

Wireless Services Distribution over GPON for Avionics

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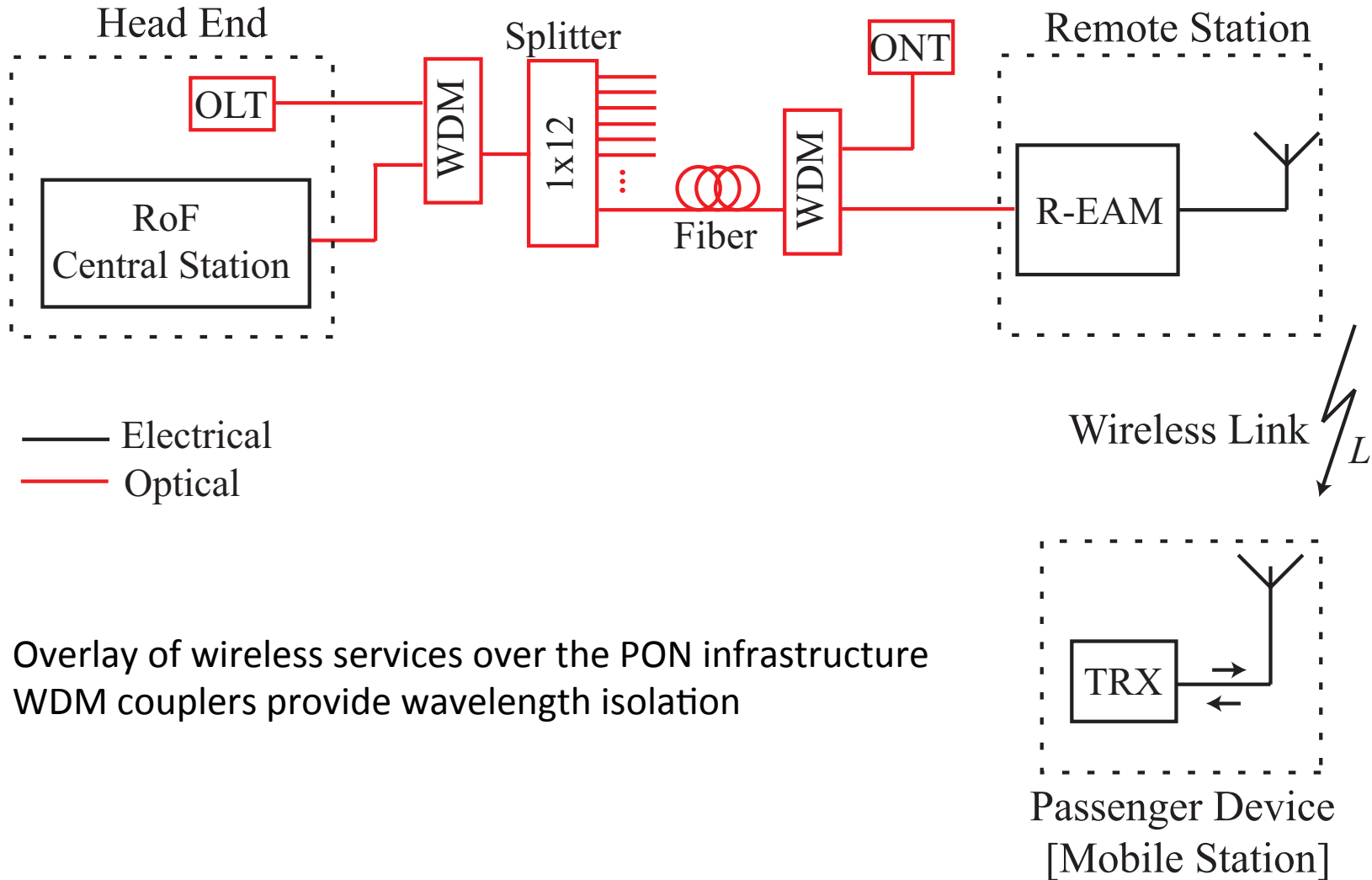


- Motivation
- Previous work on R-EAM
- Distribution of wireless services
- Experimental setup
- Experimental results
- Conclusions and future work

