




# ***MAPON digital video distribution in the European ACTS CRABS Project: simulation and experiment***

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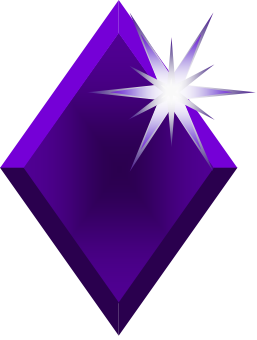
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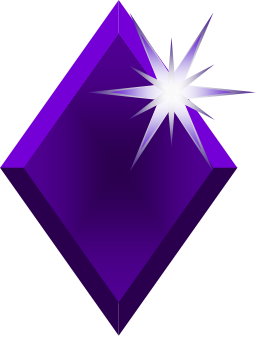
Optical Communications Group

Politecnico di Torino



# *Presentation Outline*

- ❑ Overview of the ACTS-CRABS Project
  - ❑ Cellular Radio Access for Broadband Services
- ❑ Introduction to MAPON
  - ❑ Master Antenna Passive Optical Network
- ❑ Simulations and Field Trial results
- ❑ Optical Up-link
- ❑ Future plans

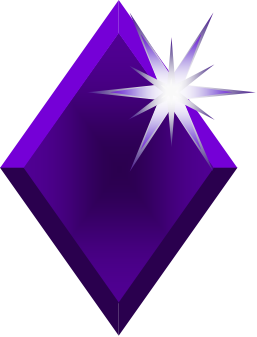


# *ACTS - CRABS Project*

## *Introduction*

- ❑ A new solution for the access and distribution network in urban areas.
- ❑ Targets:
  - ❑ Distribution of broadband video signals for the downstream traffic
  - ❑ Interactivity (upstream traffic)
- ❑ Partners:

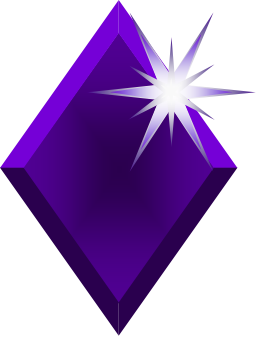
Philips, Telenor, Rai, Eurobell, Demokritos,  
Thomson, Joanneum Research, Testcom



# *ACTS - CRABS Project*

## *Physical Layers solutions*

- ❑ Cellular distribution:
  - ❑ cell radius: 1-5 Km
  - ❑ 40 GHz air link (requires direct view-of-sight among antennas)
  - ❑ 1 GHz downstream bandwidth for the video distribution
  - ❑ up to 1 GHz upstream bandwidth (shared among all users belonging to the same cell)

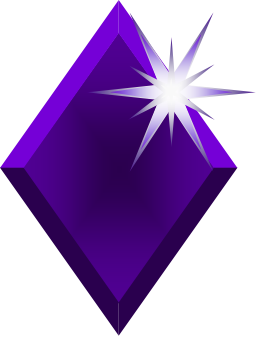


# *Distribution inside buildings: Optical Fibers*

- ❑ Distribution from the rooftop 40 GHz antenna to the final users by

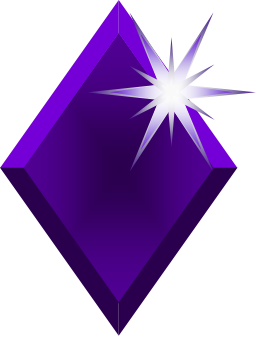
## **Optical Multimode Fibers**

- ❑ Advantages of multimode fibers over high-frequency coaxial cables
  - ❑ multimode fiber solution can cover 200-300 m around 2 GHz without regeneration
  - ❑ less expensive
  - ❑ easier to install (fibers are lighter and more bendable than coaxial cables)



