



Relays: Deployment Scenarios and Design Choices

Centre of Excellence in Wireless Technology
(CEWiT India)

Agenda Item: 12.6
Discussion / Decision

Prevailing Scenarios

- Position paper, combining view point of CEWiT and BWCI (Broadband Wireless Consortium of India)*
- Indian operators are facing two critical deployment problems
 - Poor cell-edge coverage (very-low and low SINR values)
 - Poor in-building throughput performance
- Possible solutions and their implications
 - Deploy more eNB nodes
 - Too expensive
 - Deploy femto-cells (Home eNB)
 - Availability of backhaul will be a major issue
 - Relays
 - Feasible if **cost and complexity can be kept low**

Relay Alternatives – Our Position

- L3 relay
 - Almost similar to eNB in terms of basic functionality
 - Possible to use in-band backhaul (no extra spectrum needed)
 - Effective as a means to provide a fat 'data-pipe'
 - Effective for extending coverage

- L2 relay

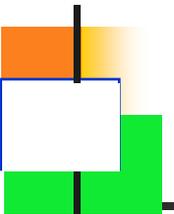
- L1 relay
 - Simple, cost effective
 - Easy deployment, configuration and maintenance
 - Effective for coverage extension

L3 Relays

- The primary objective of L3 relays is to **increase throughput**



- It is assumed that the relay node has **good visibility w.r.t parent eNB**
 - Relay-eNB link resembles a fat pipe
- Deployment could either be
 - In building
 - On Rooftop
- In terms of functionality, L3 relay is **more or less like an ordinary eNB**



Use Cases

- L3 relays will typically be deployed in
 - Enterprise
 - Residential Premises (e.g. Apartment blocks)

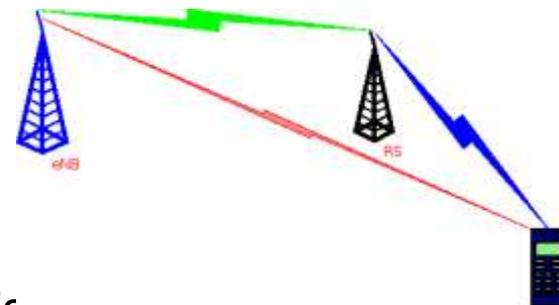
- Basic requirements are the same in both cases but there are some differences as well
 - **Operator support** will be required for residential deployments unlike enterprise scenario where IT support teams will be able to handle it
 - **Frequent handovers** in case of residential deployment
 - **Sustained throughput and guaranteed QoS** in enterprise

L3 Relay Requirements

- Closed / open access
 - Allowing registered users to all users
- Configuration
 - Both operation and self-configuration should be supported
 - In case of self-configuration, operator must be able to control transmit power
- Backhaul
 - In-band
 - No extra spectrum necessity
 - Low-latency
 - No additional delay introduced in the system
 - Low signalling overhead
 - Improved link utilization
- Power-efficiency
 - Necessary and a priority considering some of the deployment scenarios

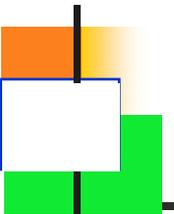
L1 Relays

- Good for addressing the cell-edge problem
- L1 relays better than L2 in terms of
 - Diversity multiplexing trade off
 - Effective when the first hop link to the cell-edge is NLOS
 - Delay is few OFDM symbols compared to 1 Frame delay in L3 relays
 - Works well when first hop (eNB – Relay) is LOS
- Improvements possible by combining the L1 relay with minimal intelligence (call it L1.5)
 - No scheduling at Relay Station
 - Results in very low noise amplification compared to A&F
 - Maybe suitable for Cooperative relaying



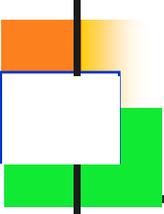
Enhancements to L1 Relay

- Improve S(I)NR at the relay before retransmission
 - System should tolerate 1 to a few OFDM symbols of delay
- Selective forwarding of user data
 - System should tolerate 1 to a few subframes of delay
- Results in
 - Better coverage
 - Marginal to high throughput improvement
 - Lower interference to other users
- Requires standardization support
 - Control signalling to indicate that UE is served by relay (non-transparent)
 - Control signalling to indicate that there is a finite delay
- Possible gains over simple L1 repeater needs further study



Conclusions

- L1 and L3 relays are seen viable deployment options
 - Extend coverage (e.g. rural areas)
 - Enhance throughput (e.g. in-building)
- In L3 relays, attention needs to be paid to the backhaul so that impact on latency is minimised and signalling overhead is reduced as much as possible
- Advanced L1 relays that can provide some enhancement without sacrificing on the simplicity needs to be investigated



References

1. TR 36.913 v8.0.0, "Requirements for Further Advancements for E-UTRA (LTE-Advanced)"
2. REV-080050, CEWiT, "IMT Advanced Technical Requirements -- An India Perspective"
3. R1-081714, CEWiT, "IMT Advanced RAN1 Requirements - An India Perspective"