- Future aircrafts will likely use PONs to provide infotainment to passengers
- Deploying distributed wireless Access Points is not optimal solution
 - Higher cost and maintenance
- Radio-over-Fiber enables a centralized solution
 - Complexity aggregated in the Head-End
 - Lower cost and maintenance
- Fiber PON infrastructure might enable the distribution of wireless services to passengers

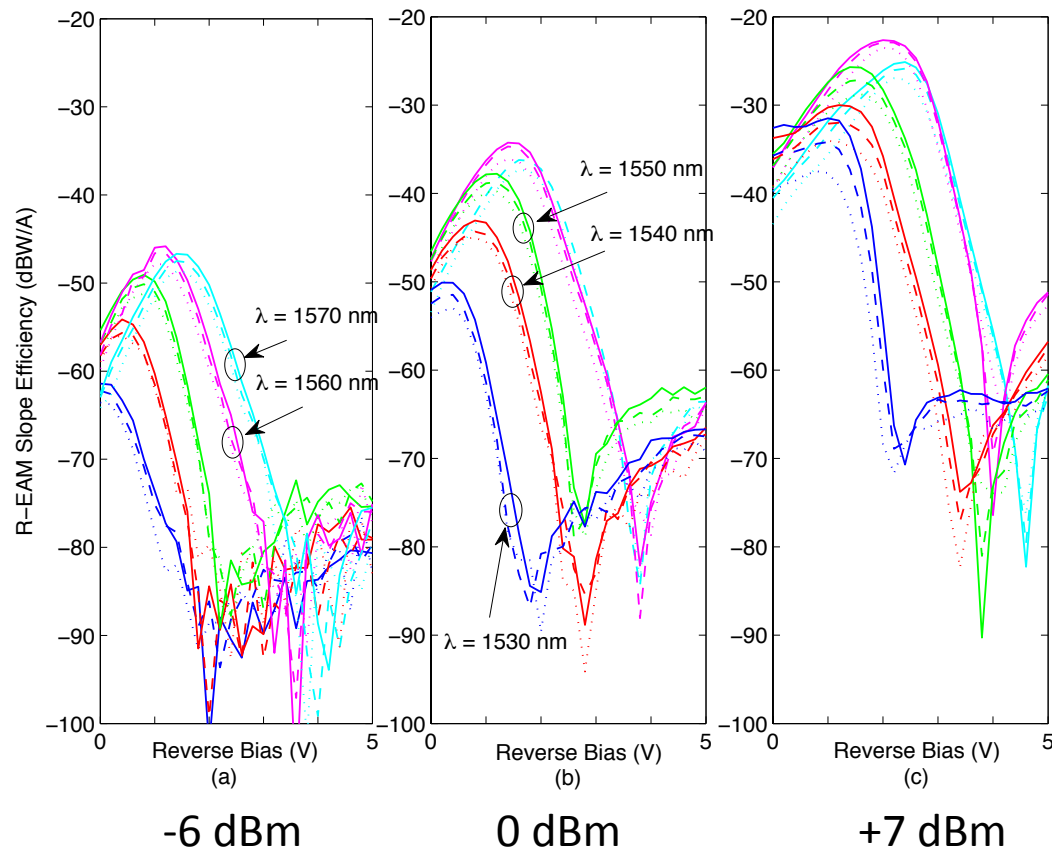


Motivation: Passive Optical Network





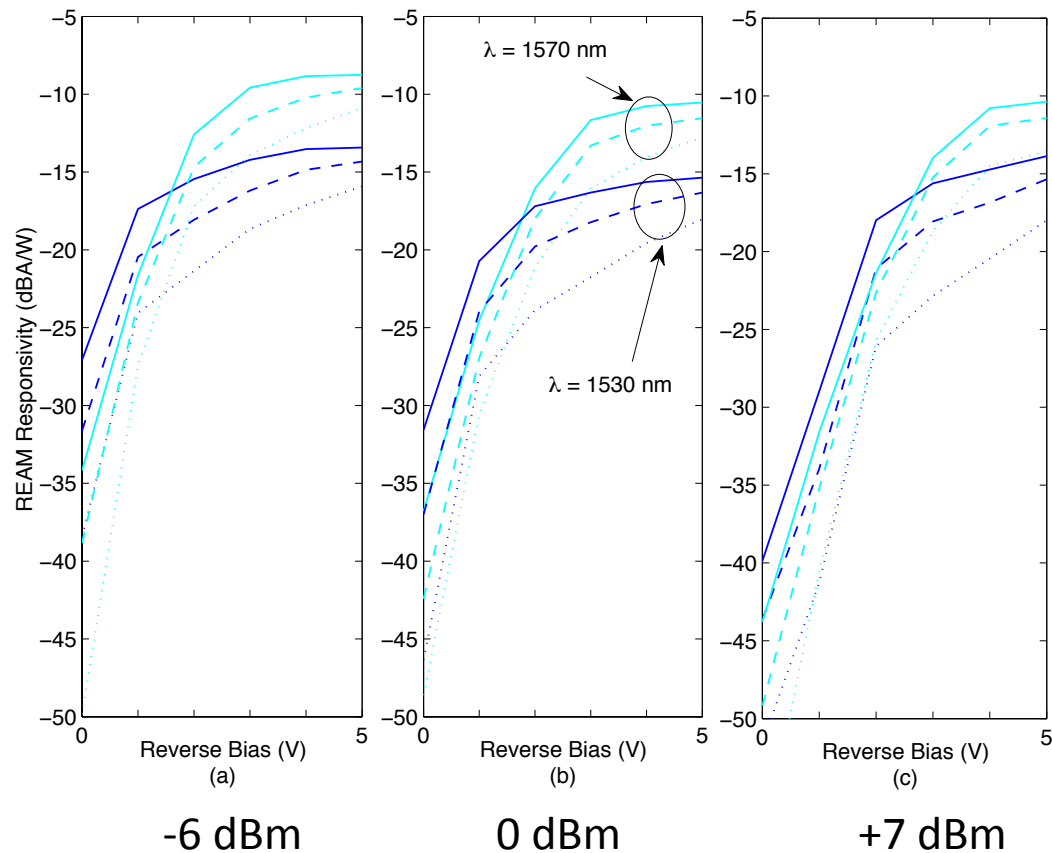
- Experimental characterization of R-EAM: E/O conversion





Previous work

- Experimental characterization of R-EAM: O/E conversion





Distribution of wireless services

GSM/UMTS/LTE

- One cell is enough in the entire cabin: typically implemented with a leaky antenna.
- Band occupation from 700 to 2100MHz: quad-band compatibility for GSM-1800/1900.
- Can be frequency multiplexed in electrical domain with Wi-Fi (subcarrier multiplexed).

Wi-Fi [IEEE 802.11abgn]

- Only 3 non-overlapping channels available in 802.11b/g bands.
- 8 channels available in 802.11a bands.
- 802.11a/n bands can be subcarrier multiplexed with 802.11b/g bands.

UWB [Wimedia]

- Good candidate to provide a wireless seat
- Maximum bitrate for each cell is 480Mbps using current OFDM-UWB devices.
- Very low transmitted power: low interference between cells and other systems in air planes