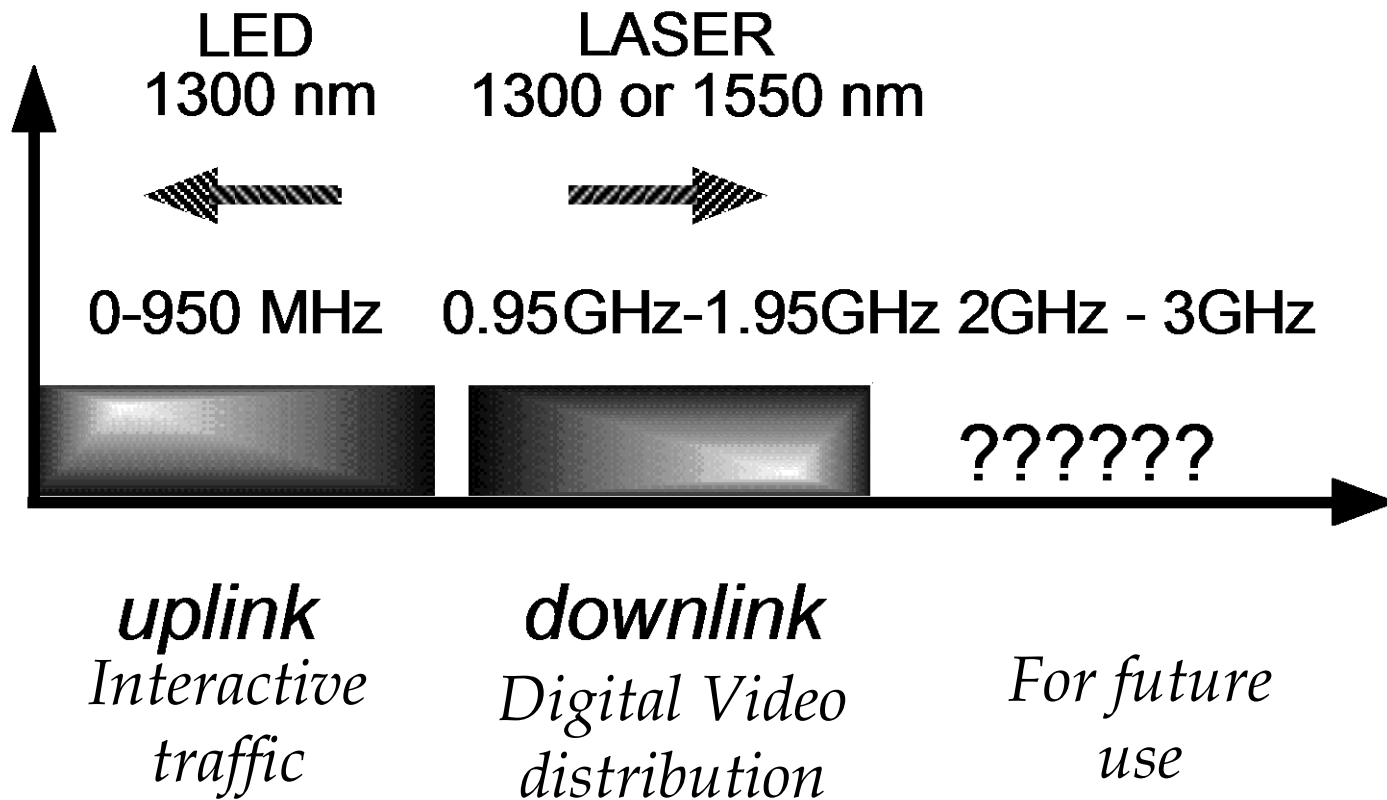
# *MAPON Requirements*

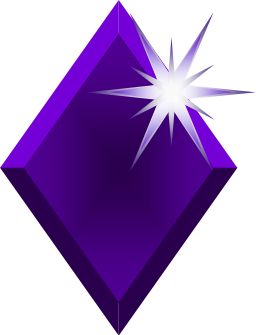
- ❑ 32-64 users over 200-300 meter (typical residential building requirement)
- ❑ inexpensive technology
- ❑ bi-directional propagation over a *single* multimode fiber
- ❑ *down-link bandwidth*: 1-2.5 GHz (after down-conversion from 40 GHz)
- ❑ *up-link bandwidth*: DC-800 MHz, shared among all users



