Low-cost-relay interaction with BS

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Purpose:
Descriptions of low-cost relay interaction with BS (elaboration of the concept introduced in IEEE C802.16j-018/031).

Scope

- Low-cost relay (A.K.A. simple relay)
  - Summary of fundamentals
  - Interaction with BS

Simple relay concepts, usage models, deployment scenarios and frame structures are described in contributions IEEE_C802.16j-018 and IEEE_C802.16j-031, May 2006

Simple relay fundamentals (1)

Cost	Approximately CPE cost
Usage models	Fixed Infrastructure; in building and temporary coverage.
Mobility	Fixed; nomadic
Ownership	Infrastructure provider; user
Deployment	Planned; opportunistic

Simple relay fundamentals (2)

Availability	Obtained by RS coverage areas overlapping
Radio planning	BS dynamic updates to compensate for RS failures
Management	Centralized at BS
Frame building	Centralized at BS

Simple relay fundamentals (3)

Low cost implications:

- ⇒Self installed – Minimal installation cost
- ⇒No RS' HW redundancy
- ⇒Half-duplex
- ⇒Performs simple tasks only; most processes are in the BS SW; reduced set of RS⇔BS MAC messages

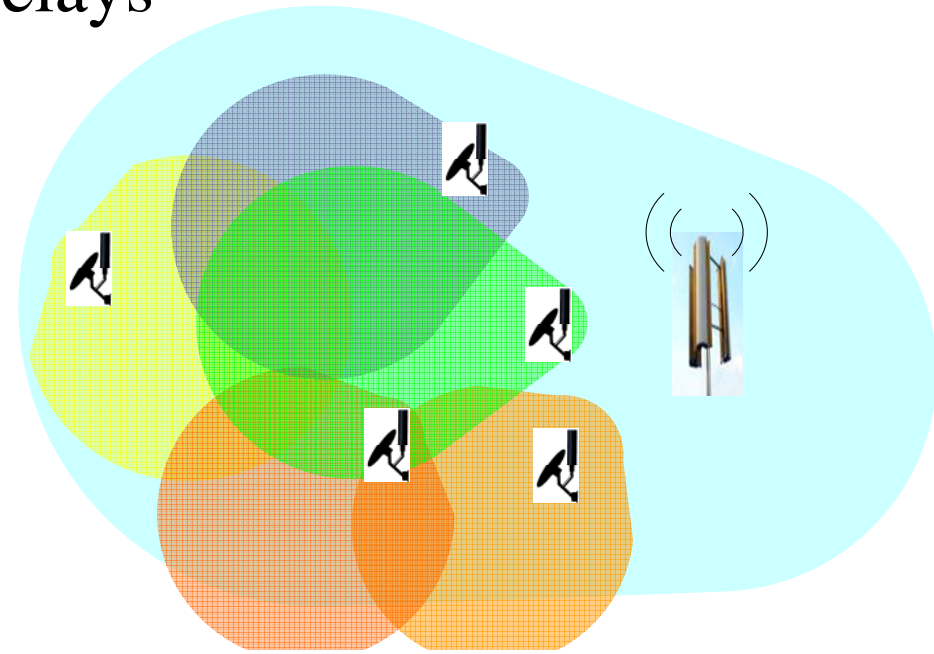
Simple relay fundamentals (4)

Availability:

⇒Obtained with redundant relays

⇒Coverage areas overlap

⇒Relay antenna's beam adaptive and compensate other RS availability



Simple relay fundamentals (5)

Relay vs. BS radio planning:

BS only system	**BS & RS system**
MS communicates to BS it receives best	MS may communicates to the BS while masked by nearby RS
BS power planning	RS coverage area overlap Large fringes area
BS static coverage	RS coverage changes with RS availability

Frame building at BS and at RS

Distributed	**Centralized**
Each RS builds its own frames	BS builds all RS frames (centralized hierarchic scheduling)
Infringement controlled by RS locations and subcarrier reuse	Better BW utilization (due to infringement control) when RS locations are not well planned
Standby	Macro-STC
End-to-end QoS	Next hop QoS