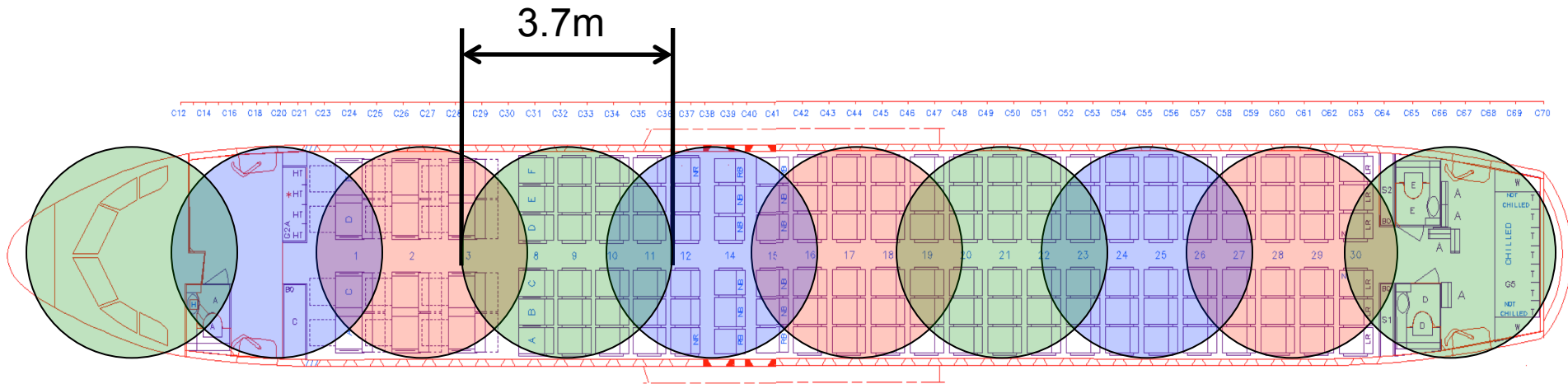
WiGig [IEEE802.11ad]

- Provides better cell discrimination and high bit rate per user.
- Uses the 59-64GHz band (available in all countries): transport in IF over fiber.
- Maximum bitrate per user is 7Gbps: high quality uncompressed video possible!