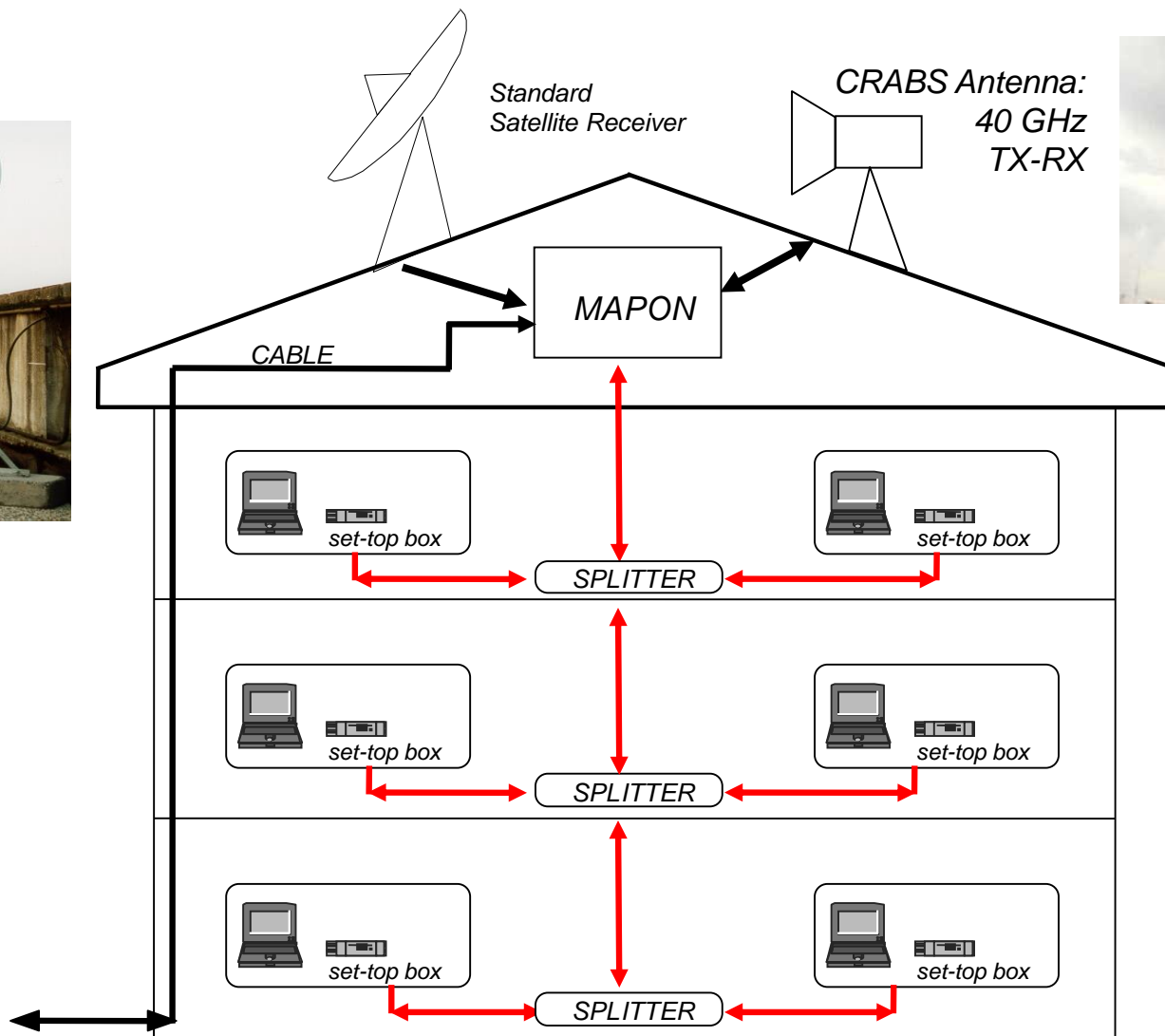
# MAPON

## *frequency planning*

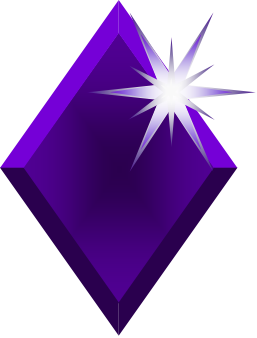




# MAPON Architecture



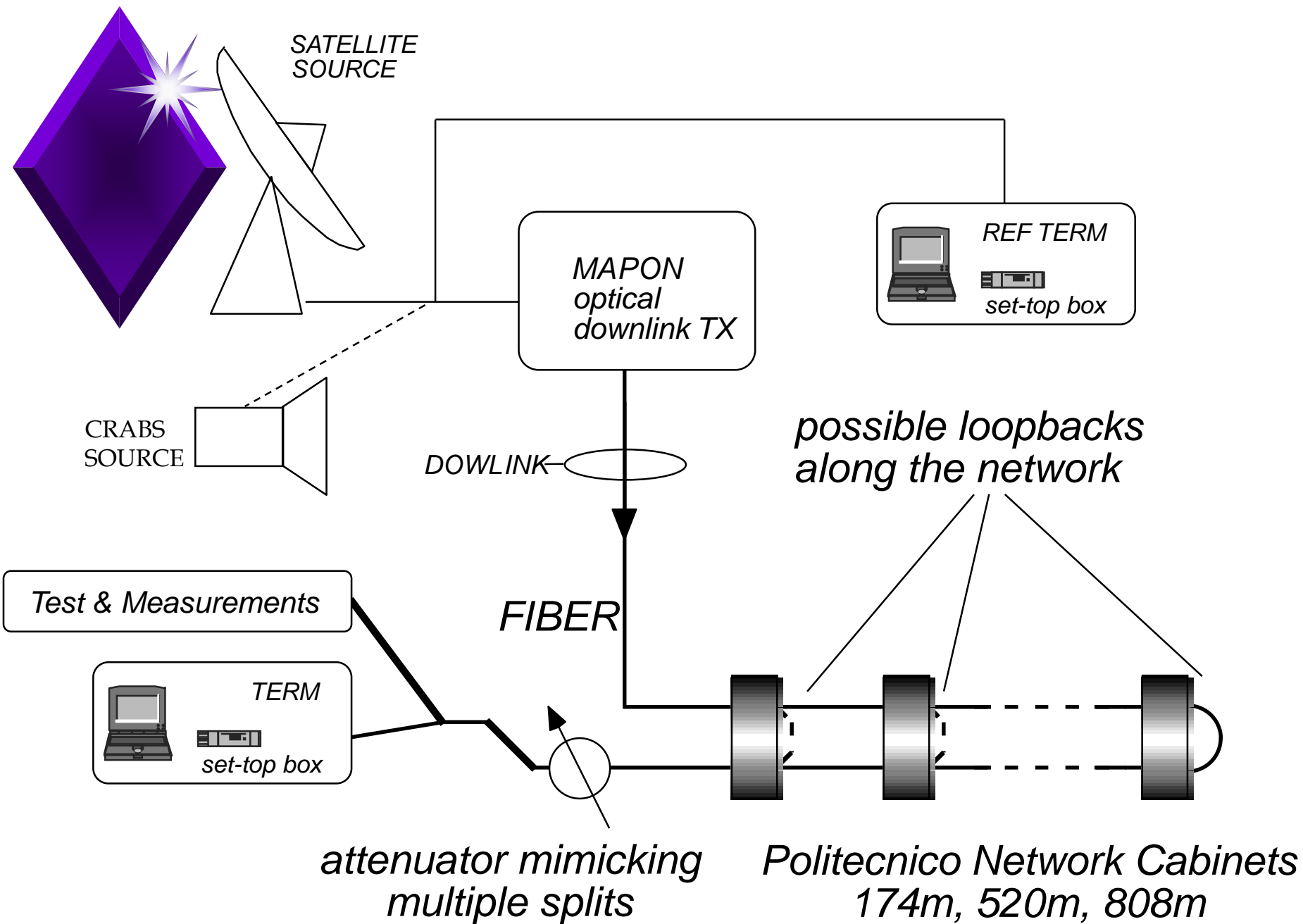


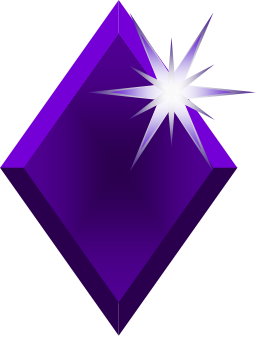


