FSO-based relaying/backhauling architecture

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Purpose:

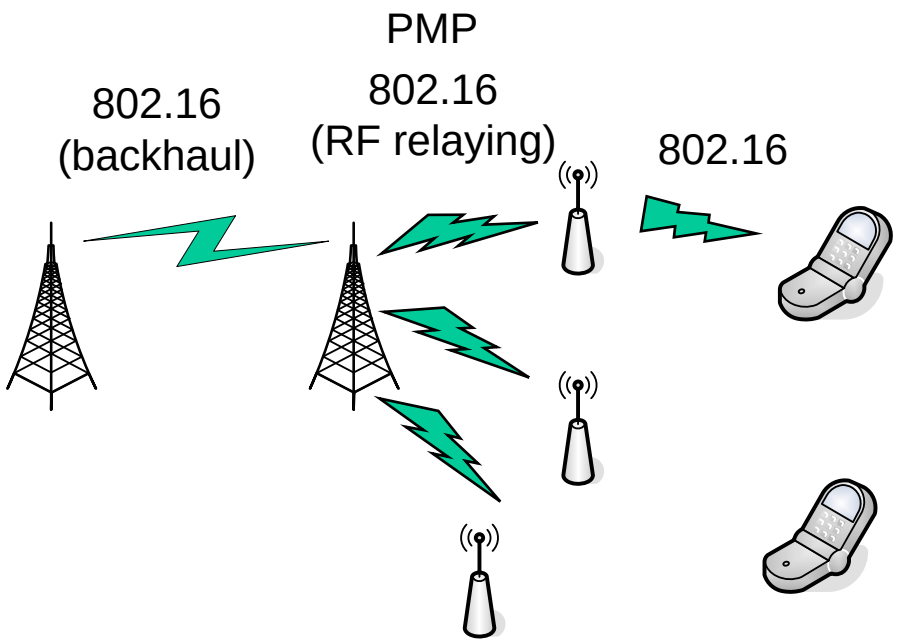
Propose a low cost and high throughput relaying/backhauling architecture based on free space optics (FSO)

Outline

- RF relaying
- RoF (Radio over Fiber) relaying
- Proposed FSO(Free Space Optics) relaying and backhauling
- Summary

RF relaying

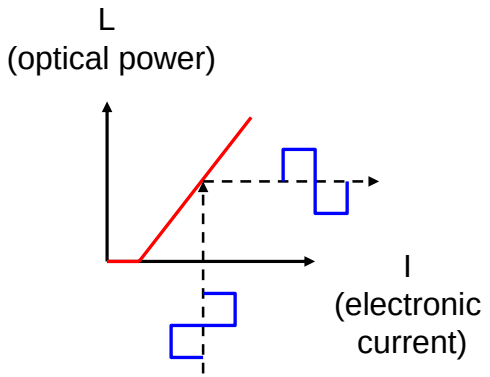
- Relaying solutions
  - AF: Amplify-and-Forward
  - DF: Decode-and-Forward
- Benefits:
  - Reach extension
  - Increase capacity
  - Improved uniform data rate coverage
- Problem
  - Intra cell inference by relay station?
  - Costly RF relaying equipment



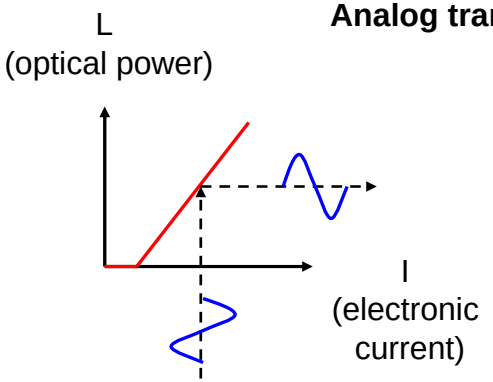
Basics of optical communication

- Principle of optical communication:
  - Transmitter:
    - Direct modulation: LED, LD (FP, DFB laser)
    - External modulator: MZM, EAM
  - Receiver:
    - IMDD: PIN, APD diode
- Applications
  - Digital transmission
    - Optical backbone
  - Analog transmission
    - CATV, RoF