Distribution of wireless services

Wi-Fi

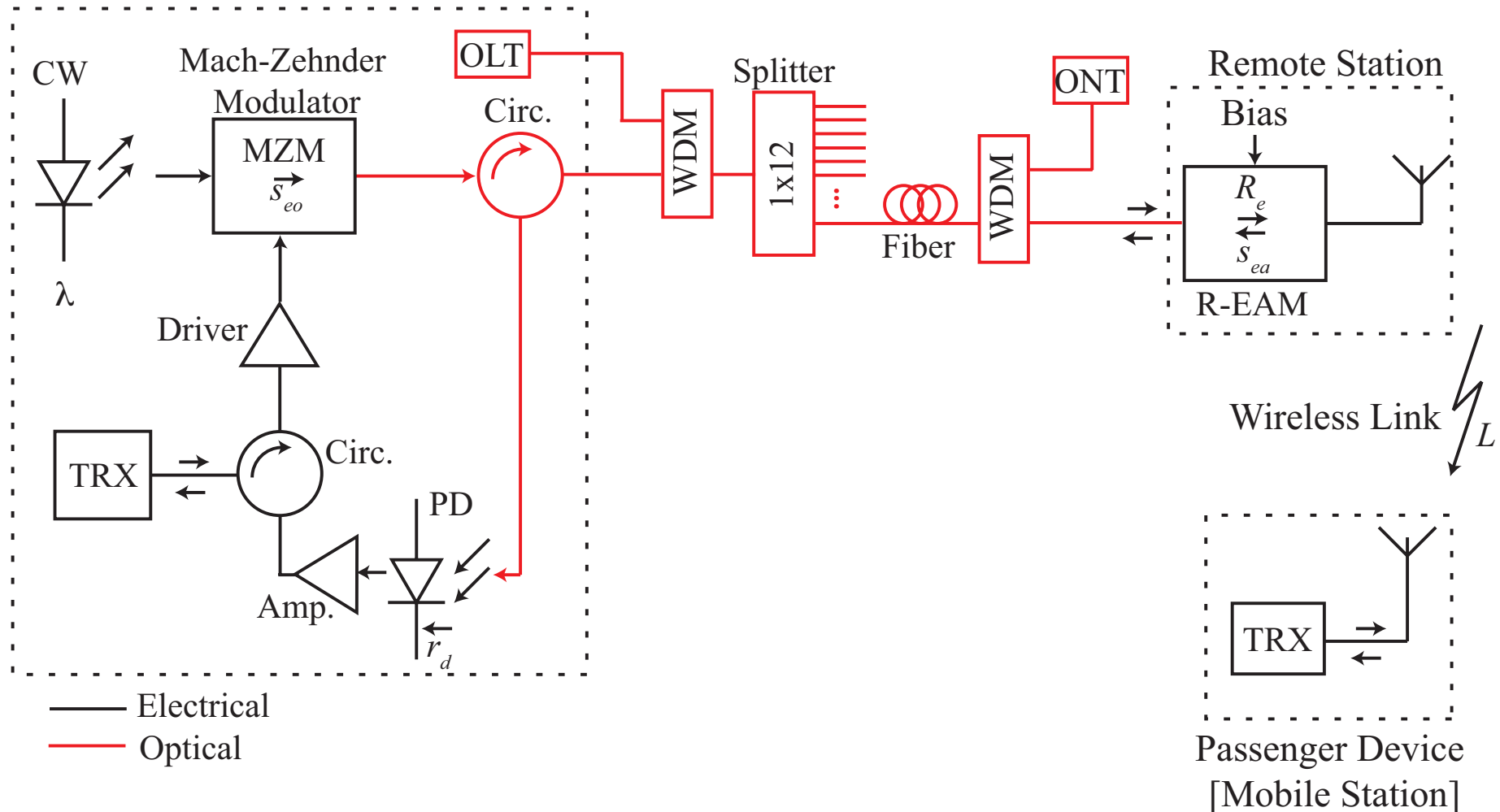


- Each cell has one RoF based access-point.
- 12 or 24 users in each cell, 10 cells for this example.
- Each cell can have one of 3 (at 2.4GHz) or 8 (at 5GHz) distinct bands (in Europe, USA and Japan).