# *Politecnico di Torino*

## *CRABS-MAPON Field Trial*

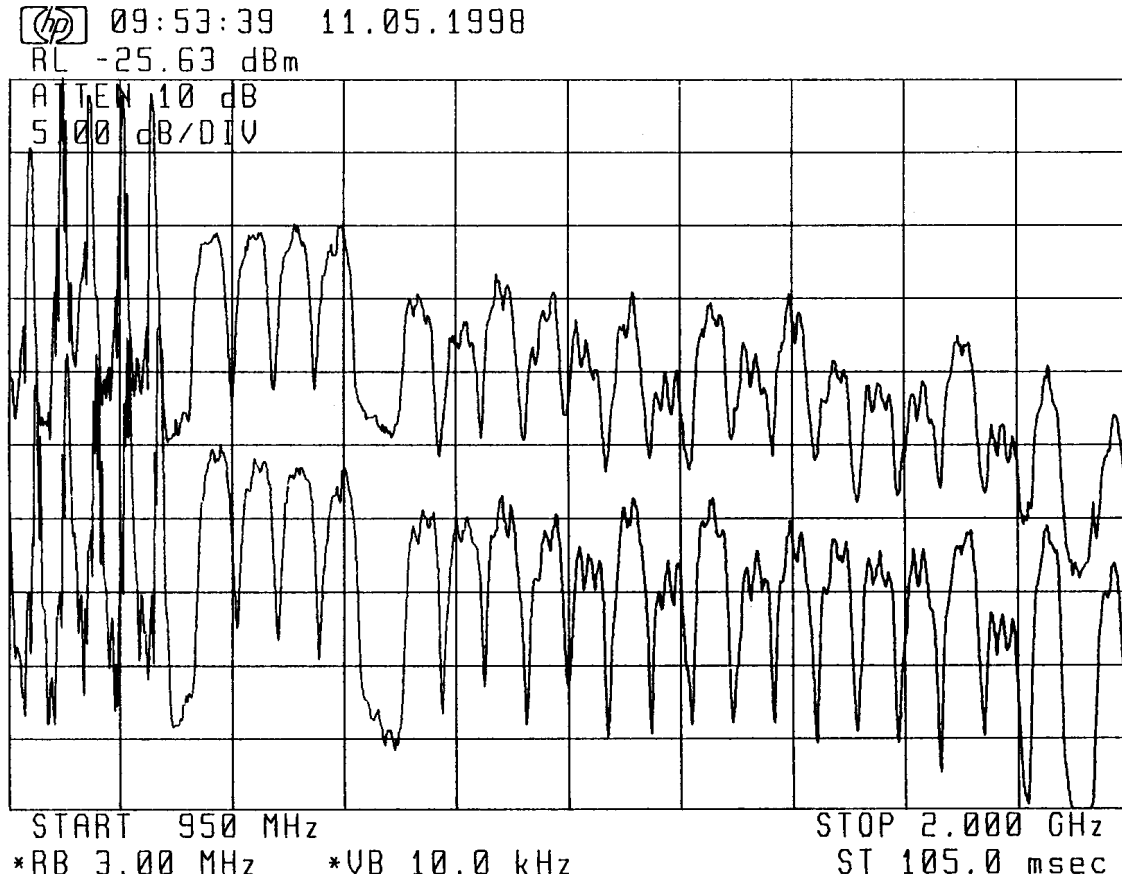
- ❑ RX antenna placed on a rooftop
- ❑ Digital Video signals coming from:
  - ❑ Standard commercial satellites (ASTRA, HOTBIRD)
  - ❑ Crabs 40 GHz signal down converted to first IF (1-2 GHz)
- ❑ propagation along an installed multimode fibre network (standard 62.5/125, originally deployed for a FDDI backbone)
  - ❑ downlink system has been completed;
  - ❑ uplink is under development and test





