RELAYING IN 3GPP LTE

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CONTENT

› Motivation and Scenarios
› 3GPP LTE Relaying
  – Architecture
  – Radio Protocols
› Performance
› Summary & Conclusion
Relaying promises…

› increased coverage and/or cell-edge performance
  – which is especially useful since
    › LTE will operate on high carrier frequencies, i.e., 2.6GHz
    › UL SINR becomes Tx power limited when transmitting broadband at the cell edge
    › Majority of mobile traffic is generated indoor

› cost efficient operation and reduced site acquisition costs
  – which is especially useful since the future demand for high capacity will result in ultra-dense deployments of network nodes
DEPLOYMENT SCENARIOS

Urban Broadband (Improved Indoor)

• Improve (UL) cell edge data rate
• SINR noise limited due to severe shadowing, e.g., indoor, in street canyons ...
• New sites, planned indoor/outdoor deployment below rooftop
• Possible in case of low/medium load → Future evolution to Picos

Rural Coverage (Initial Roll-out)

• Extend coverage
• SINR noise limited due to large distances
• New sites, planned outdoor deployment above rooftop
• Can be addressed with other solutions e.g. microwave
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RELAYING IN 3GPP LTE

› History
  – Studied during 2009
    › Study Item on LTE-Advanced
  – Standardization during 2010
    › Ericsson is LTE Rel.10 Work Item Rapporteur

› Objective
  – Inband and outband relaying
    › Access and backhaul on same or different carrier
  – Relay Node (RN) cell appears as a regular cell distinct from the donor eNB (DeNB) cell
    › Backward compatible access link
  – Radio protocols terminate in the relay
  – UEs should be able to connect to the donor cell
DeNB provides proxy functionality, hiding the RNs from MMEs / GWs serving the UEs
- The RN is seen as a new cell under the DeNB
- The DeNB appears to the RN as an MME (for S1) and as an eNB (for X2)

DeNB provides Gateway-like functionality for the RN
- creates a session for the RN
- manages EPS bearers for the RN

MME (RN) functionality for MMEs serving the RNs are supported by the “normal” MMEs
INBAND RELAY

› Due to self-interference RNs cannot simultaneously
  – Transmit on access (DL) and receive on backhaul (DL)
  – Receive on access (UL) and transmit on backhaul (UL)

› RN separates backhaul and access in time
  – Access (backhaul) link operates on access (backhaul) subframes only
IMPACT OF INBAND RELAYING

› Backhaul Control Channel (R-PDCCH)
  – For control information to RNs which are not able to read the normal PDCCH

› Relay Timing
  – DeNB-RN synchronization
  – Tx-RX switching at RN

› RRC configuration of backhaul subframes

› The RN might not be able to listen to paging and system information updates
  – Dedicated signaling
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QUALITATIVE PERFORMANCE

› Inband relaying
  - Improved coverage and cell-edge bit rate due to signal regeneration
  - Reduced peak rate for relay users due to backhaul subframes
  - Degraded throughput for non-relay users due to increased interference

› Outband relaying
  - Improved capacity
  - But larger spectrum demand
  - Even better when migrating to Pico
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SUMMARY & CONCLUSION

› Future mobile radio networks need to provide
  – wide area coverage
  – excellent (cell-edge) data rates
  – low costs per bit

› Relaying is one feature (among others) to meet those requirements

› Relaying will be introduced in LTE Rel.10
  – Inband relaying extends coverage
  – Outband relaying increases capacity in addition
  – Potential evolution path to Pico basestations