Integrated Access and Backhaul at mmWave Frequencies

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Integrated Access and Backhaul for NR

Integrated Access and Backhaul is a promising 3GPP Study Item for NR

- **mmWave** propagation characteristics necessitate **dense** gNB deployment
- However, providing wired connection to each base station is **expensive**
- IAB enables dense mmWave scenarios without the associated backhaul costs
- IAB enables flexible deployments for **coverage and capacity** extensions
- IAB enables **efficient** re-use of radio resources
- IAB includes more advanced capabilities than the LTE Relay Node

ns-3 mmWave extension for IAB

Extend the ns-3 mmWave module with advanced NR features
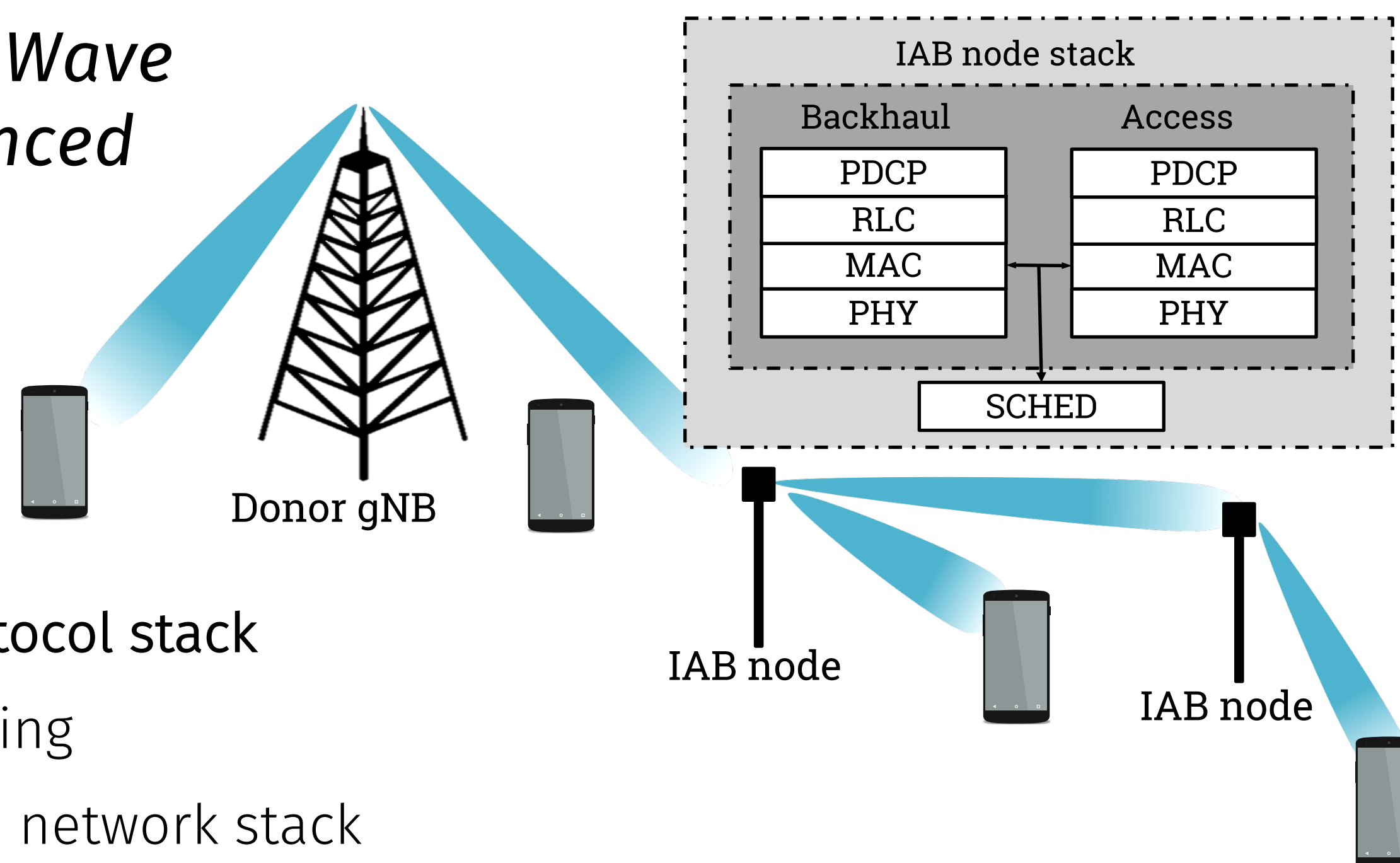