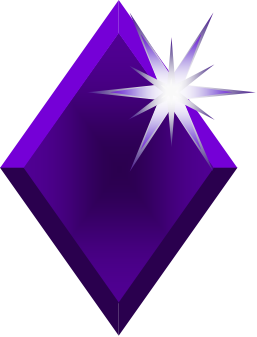
# *Trial measurements*

*Transmitted and received power spectrum*



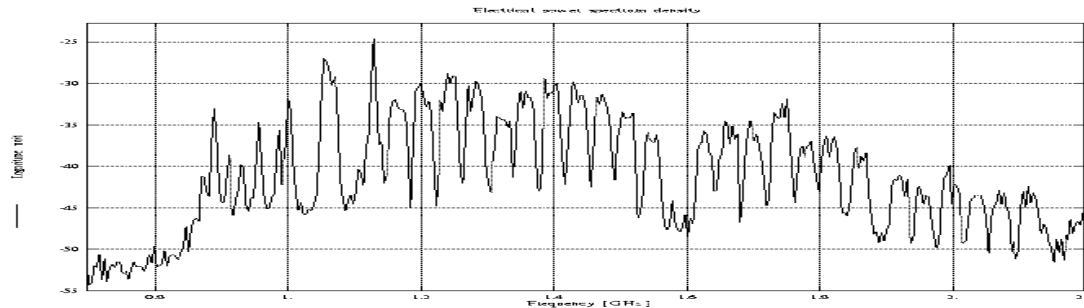
➤ Received signal

➤ Transmitted signal

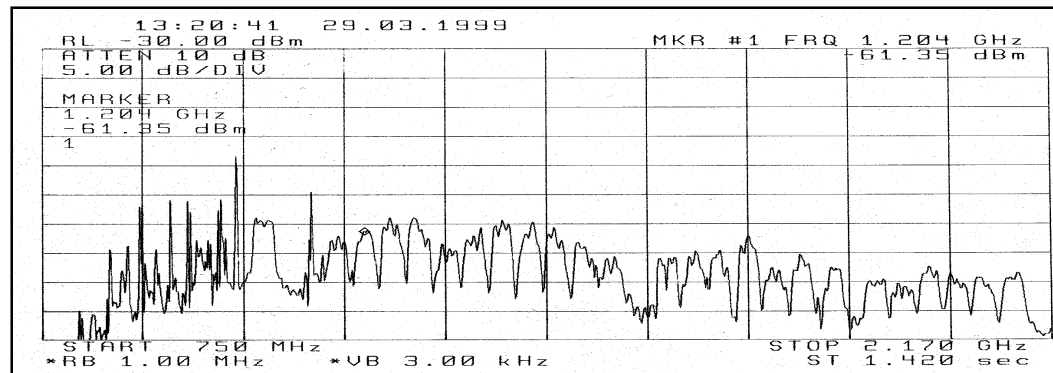


# Results: *Simulations and Measurements*

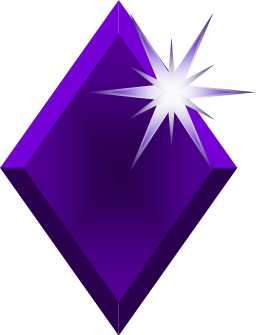
*RF signal (optical-to-electrical conversion)*



