

# Performance Analysis of Cognitive Radio Systems with Imperfect Channel Knowledge

Doctorate Presentation

M. Sc. Ankit Kaushik | 31 January 2017

Prof. Dr. rer. nat. Friedrich K. Jondral (Main referent)

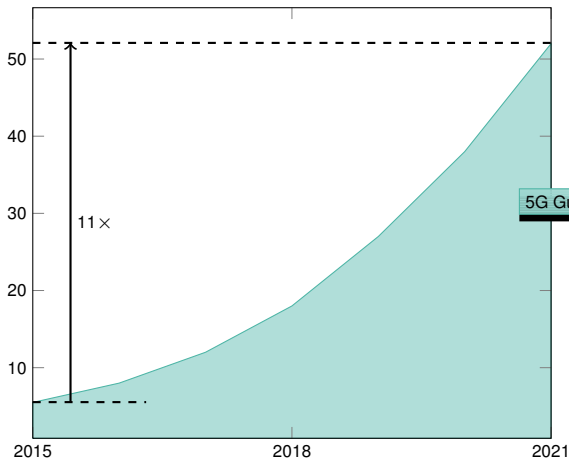
Prof. Dr. -Ing. Anja Klein (Coreferent)

Communications Engineering Lab  
Prof. Dr. rer. nat. Friedrich K. Jondral



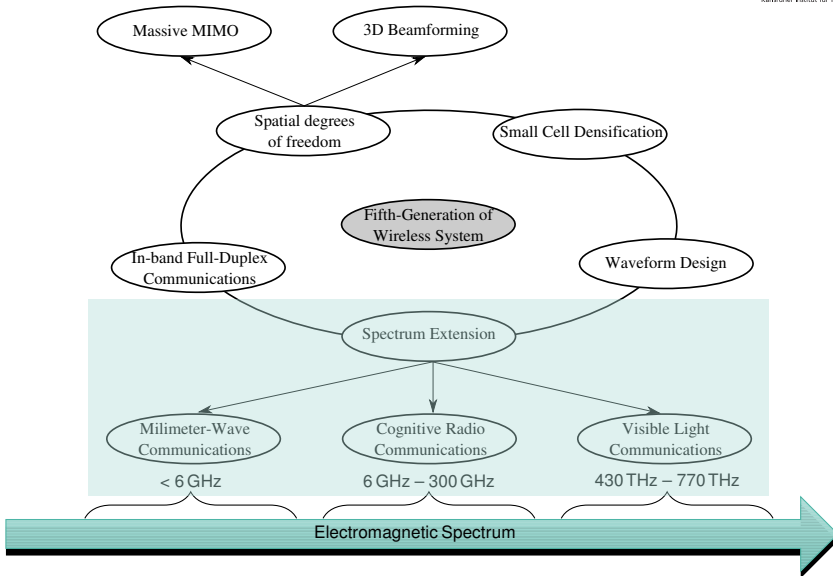


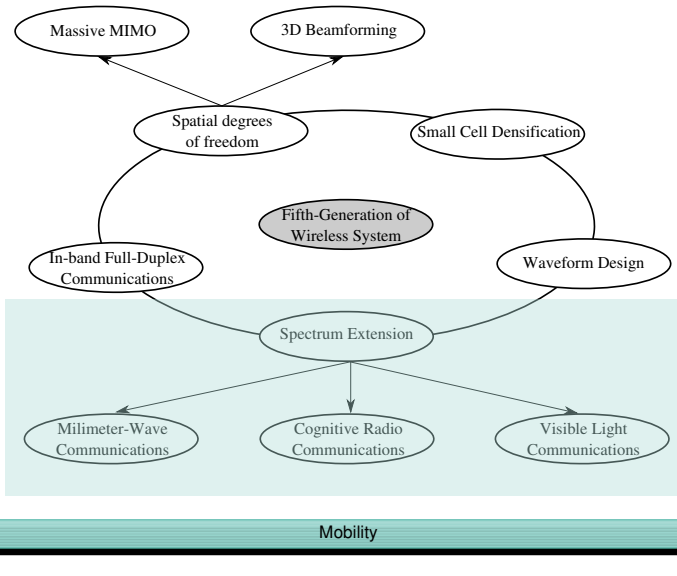
Global mobile traffic (monthly ExaBytes)

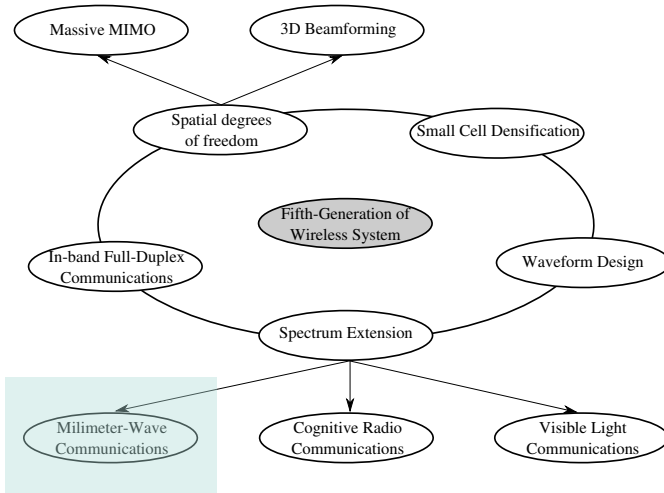


5G Guidelines

- Data rate ( $1000\times$ )
- Latency ( $< 1\text{ ms}$ )
- Energy- and cost-efficiency







