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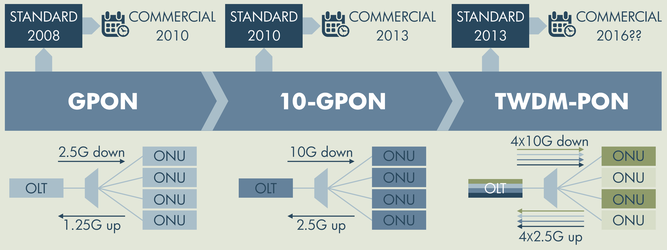
ADDRESSED RESEARCH QUESTIONS/PROBLEMS

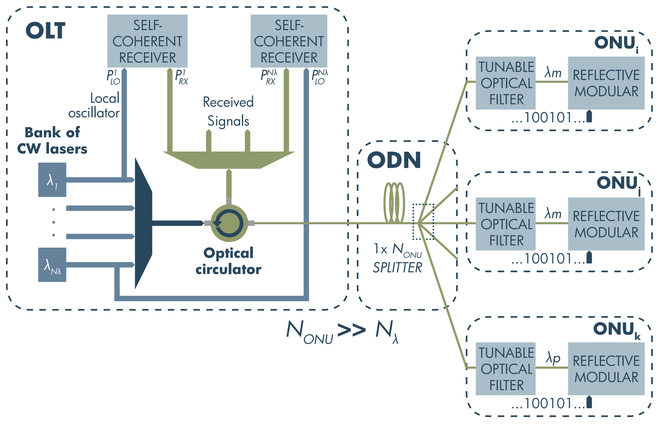
THE FINAL **NG-PON2** STANDARD (ITU-T RECOMMENDATION G.989.1) IS BASED ON TIME-AND-WAVELENGTH-DIVISION-MULTIPLEXING APPROACH:

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



- 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 TRANSCEIVERS 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**

TWDM-COHERENT AND REFLECTIVE PON ARCHITECTURE



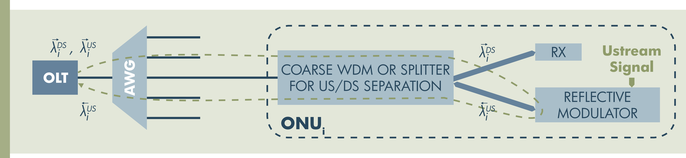
ADOPTED METHODOLOGIES

1 REFLECTIVE ONU

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

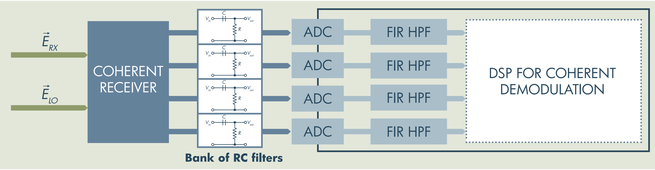
PROs » **NO** NEED FOR **TUNABLE LASER** AT ONU
CONs » **LIMITED ODN POWER BUDGET** DUE TO SEVERAL SPURIOUS EFFECTS, INCLUDING:

- RAYLEIGH BACK-SCATTERING (RBS) AND CONCENTRATED **REFLECTIONS**
- LIMITED OPTICAL POWER AT THE RECEIVER SIDE



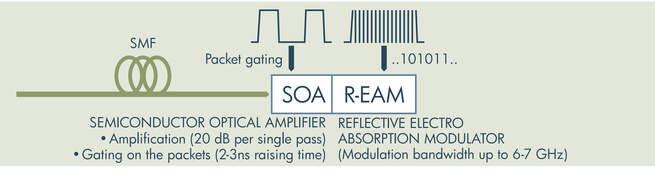
2 COHERENT DETECTION ON THE UPSTREAM REFLECTIVELY-MODULATED SIGNAL

- BETTER **SENSITIVITY** THAN DIRECT DETECTION -> ACHIEVEMENT OF HIGHER ODN 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



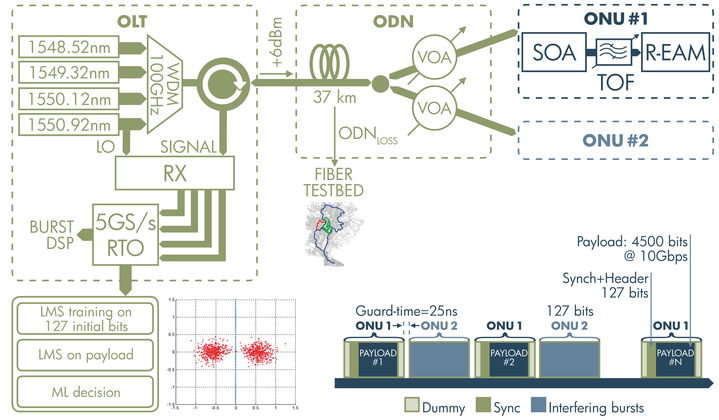
3 BURST-MODE TRANSMISSION AND COHERENT BURST-MODE DETECTION

- 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 R-EAM COMBINATION
- BURST-MODE COHERENCE DETECTION IS BASED ON A FAST CONVERGENCE DSP ALGORITHM (~100 BITS SYNC PATTERN)



EXPERIMENTAL RESULTS

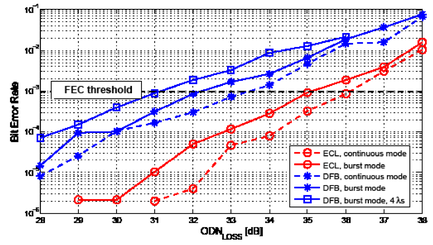
SYSTEM SETUP: UPSTREAM TRANSMISSION



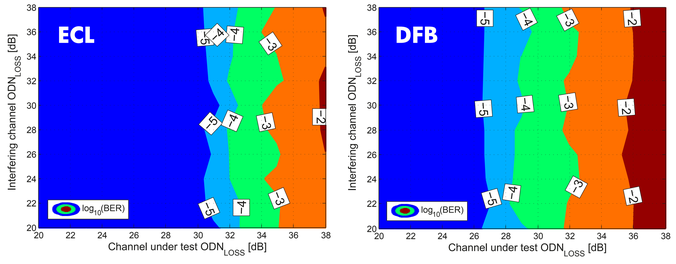
EXPERIMENTS USED AN OFF-LINE PROCESSING APPROACH

TO OBTAIN STABLE BER VALUES, WE ESTIMATE AND AVERAGE IT OVER A LARGE NUMBER OF PACKETS (APPROX. 1800 PACKETS FOR EACH BER ESTIMATION)

1 ACTIVE ONU



2 ACTIVE ONUs



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 UP-STREAM WAVELENGTH