Simulation



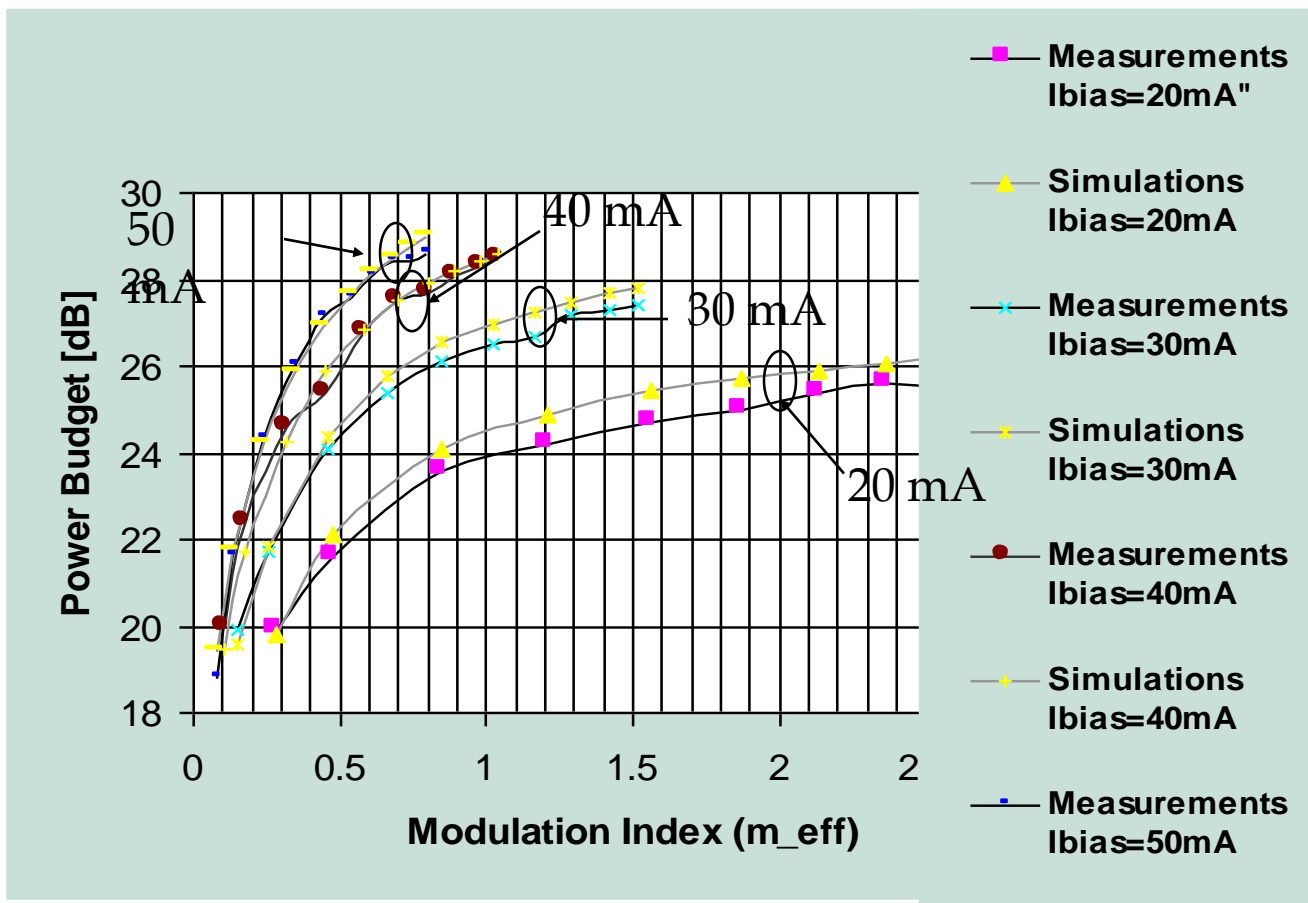
Measurement

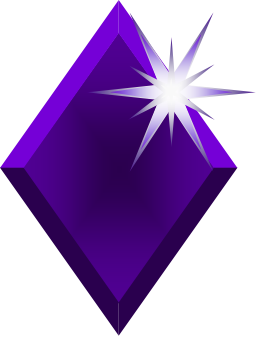


# Results:

## *Simulations and Measurements*

### *Optical Power Budget*



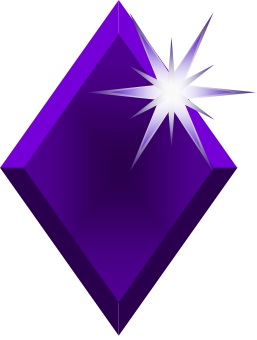


# *Politecnico Trial Results*

- ❑ Hotbird (8 digital carriers), ASTRA (23 digital carriers) and CRABS signals tested
- ❑ up to 800m all configurations
- ❑ measured optical loss budget on ASTRA  
28 dB ----> **128/256 users**  

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**64 users + margin**



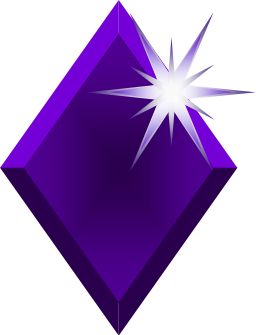
# *Politecnico Trial Results*

□ TX implementation cost (quantity 1):