A Cognitive Radio (CR) is an agile system that allows efficient usage (secondary access) of the spectrum below 6 Hz

An Cognitive Small Cell (CSC) is a network entity that enable CR communications for the devices operating indoor

## Network Elements

- Cognitive Small Cell-Base Station (CSC-BS)
- Mobile Station (MS)
- Macro Cell-Base Station (MC-BS)

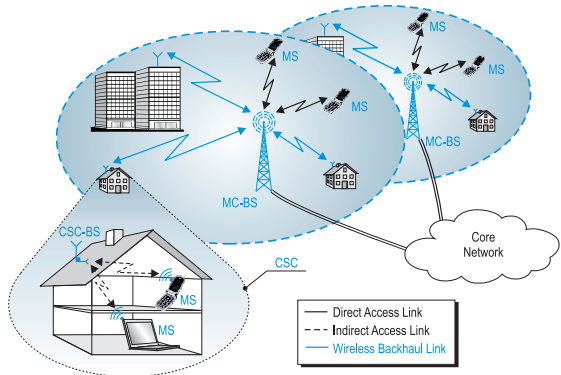
## Spectrum Access

- Wireless backhaul (CSC-BS  $\leftrightarrow$  MC-BS)
- Direct (MC-BS  $\leftrightarrow$  MS)
- Indirect (CSC-BS  $\leftrightarrow$  MS)

## Indoor?

- 70% traffic is originated indoor
- Spatial separation

CSC in a preliminary 5G network



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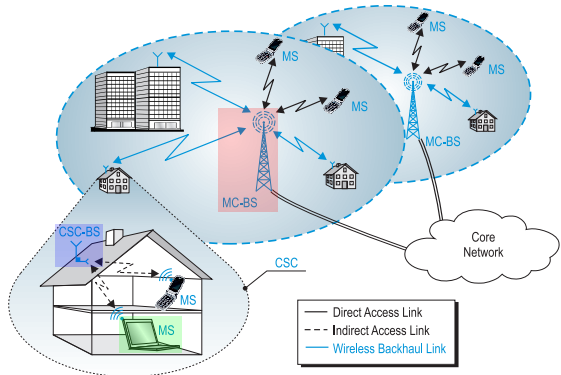
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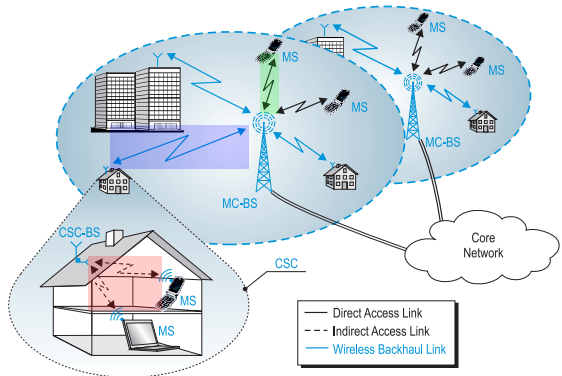
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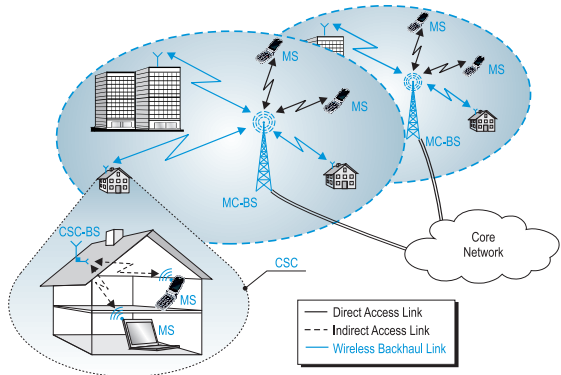
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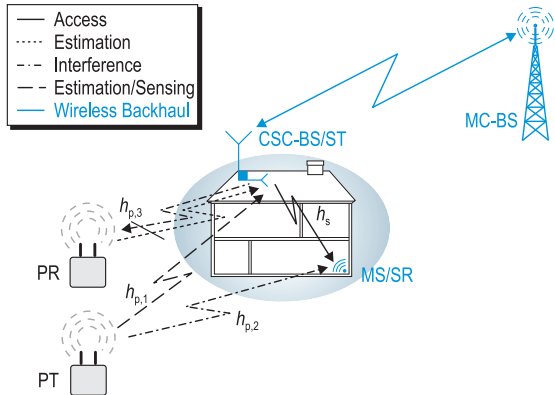
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# Imperfect Channel Knowledge

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$ST(\Leftrightarrow \text{CSC-BS}), SR(\Leftrightarrow \text{MS}), PT \text{ and } PR$

















# Conclusion

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Thank you for your Attention!