

3GPP RAN #75

Dubrovnik, Croatia, March 6-9, 2017

Agenda item: 9.1

RP-170176

Motivation for SID on Integrated Access & Backhaul (IAB) in NR



Integrated Access and Backhaul: Objectives

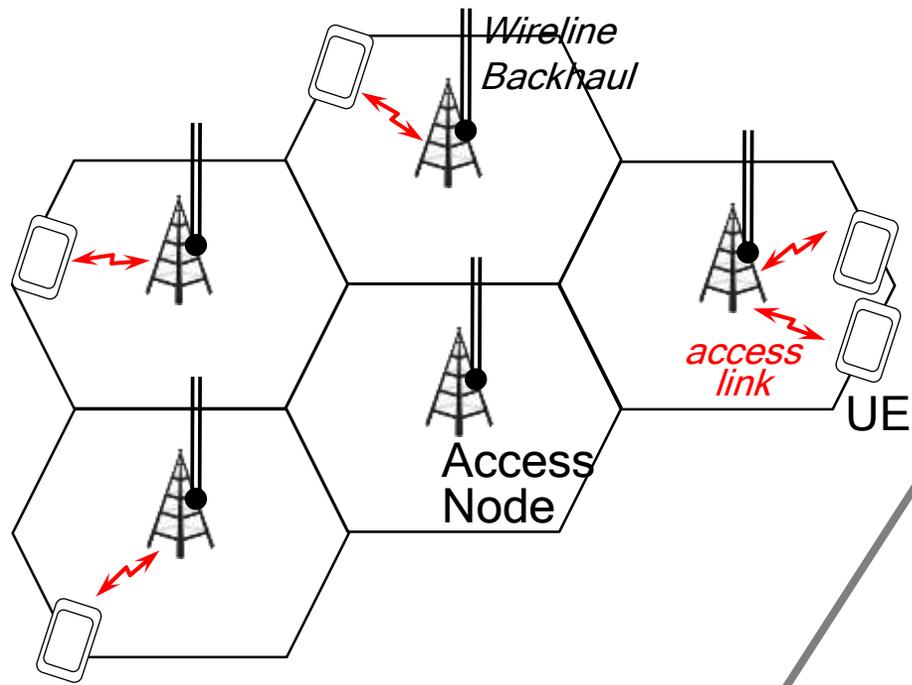
- High densification of access nodes creates deployment and management problem
- Wireless backhauling can address these challenges in the following manner:
 - It can enable simpler deployment and incremental rollout by reducing reliance on the availability of wired backhaul.
 - Network planning and installation efforts can be reduced by leveraging features such as self-configuration, self-organization and self-optimization.
- Integration of wireless access and backhauling (IAB) enables easier management and more resource-efficient operation.

Issue and Opportunity: IAB for mmWave RAT

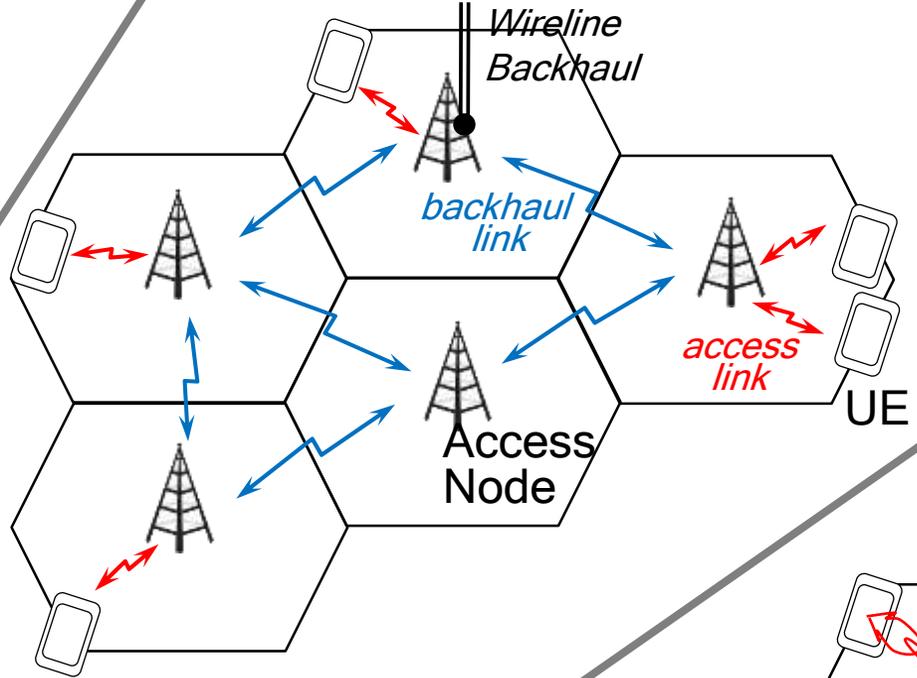
- mmWave access is inherently a small-cell technology, and relies on densified deployment to provide service over an extended area.
 - Note: Rollout via sparse overlay with incremental fill-ins, as used for sub-6 RATs, is not a viable option for mmWave access due to its limited range.
- Wireless self-backhauling is therefore crucial to incrementally roll out mmWave access.
- Wireless self-backhauling can benefit from mmWave-specific assets such as high link capacity, interference suppression due to narrow beams and autonomous beam discovery/tracking.