- Max bit rate per stream is 300 Mbps (including overheads) with 2x2 MIMO and 40 MHz channels (802.11n standard).



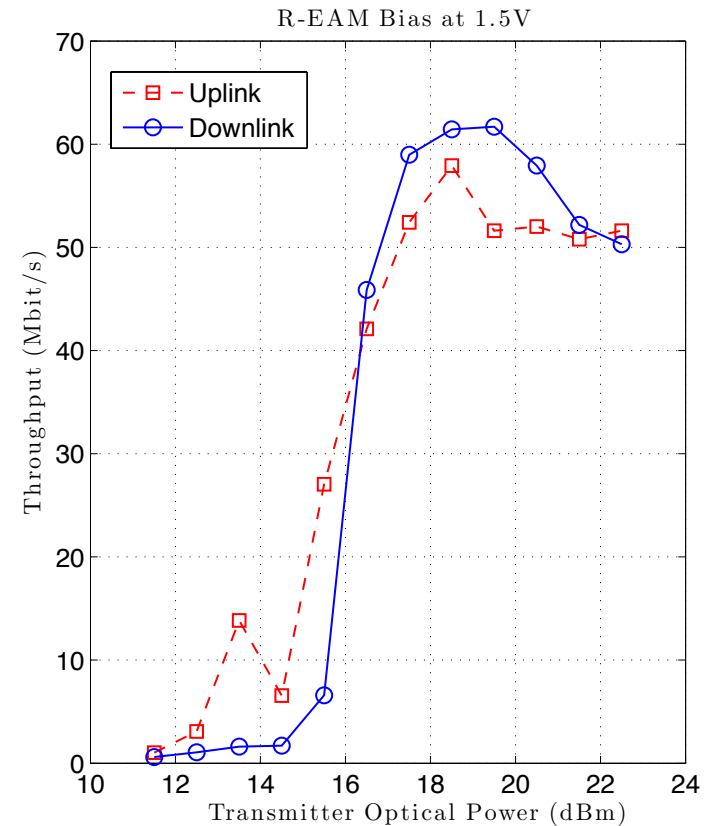
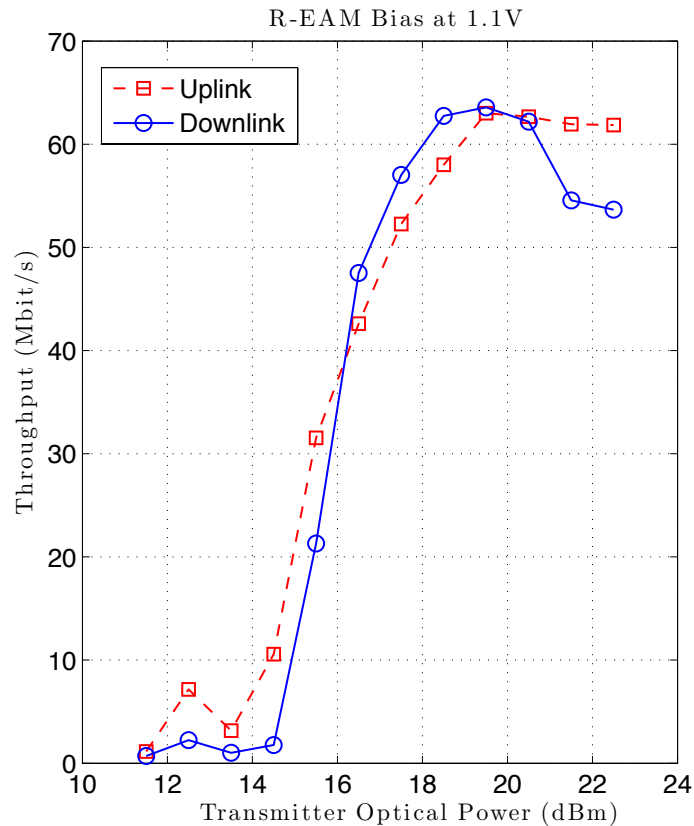
Experimental Setup: IEEE 802.11n transmission