- Implement an **IAB protocol stack**
  - L2 (PDCP)/L3 relaying
  - Realistic 3GPP-like network stack
  - Backhaul-aware access scheduler
  - Multi- and single-hop topologies with autonomous discovery
- Goal: study end-to-end performance of IAB multi-hop and single-hop networks
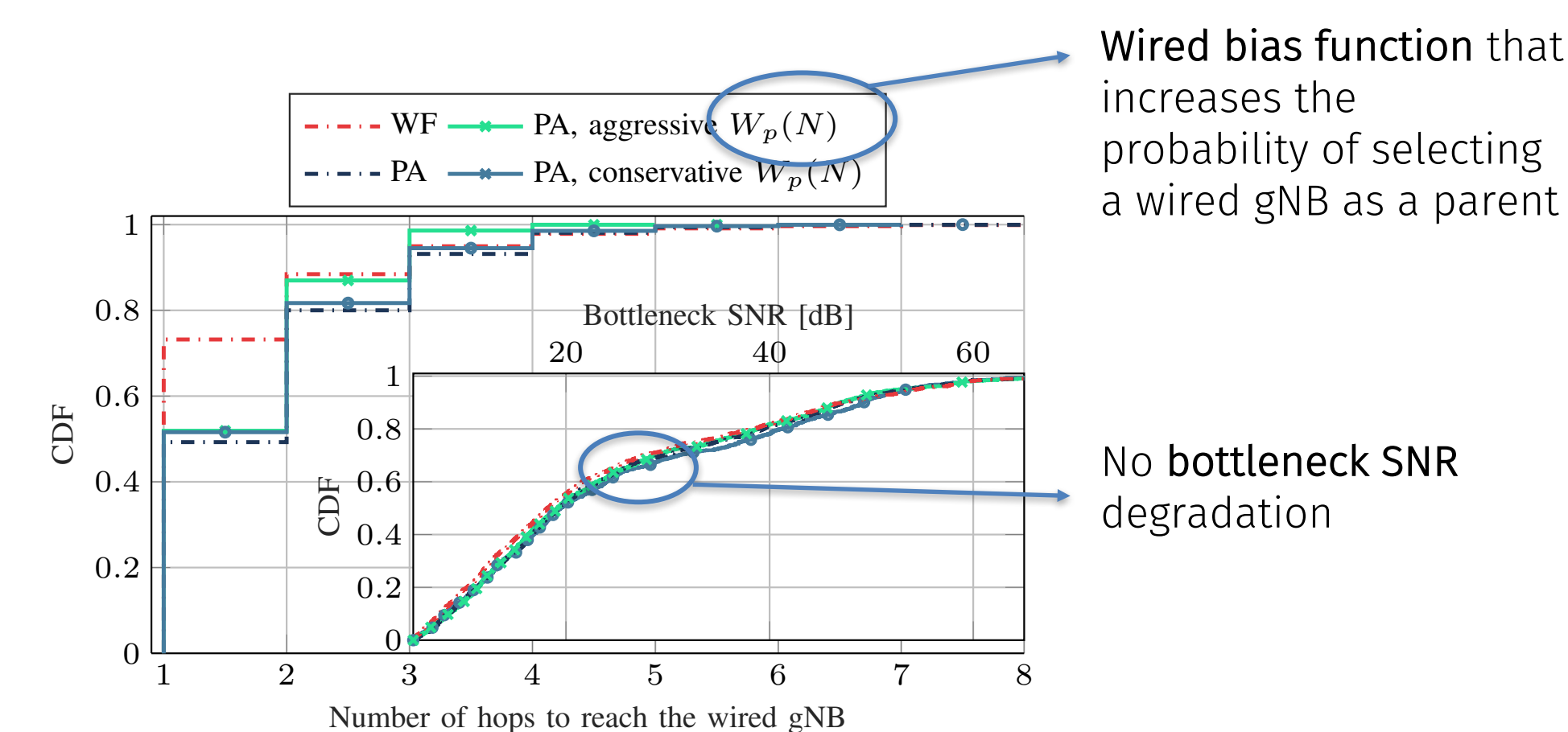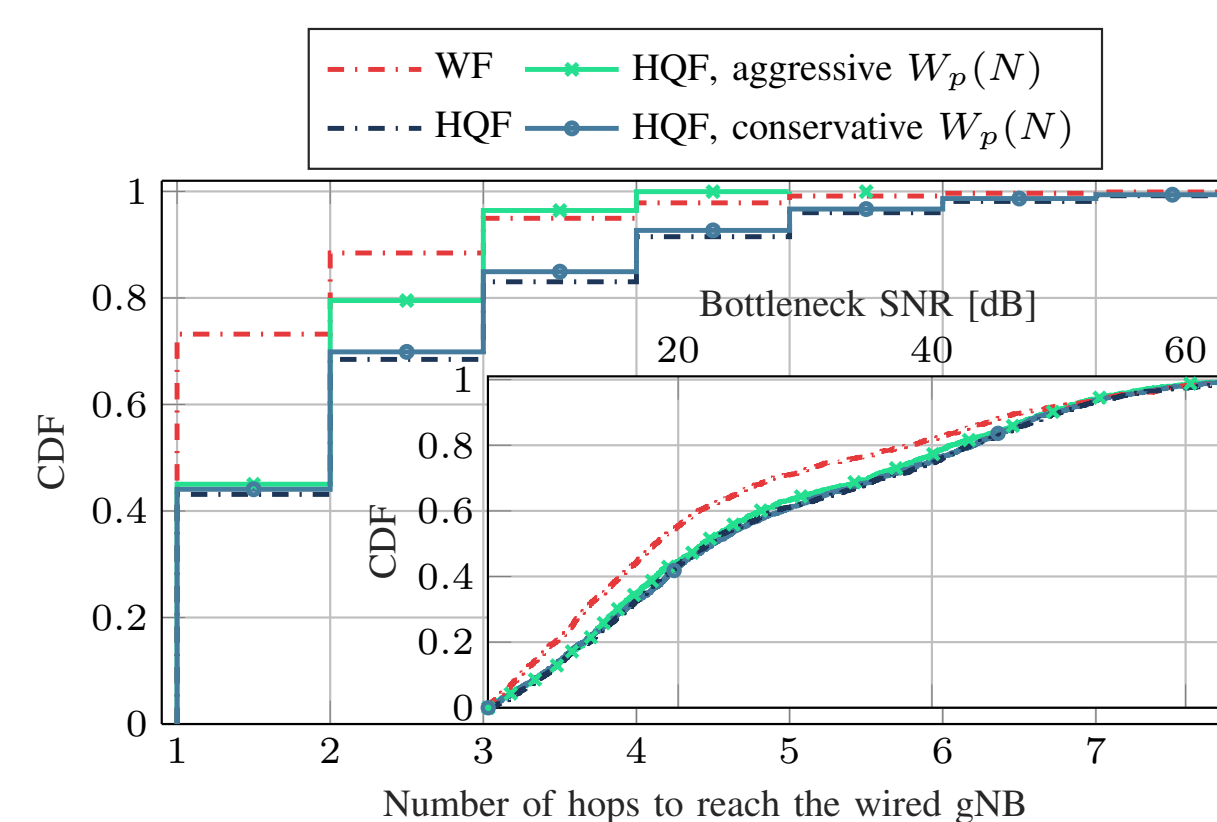 - Identify impact of different configurations and deployment scenarios