Need for Timely Availability of IAB

- Benefits of IAB are crucial during network rollout and initial network growth phase
- To leverage these benefits, IAB has to be available when NR rollout occurs.

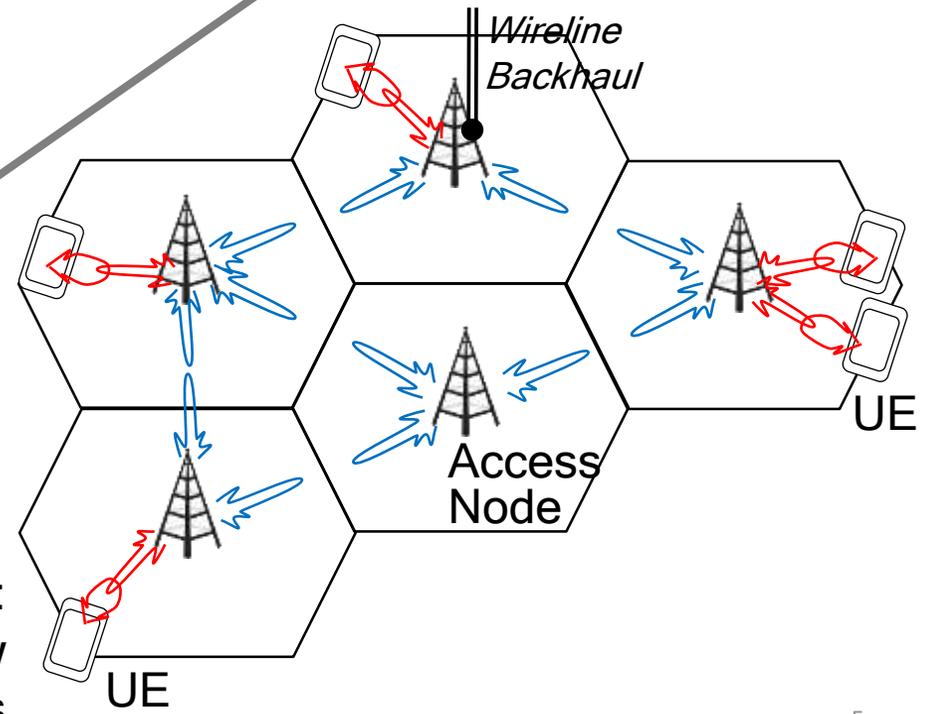


W/o IAB: Separate wireline backhaul needed for each access node



With IAB: IAB allows sharing of one backhaul link among multiple access nodes.

Deployment examples with and w/o IAB



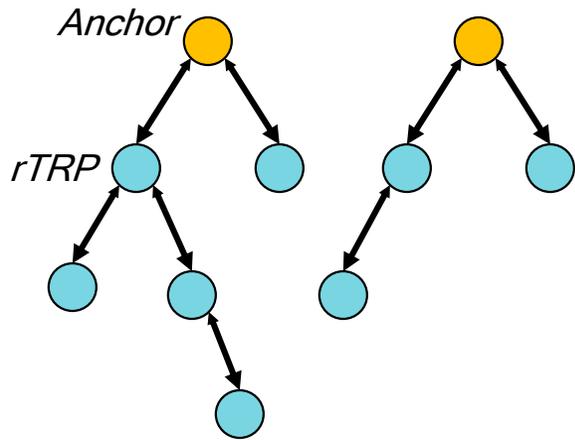
With IAB for mmWave RAT: IAB benefits from narrow beams of mmWaves

