REFLECTIVE ONU

THE CW SIGNAL GENERATED AT THE OLT SIDE IS REFLECTED, AMPLIFIED AND MODULATED USING A REFLECTIVE MODULATOR.

PROS
- NO NEED FOR TUNABLE LASER AT ONU
- LIMITED ODN POWER BUDGET DUE TO SEVERAL SPURIOUS EFFECTS, INCLUDING:
  - Rayleigh Backscattering (RBS) AND CONCENTRATED REFLECTIONS
  - LIMITED OPTICAL POWER AT THE RECEIVER SIDE

CONS
- LIMITED ODN LOSS VALUES GREATER THAN OR EQUAL TO 28 Db
- WITHOUT A TUNABLE FILTER REQUIRED FOR US AND DS WAVELENGTH SEPARATION, IT IS A VERY FLEXIBLE BUT ALSO VERY EXPENSIVE SOLUTION

COHERENT DETECTION ON THE UPSTREAM REFLECTIVELY-MODULATED SIGNAL

- BETTER SENSITIVITY THAN DIRECT DETECTION => ACHIEVEMENT OF HIGHER ODM LOSSES
- MUCH LARGER RESILIENCE TO SPURIOUS BACK REFLECTIONS
- THANKS TO AN OPTIMIZED ELECTRICAL AND DIGITAL HIGH-PASS FILTER (HPF) AND 8B/10B CODING
- ITS HIGHER COST IS AFFORDABLE SINCE IT IS PLACED AT THE OLT SIDE

BURST-MODE TRANSMISSION AND COHERENT BURST-MODE DETECTION

- ONE DEDICATED WAVELENGTH PER USER DOES NOT OFFER ENOUGH GRANULARITY AND IS LIKELY TOO EXPENSIVE
- A COHERENT RECEIVER PER SINGLE USER IS LIKELY TOO EXPENSIVE, EVEN INSIDE THE CENTRAL OFFICE
- BURST-MODE TRANSMISSION CAN BE REALIZED BY A SOA AND REAM COMBINATION
- BURST-MODE COHERENCE DETECTION IS BASED ON A FAST CONVERGENCE DSP ALGORITHM (~100 BITS SYNC PATTERN)

CONCLUSIONS

THE PROPOSED SOLUTION HAS BASICALLY THE SAME PHYSICAL LAYER PERFORMANCE AS ITU-T TWDM-PON, AND THE FOLLOWING PROS (AND CONS) IN TERMS OF COSTS:

AT THE ONU SIDE:
- AN OPTICAL TUNABLE FILTER
- A SOA-REAM STRUCTURE
- NO TUNABLE LASERS

AT THE OLT SIDE:
- A SET OF DFB LASERS ON A 100 GHz GRID
- A COHERENT RECEIVER PER EACH UPSTREAM WAVELENGTH

ADDRESSED RESEARCH QUESTIONS/PROBLEMS

- FOR A TYPICAL PON WITH 64 USERS, THE ATTENUATION DUE TO THE SPLITTER ALONE IS AROUND 19-20 Db
- THE SYSTEM POWER BUDGET SHOULD ALSO TAKE INTO ACCOUNT SYSTEM MARGIN, FIBER LOSS, PENALTIES DUE TO DISPERSION, REFLECTIONS, AGEING, ETC.
- TYPICALLY, MOST PON TRANSCIEVERS SHOULD COPE WITH ODN-LOSS VALUES GREATER THAN OR EQUAL TO 28 db WITHOUT ANY OPTICAL AMPLIFICATION ALONG THE LINK
- PROVIDING EACH ONU WITH A TUNABLE LASER AND A TUNABLE FILTER, REQUIRED FOR US AND DS WAVELENGTH SEPARATION, IS A VERY FLEXIBLE BUT ALSO VERY EXPENSIVE SOLUTION

ADOPED METHODOLOGIES

THE FINAL NG-PON2 STANDARD (ITU-T RECOMMENDATION G.989.1) IS BASED ON TIME-AND-WAVELENGTH-DIVISION-MULTIPLEXING APPROACH:

- AT LEAST FOUR WAVELENGTHS
- EACH WAVELENGTH CARRIES 10 Gb/s DOWNSTREAM, 2.5 Gb/s UPSTREAM
- UP TO 40 KM REACH, UP TO 35 DB POWER BUDGET

TWDM-COHERENT AND REFLECTIVE PON ARCHITECTURE

SYSTEM SETUP: UPSTREAM TRANSMISSION

EXPERIMENTAL RESULTS

CONCLUSIONS