Distributed Path Selection

Preliminary performance evaluation for path selection strategies

Highest-quality-first (HQF)	Select the link with the highest SNR.
Wired-first (WF)	Select the wired gNB, if available.
Position-aware (PA)	Select the link with the highest SNR among those with parents closer to a wired gNB.
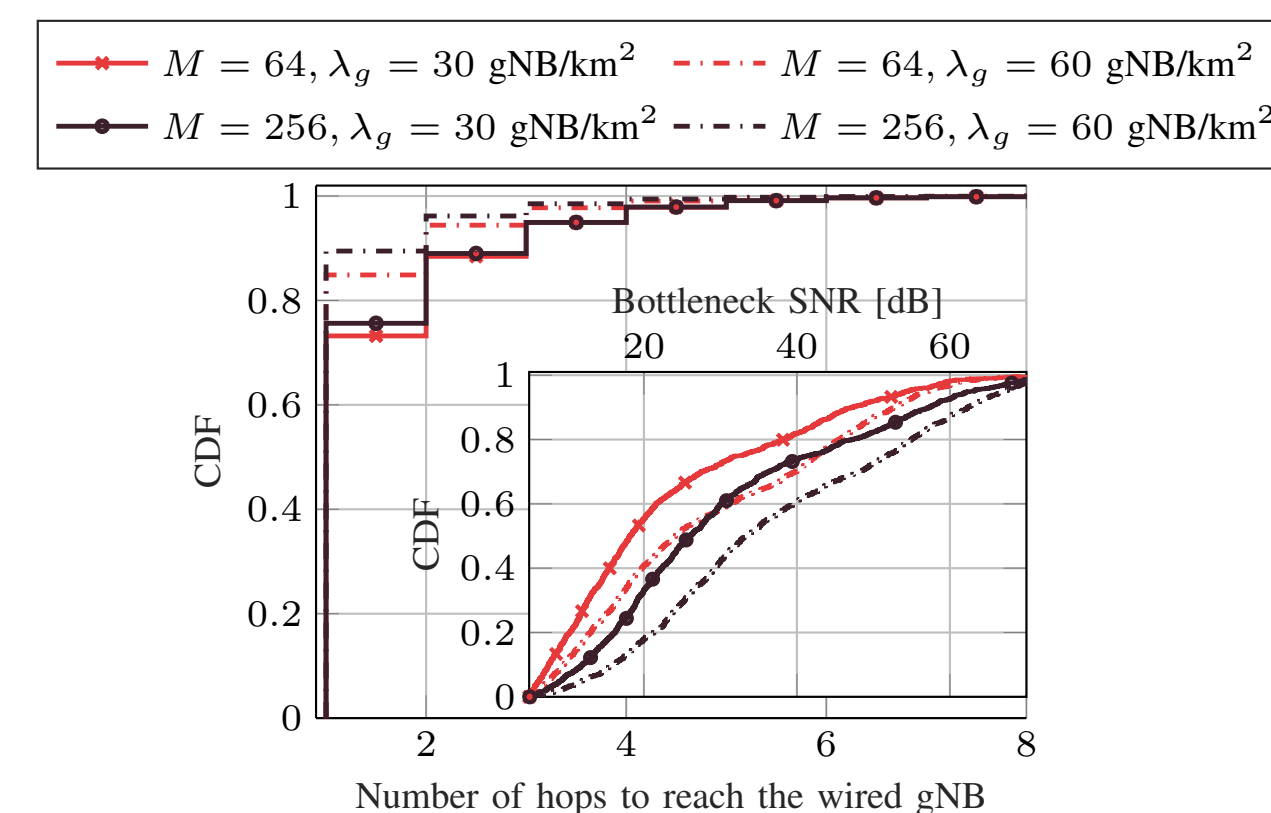
- Enhanced backhauling achieved by **densifying the network**.
  For **low SNR regimes**, densification is more effective than directionality
- Increasing the **MIMO array size** has beneficial effects on both the number of hops and the bottleneck SNR

Wired bias function that increases the probability of selecting a wired gNB as a parent

No **bottleneck SNR** degradation

Main takeaways

- WF approach **minimizes the number of hops** required to connect to a wired gNB
- WF is **affected by performance degradation** in terms of bottleneck SNR
- PA strategy delivers **improved performance** leveraging on *context information*
- Beneficial to design **bias functions** to influence the relay selection
  - Reduced number of hops to reach wired gNB
  - No significant performance degradation in the quality of the weakest link

- 3GPP, "RP-171880 - Study on Integrated Access and Backhaul for NR", 3GPP TSG RAN Meeting #77, Sapporo, Japan, 11th – 14th September 2017.
- M. Polese, M. Giordani, A. Roy, D. Castor, M. Zorzi, "Distributed Path Selection Strategies for Integrated Access and Backhaul at mmWaves", *submitted to IEEE GLOBECOM*, 2018.