SA1 Requirements for Self-Backhauling

TS 22.261 - Service requirements for the 5G system; Stage 1 (Release 15)

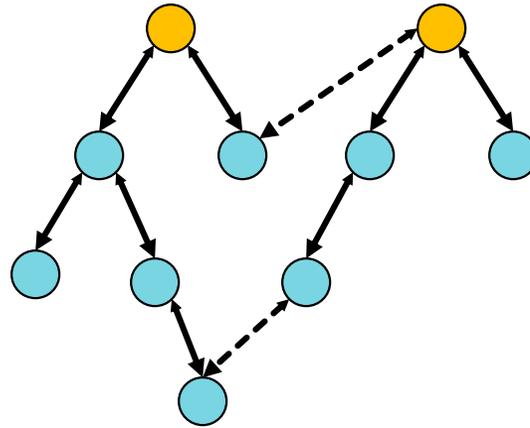
- The 5G network shall enable operators to support wireless self-backhaul using NR and E-UTRA.
- The 5G network shall support flexible and efficient wireless self-backhaul for both indoor and outdoor scenarios.
- The 5G network shall support flexible partitioning of radio resources between access and backhaul functions.
- The 5G network shall support autonomous configuration of access and wireless self-backhaul functions.
- The 5G network shall support multi-hop wireless self-backhauling.
 - NOTE 1: This is to enable flexible extension of range and coverage area.
- The 5G network shall support autonomous adaptation on wireless self-backhaul network topologies to minimize service disruptions.
- The 5G network shall support topologically redundant connectivity on the wireless self-backhaul.
 - NOTE 2: This is to enhance reliability and capacity and reduce latency.