Head End [Central Station]





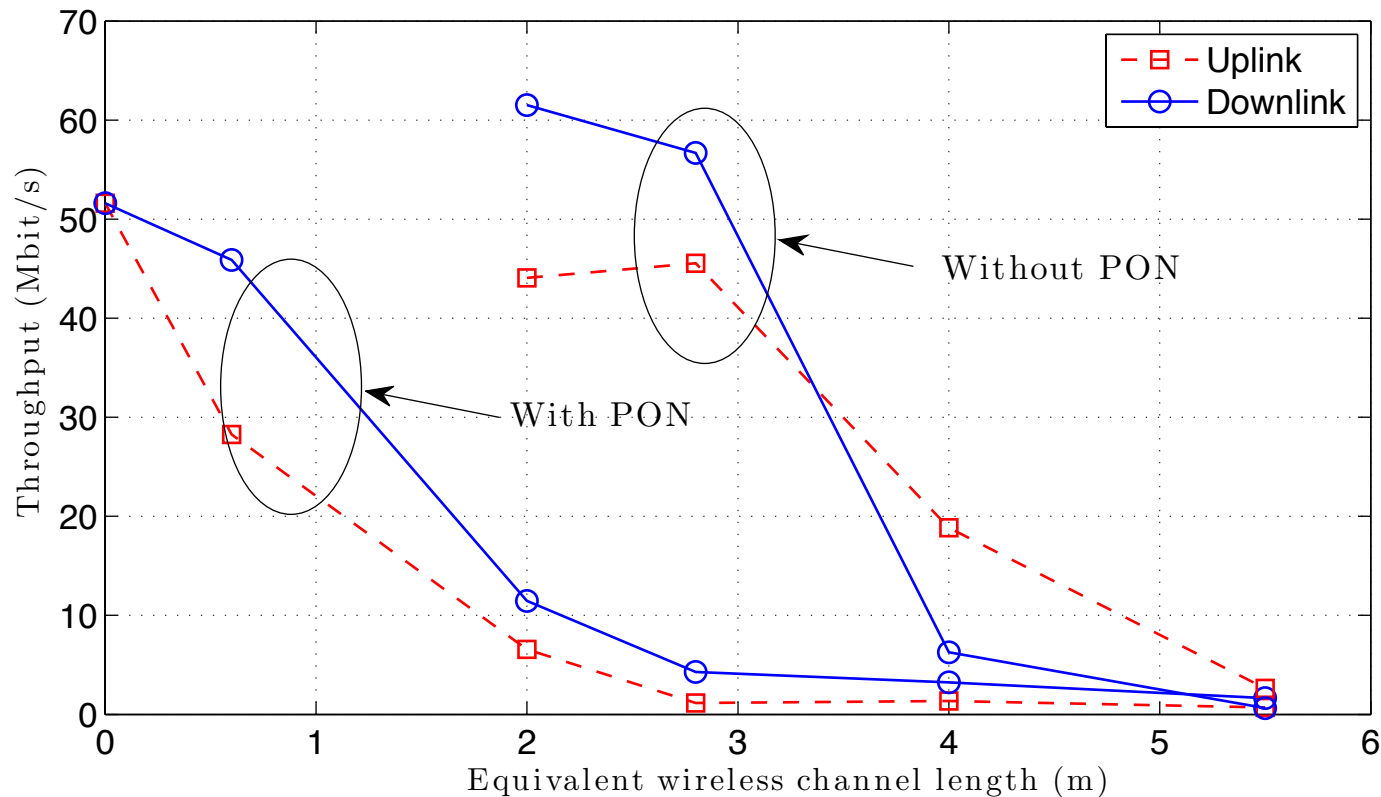
Experimental Results: IEEE 802.11n transmission w/o wireless channel