Digital transmission

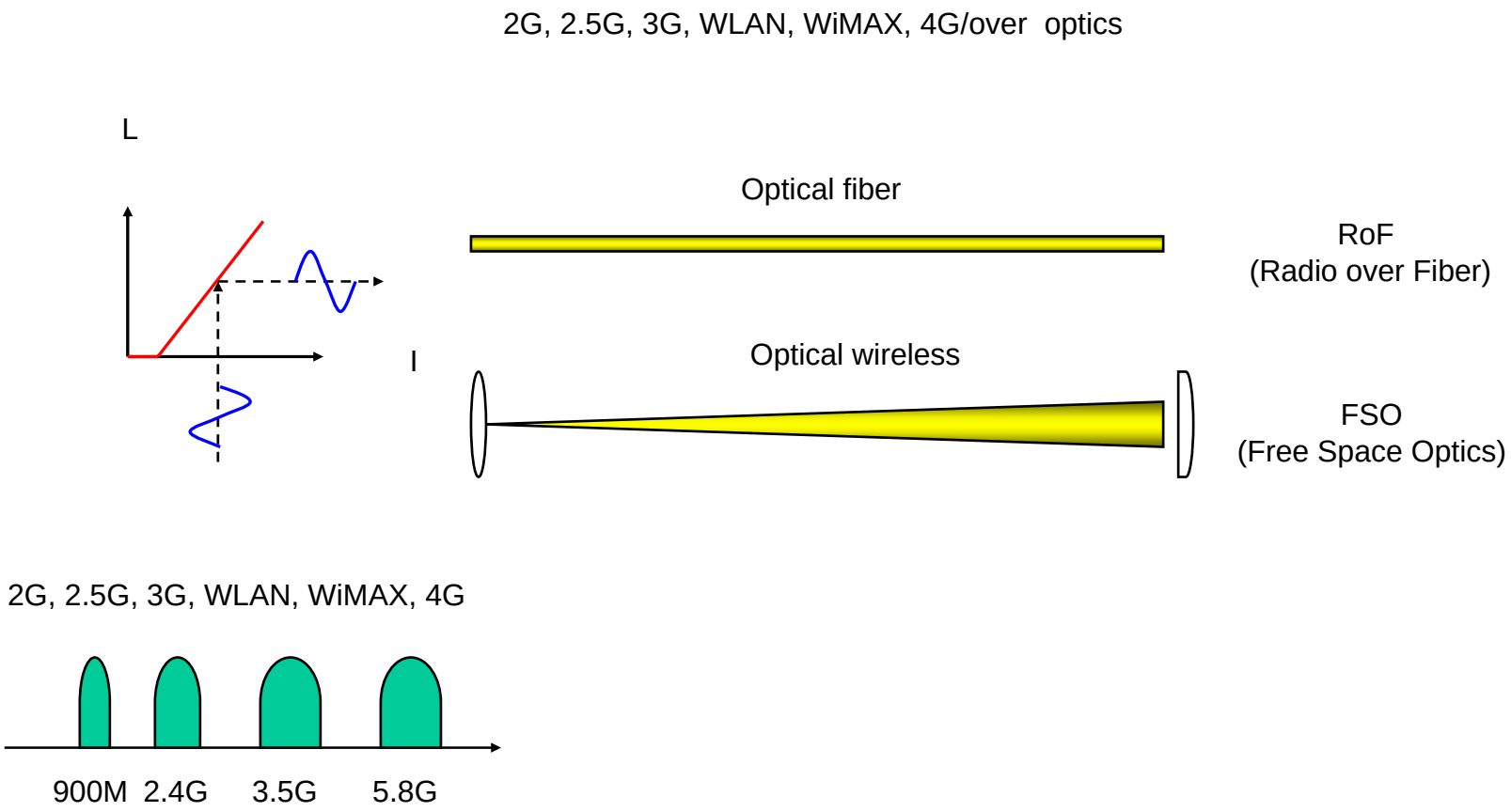


Analog transmission



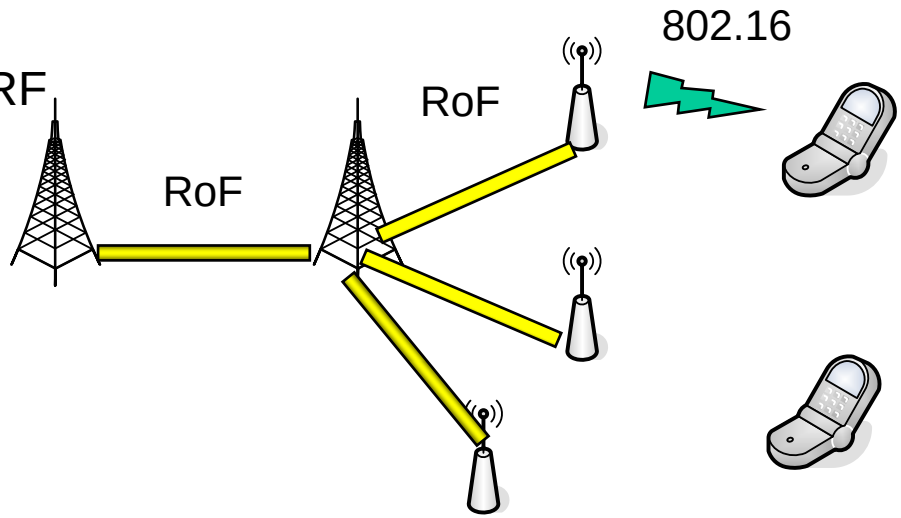
Optical relaying

- Subcarrier Modulation (SCM) for RF signal relaying by analog transmission



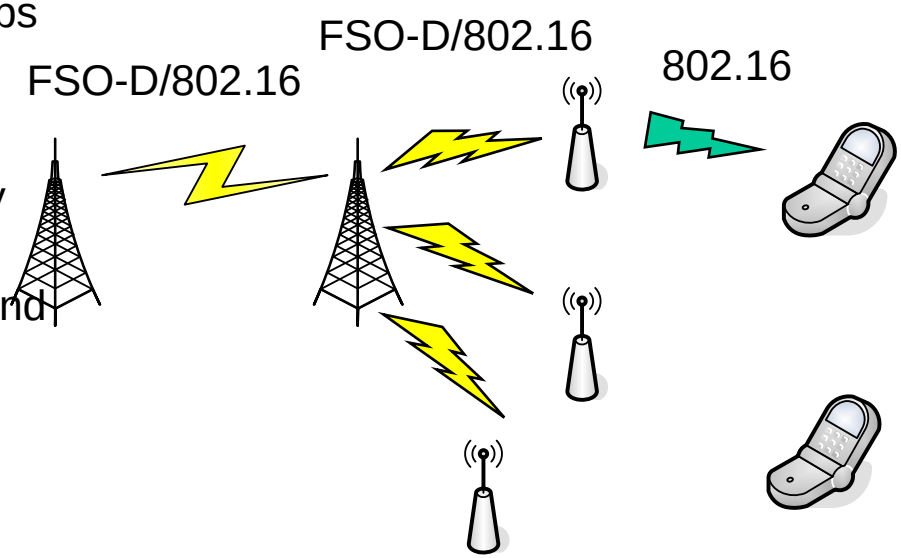
RoF relaying

- Pros:
  - Higher capacity than RF relaying
  - Lower equipment cost than RF relaying
  - Better resource reuse
- Cons:
  - High installation engineering cost



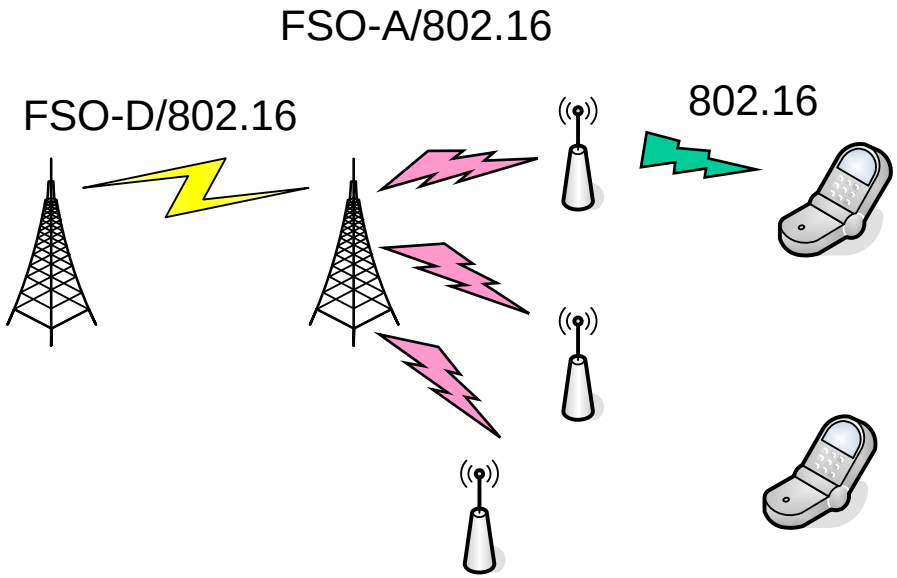
Proposed digital FSO relaying

- Features of Digital FSO (FSO-D):
  - Long distance, high bandwidth, less power (e.g. throughput: 1Gps for 4km)
  - Like a directional antenna with large antenna gain (dBi)
  - Low interference/noise immunity
- Pros:
  - Combine the advantage of RF and RoF relaying
  - High throughput yet low installation cost
  - 10 times backhaul capacity than RF backhaul
- Cons:
  - Sensitive to weather condition (Fog), but this could be solved by hybrid RF/FSO system @ 99.999% reliability



Proposed analog FSO relaying

- Requirement of of Analog FSO (FSO-A):
  - Multi-standards radio frequency over FSO
  - Signal transparency: without format conversion compared to digital FSO
- Pros:
  - Combine the advantage of RF and RoF relaying
  - High throughput yet low installation cost
  - Suitable for PMP network
  - Easy to migration to 4G network
- Cons/Difficulties:
  - Linearity of laser diode
  - Up/down convert maybe needed
  - Products not available yet



Summary

- A hybrid RF/digital FSO architecture is proposed for improving the capacity/throughput of relaying network and backhaul system
- A hybrid RF/analog FSO architecture is proposed for improving the capacity/throughput of relaying network
- A novel analog FSO concept is proposed for migrating to future systems
- A novel analog FSO concept is proposed to support multi-standard wireless over FSO to accelerate the deployment of next generation broadband wireless access system

References

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