Issues to be Studied: Topologies Supported



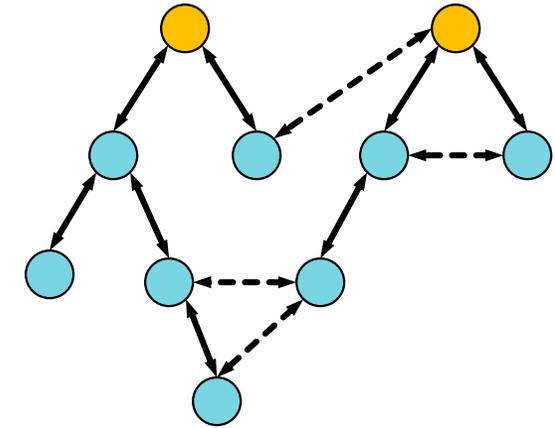
Spanning tree

- No redundancy
- Simple route management



Directed acyclic graph

- Adds redundant connectivity
- More complex route management

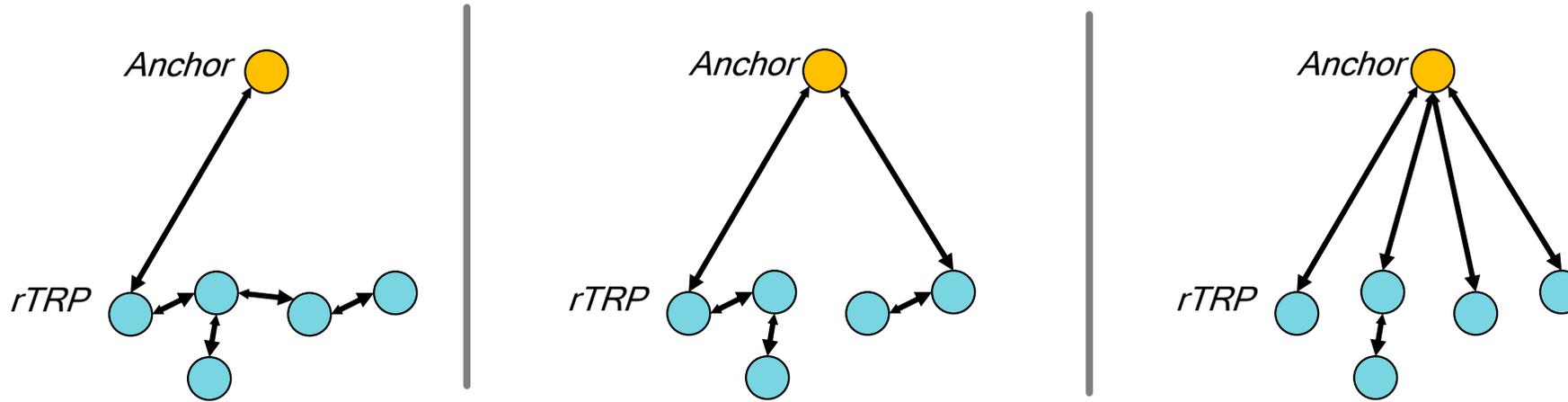


Arbitrary topology

- Very flexible
- Very complex route management

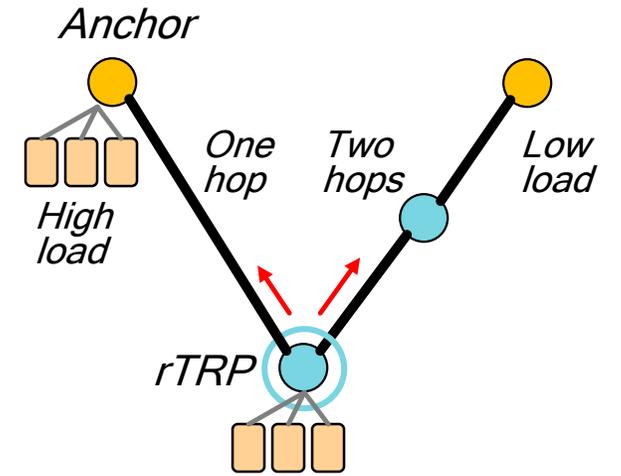
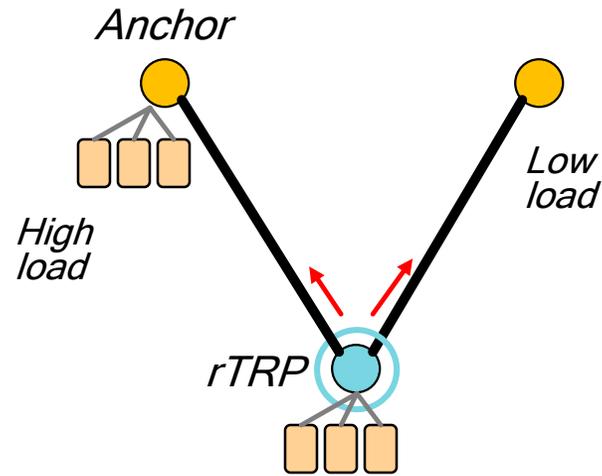
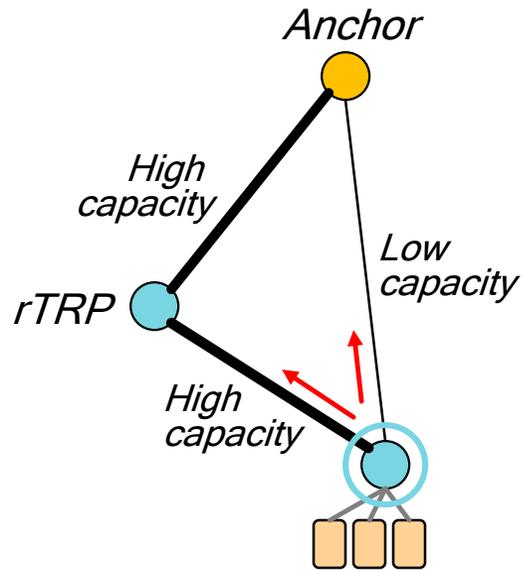
- Trade-off to be considered among complexity, robustness and resource efficiency

Issues to be Studied: Topology Management



- Multiple topologies possible for a given deployment
- Management function needed to dynamically select and configure best topology
 - Centralized management function
 - Distributed/autonomous management