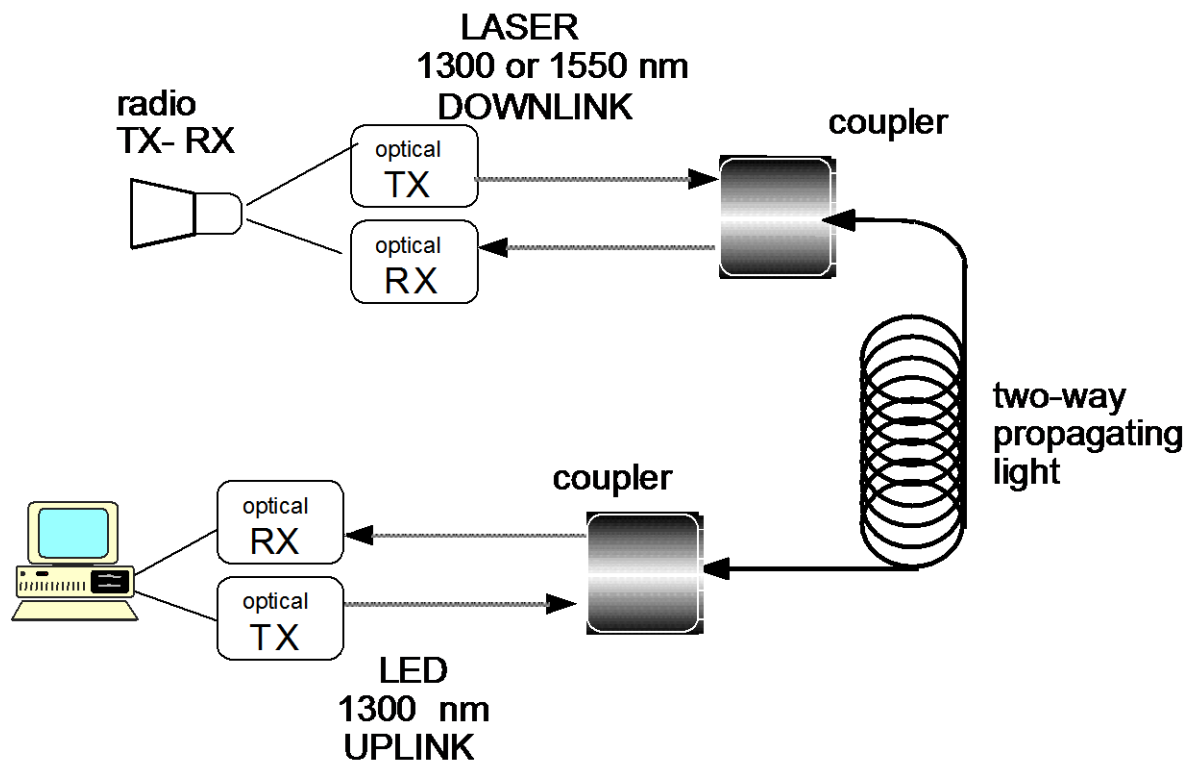
**1000 US\$**

□ RX implementation cost (quantity 1):

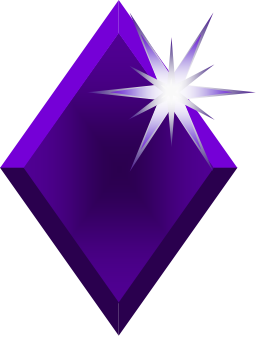
**150 US\$**



# *Optical Up-Link System Architecture*

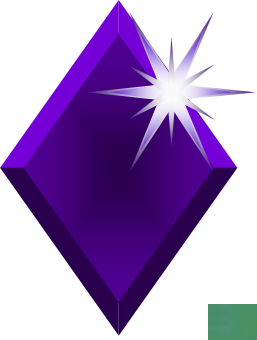






# *Target MAPON Up-link Performance*

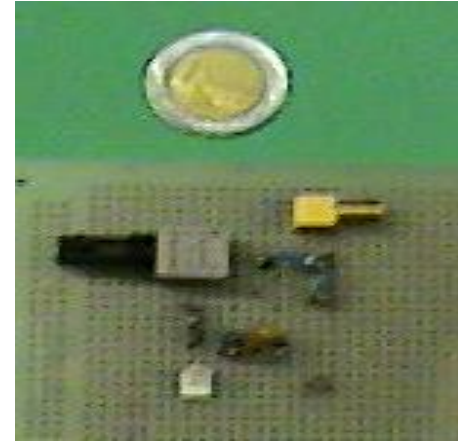
- ❑ cheapest possible technology
- ❑ bi-directional propagation
  - ❑ one fibre per household carrying both uplink and downlink
- ❑ uplink:
  - ❑ up to 500 Mbit/s burst speed per user (TDM)
  - ❑ FDM possible DC - 600 MHz
- ❑ Uplink format: commercial cable modem



# *Up-link Hardware*

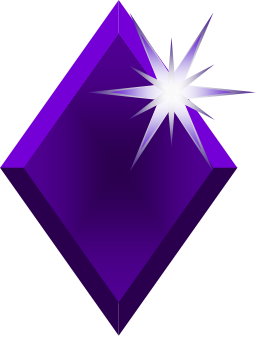


Transmitter



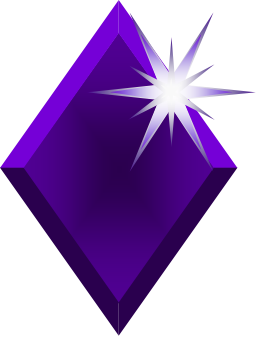
Receiver

- ❑ first measurements confirm the requested bandwidth for cable modem
- ❑ the devices are still under test



# *Future Plans*

- ❑ Experiments on the up-link hardware (and new designing if requested)
- ❑ Design and realisation of optical transmitter and receiver dual-band (downlink for two sources)
- ❑ Demonstrator with 8 interactive users (optical down-link and optical up-link) connected with a CRABS cell in a RAI site.



# *Acknowledgements*

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for the fruitful collaboration,  
and



for simulation with 