- Optimum transmitted power of +19dBm
- Degradation at low optical power due to SNR limitation



Experimental Results: IEEE 802.11n transmission Effect of wireless channel [passive remote station]

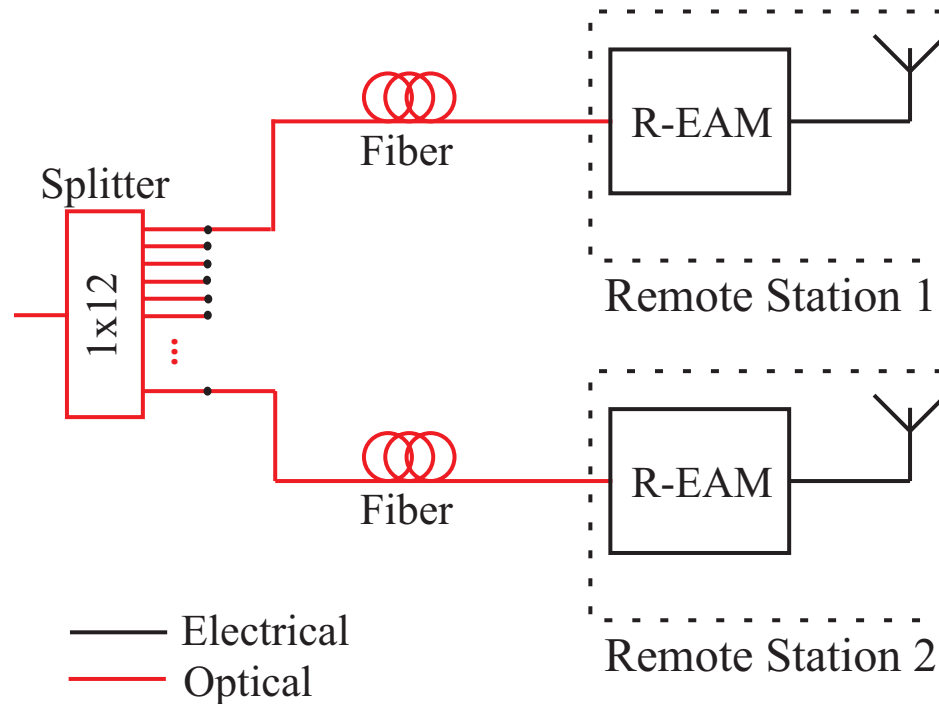


- Higher distances would be achieved by using an active remote station (with amplification)



Experimental Results: IEEE 802.11n transmission

Optical beat interference



- Reflected optical signals of identical wavelength combine in the splitter in the Uplink direction
- Experimentally observed throughput reduction: 80-90%



Conclusions and future work

- Distribution of wireless services over the PON has been shown
- Effectiveness of passive remote station very limited with the PON
- Optical beat interference precludes usage of more remote stations
- Further optimizations of measurement setup are being performed
- Evaluation of UWB performance
- Establish a comparison with VCSEL based approach



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- EC Framework 7 (FP7) project DAPHNE (www.fp7daphne.eu) “Developing aircraft photonic networks” (grant ACP8-GA - 2009-233709).
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Thank You!