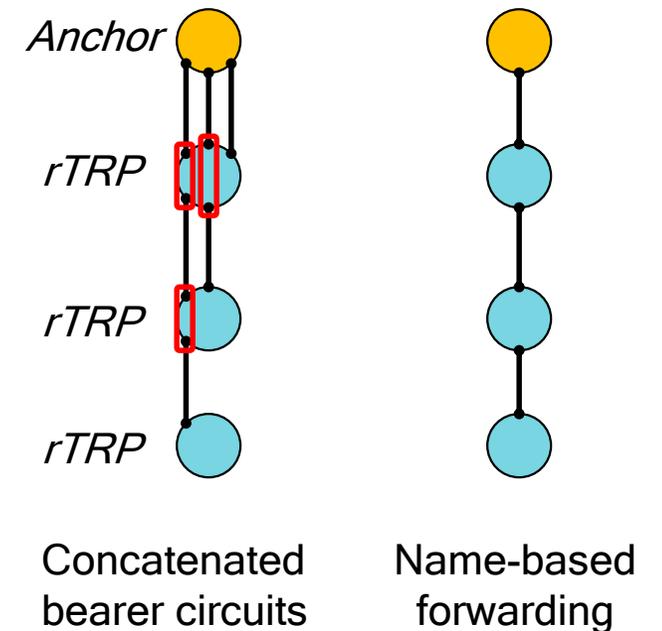
Issues to be Studied: Route Management



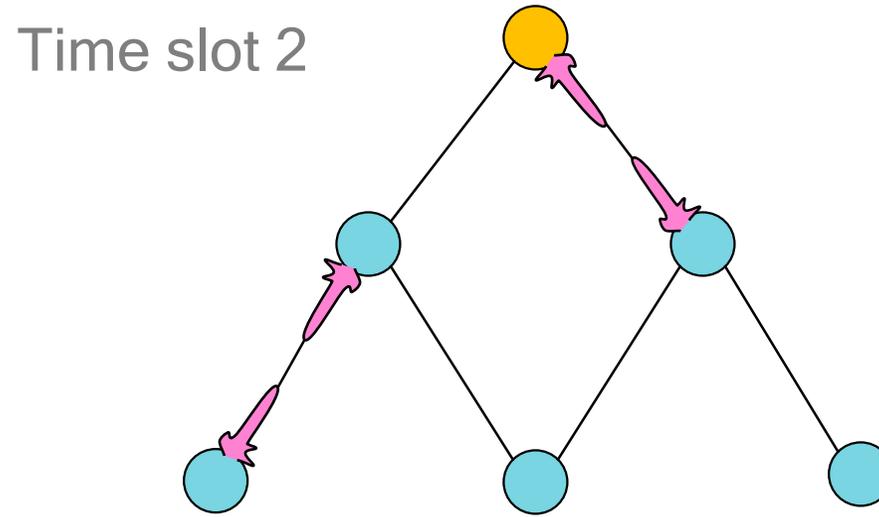
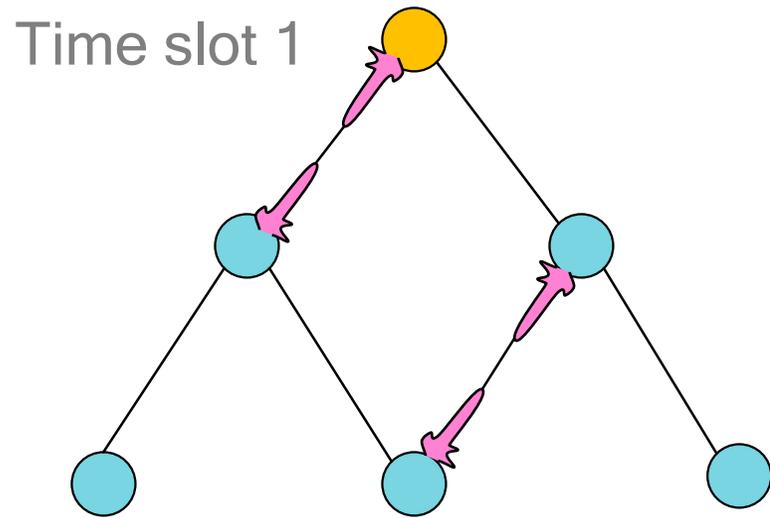
- Route selection & load balancing applies to topologies with redundant connectivity
- It has to consider latency, capacity and load on each route
- It needs to be implicitly handled by topology management for spanning-tree topologies

Issues to be Studied: Transport on Backhaul

- Forwarding on L2 vs. L3
 - L2: Requires concatenated bearer circuits or (new) backhaul-wide L2-name space for forwarding.
 - L3: Use of IP may imply interaction with core network (EPC or NGC)
- Security
 - Hop-by-Hop vs. path-based security
- Transport optimization
 - Packet reordering hop-by-hop vs. path-based



Issues to be Studied: Half-duplexing & Cross-link Interference



- Half-duplexing problem: Requires coordination of access/backhaul link activity
- Inter-link interference: Requires coordination of beams among access/backhaul links.

Conclusion

- IAB enables simpler deployment and incremental rollout of densified small-cell access networks.
- IAB is an essential pre-requisite for the rollout of mmWave access.
- Timely availability of IAB is fundamental to these benefits.
- SA1 has already defined requirements for self-backhauling.

Thank you

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