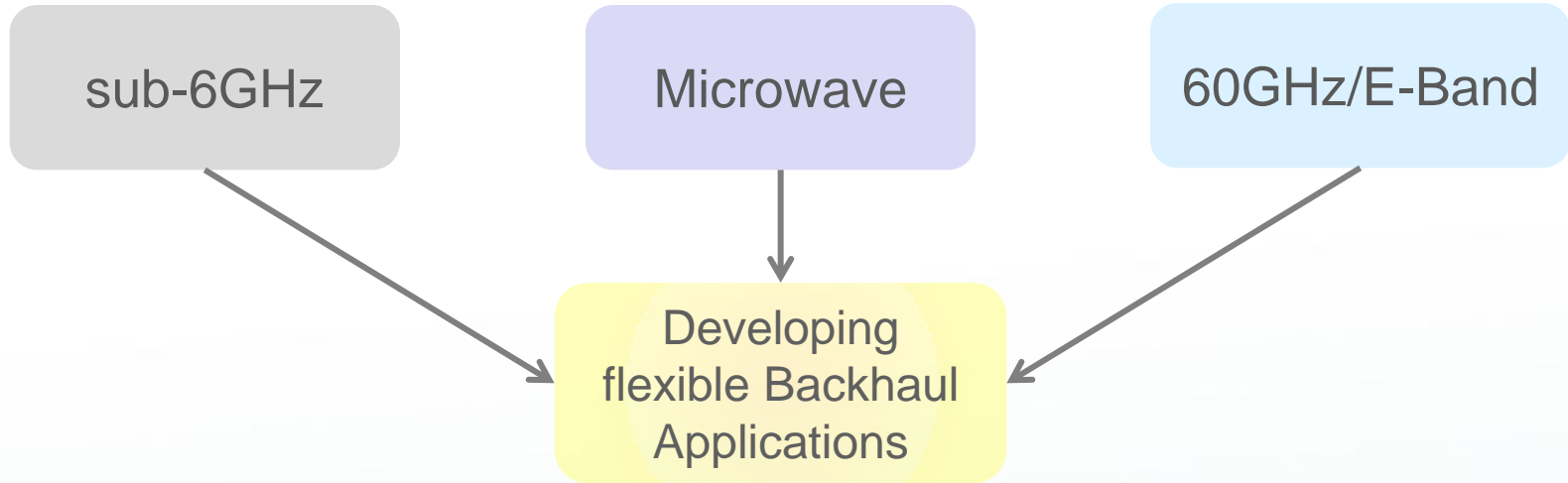|	
PtP Link Topology ⇒ Gigabit+ on any frequency band • Options: sub-6GHz, Microwave, E-Band ⇒ Targeting LOS and NLOS applications	LOS/NLOS
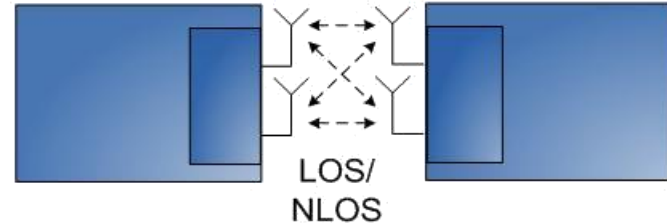
PtMP Link Topology
 	
⇒ Gigabit+ aggregated Throughput
   • sub-6GHz, Microwave, E-Band
⇒ Targeting any combination
   • LOS-NLOS / LOS-LOS / NLOS-NLOS
	LOS/NLOS

Multi-Spectrum Relay
 	
⇒ Any combination of Frequency Bands
   • sub-6GHz / Microwave Link / E-Band
⇒ Any combination of Link Topologies
   • LOS-NLOS / LOS-LOS / NLOS-NLOS
   • PtP / PtP, PtP / PtMP
	NLOS/LOS
	LOS/NLOS
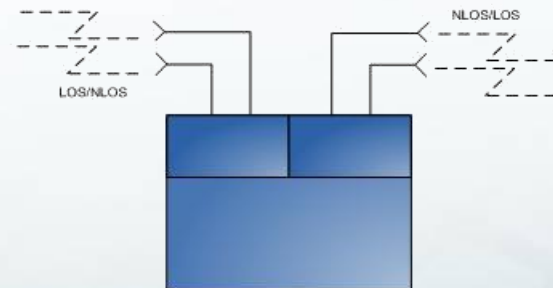
The Backhaul System Architecture Challenge
Developing a Platform flexible enough to support multiple Link Topologies & Frequency Bands !

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┌──────────────┐     ┌──────────────┐     ┌──────────────────┐
│   sub-6GHz   │     │   Microwave  │     │   60GHz/E-Band   │
└──────────────┘     └──────────────┘     └──────────────────┘
          ╲                 │                    ╱
           ╲                ▼                   ╱
            ▶  ┌──────────────────────────┐  ◀
               │        Developing         │
               │     flexible Backhaul     │
               │       Applications        │
               └──────────────────────────┘
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- ➢ No Performance Compromise
- ➢ Single, integrated R&D Effort
- ➢ Maximum SW Re-use
- ➢ Unified Air Interface

Need a Unified SW-programmable Backhaul Solution

DesignArt Tackles Mobile Backhaul
SoC-based Unified Backhaul Solutions

Sub-6Ghz

- ✓ Up to 1.4 Gbps fdx / link
- ✓ NLOS & LOS Backhaul
- ✓ Short & medium Range
- ✓ PtP & PtMP Link Topology
- ✓ XPIC, 4x4 MIMO Support
- ✓ Latency < 150 µsec

Microwave

- ✓ Up to 1.4 Gbps fdx / link
- ✓ LOS Backhaul
- ✓ Long Range
- ✓ PtP & PtMP Link Topology
- ✓ XPIC
- ✓ Latency < 50 µsec

60-80GHz

- ✓ Up to 1.4 Gbps fdx / link
- ✓ LOS Backhaul
- ✓ Short Range
- ✓ PtP & PtMP Link Topology
- ✓ XPIC
- ✓ Latency < 15 µsec

Support of FDD/TDD modes, Low SoC-Power (< 5 Watts), 100% SW Re-use
High Link Availability & hit-less Link Protection Options (> 99.999 %)

6GHz   42GHz

One SoC. One Software. Any Backhaul Application.

DesignArt proposes **SoC-based Unified Mobile Backhaul** *Solution, fully SW-programmable, for all required mobile Backhaul Applications !!!*