Task partition
(concept illustration)

Function	BS	RS	Comments
Scheduling and BW allocation	y	n	Messages tunnel via RS
MAC management	y	n	
ARQ	y	~y	
Ranging	y	~y	CDMA detection
Mobility management	y	n	
Security	y	n	

BS⇔RS connection scheme

- No scheduling and policing is done at the RS
  - ⇒MS→BS traffic tunnels via one RS→BS connection
  - ⇒BS→MS traffic tunnels via RS or a group of RS (macro-diversity); if the RS belongs to more than one Tx diversity groups, the BS opens a connection per-group

Some RS⇔BS MAC messages
(concept illustration)

- **Data-Tunnel-Downlink**
  - BS sends data, to be sent to the MS, to the RS
- **Data-Tunnel-Uplink**
  - RS sends data, received from the MS, to the BS
- **RS transmission parameters**
  - BS controls the RS frame parameters
- **RS CDMA received**
  - RS reports to the BS what CDMA codes it detected

Data-Tunnel-Downlink

RS tunnel payload fields:

- **DL_RS_Tunnel_IE**
  - The MAC PDU as to be sent by the RS
- **Subchannel offset, OFDMA Symbol offset, Boosting, Modulation and FEC rate**
  - Burst parameters for RS transmission
- **STC matrix used, RS_index, diversity antenna presented by the RS**
  - Indicating the RS its role in the macro-STC

Data-Tunnel-Uplink

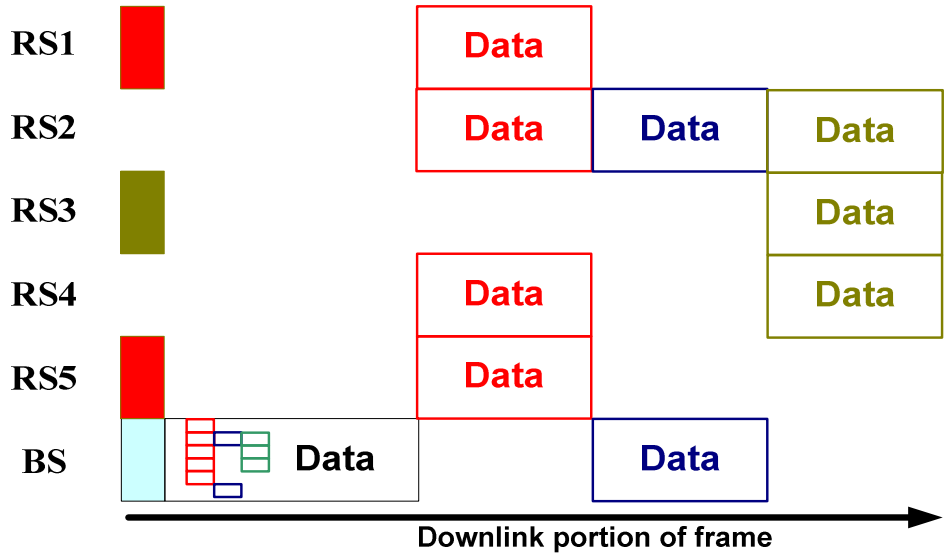
RS tunnel payload fields:

- **UL_RS_Tunnel_IE**
  - The MAC PDU as sent by the RS
- **Received OFDMA Symbol offset and received subchannel offset**
  - Indexing the messages for the BS

RS transmission parameters

MAC message fields:

- **Preamble Index (if sent)**
  - The Preamble sent by the RS
- **Preamble time shift**
  - Frame alignment for RS location compensation
- **Max transmit power**
  - Radio planning



RS CDMA received

MAC message fields:

- **UL_PermBase**
  - Seed of the CDMA codes detected
- **Ranging code, Ranging symbol, Ranging subchannel, Frame Number Index, CDMA signal strength, CDMA signal time shift**
  - CDMA received parameters

Thank you