Some Considerations on Mobile Multi-hop Relay Based System

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Purpose:
The purpose of this document is to give some recommendations on mobile multi-hop relay.

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Outline

- Scenarios
- Considerations on hop number
- Possible relay station types and usage scenarios
- Frame structure analysis
- Conclusion
Scenarios

MMR-BS

FRS

MS₁

NRS

Signaling

Data

Coverage extension

Throughput enhancement
Considerations on hop number

• More than two hops
  – Possibly used to extend cell coverage
  – System complexity increases with the number of hops
    • Packet routing
    • System crash recovery
    • Signaling overhead
  – Latency increases linearly with the number of hops

• Two hops
  – Protocols can be optimized for two hops such as
    • ARQ/HARQ
    • Cooperative relaying
Possible relay station types and usage scenarios

• Possible relay station types
  – RS does **not transmit frame header** (Type I)
  – RS transmits the **same frame header** with BS (Type II)
  – RS transmits **different frame header** with BS (Type III)

• Duplex modes of different RS types
  – Type I: TDD
  – Type II: TDD
  – Type III: TDD and HFDD (HFDD mode is suitable for mobile RS installed on the moving vehicle to avoid frequent handover of MSs)

• Throughput enhancement
  – Type I ~ Type III

• Coverage extension
  – Type II & Type III
Frame structure analysis

- A unified frame structure should be used by MMR-BS which supports all of the aforementioned RS types at the same time
- RS transceiver status transition times should be minimized, since one OFDM symbol is wasted per transition in the DL/UL sub-frame
- Pilot collision should be avoid between different RSs
- Conventional .16/.16e MS compatibility should always be kept in mind
Frame structure 1

Frame n

- MMR-BS
  - Preamble
  - DL-MAP
  - UL-MAP
  - REL-MAP

- BS→RS
  - Rx From MS

- BS→MS
  - Rx From RS

Frame n+1

- RS→MS
  - Rx From MS

- RS→BS
  - Rx From RS

RS TTG = 1 Symbol
RS RTG = 1 Symbol

RS (Type I)
- Sync With BS or RS
- Rx From RS
- BS→RS
- BS→MS

RS (Type II & III)
- Sync With BS or RS
- Rx From BS
- RS→MS
- RS→BS

MS
- Sync With BS or RS
- RX From BS or RS

Zone Switch
Frame structure 3

Frame n

MMR-BS

Preamble

UL-MAP

DL-MAP

REL-MAP

BS→RS (Type I)

BS→MS

RS→MS

Rx From BS

Sync With BS or RS

Recv Maps

Even No. Symbols

RS TTG = 1 Symbol

MS→BS

Sync With BS or RS

Recv Maps

Even No. Symbols

MS→BS or MS→RS

NULL

Zone Switch

Frame n+1

Rx From MS

Sync With BS or RS

Recv Maps

Even No. Symbols

RS TTG = 1 Symbol

RS RTG

Rx From MS

Sync With BS or RS

Recv Maps

Even No. Symbols

RS RTG

Null

Zone Switch
Frame structure analysis

- **Frame structure 1**
  - Suitable for type I RS
  - Not good for type II and III RS

- **Frame structure 2**
  - Suitable for type II and III RS
  - Not good for type I RS

- **Frame structure 3**
  - A combination of frame structure of 1 and 2
  - Optimized for all types of RS
  - RS type II or III and type I can be cascaded to support multi-hop relaying
Conclusions

• Several types of relay stations with different capabilities should be supported in the same site
• Complexity and latency increase with the number of hops
• Protocols can be optimized for two-hops