Feasibility Study of Spatial Reuse in an 802.11 Access Network

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Land-line access point (close to high-population density area)

802.11 for last-hop access within a village

Point-to-Point 802.11 link

Lodhar Apr ‘02

Mandhana Jun ‘02

MS3 Jun ‘02

Nov ‘02 Bithoor

Safipur Sep ‘02

22.5 Km

17.3 Km

12 Km

0.9 Km

5.1 Km

2.3 Km

5 Km

12 Km

37 Km

23 Km

22 Km

23 Km

Banthar Jun ‘03

Rasoolabad Mar ‘04

5 Km

Sawaiyajpur Dec ‘03

Bithoor

Sarauhan Dec ‘02

Rajajipura/Lucknow Mar ‘03

End to end distance ~80 Km

River Ganges

Not to scale

Land-line access point (close to high-population density area)
The Ashwini Deployment (Planned) West Godavari, A.P., India
Network Model

- Point-to-point links
- Multiple interfaces (radios) per node
- One directional antenna per link
- Single channel operation
Exposed interface problem within a node:
CSMA/CA (802.11 DCF) inherently allows only one link operation per node

Problems: (a) Immediate ACK, (2) CS back-off
SynOp: SynRx + SynTx

- Links at a node operating simultaneously, synchronously (on the same channel)
- Is this feasible? Yes, under certain conditions

\[
\left| P_{R_1} - P_{R_2} \right| \leq SL_{\alpha} - SIR_{reqd}
\]
Experimental Setup
Interference vs. Throughput

Throughput (Mbps) vs. SIR (dB)

Signal levels: -49 dBm, -53 dBm, -63 dBm, -78 dBm
Conclusions

- Simultaneous **Synchronous Operation (SynOp)** possible with parabolic grid antennae
- SynOp has subsequently been verified on field
  - See HotNets-2004 and Mobicom-2005 papers
- Further work:
  - **More rejection** possible at higher angles of separation
  - **Adjacent channels** can be used
- SynOp has implications for network design in other wireless technologies too: e.g. **WiMax**