OFDM Technology in Optical Access Network

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Example of the ACCORDANCE architecture*

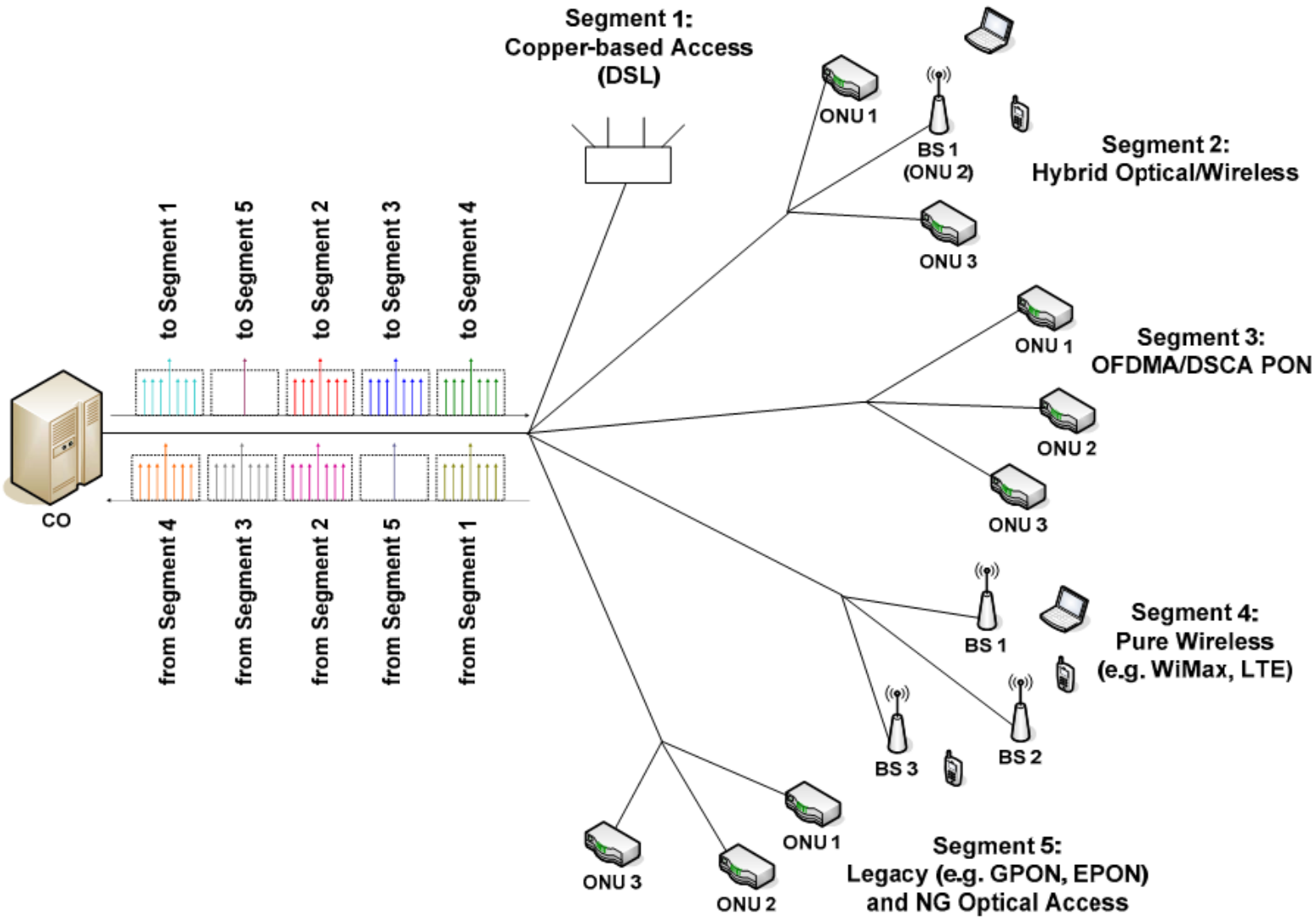

*Figure 1---ACCORDANCE: A Novel OFDMA-PON Paradigm for Ultra-High Capacity Converged Wireline-Wireless Access Networks , ICTON -2010

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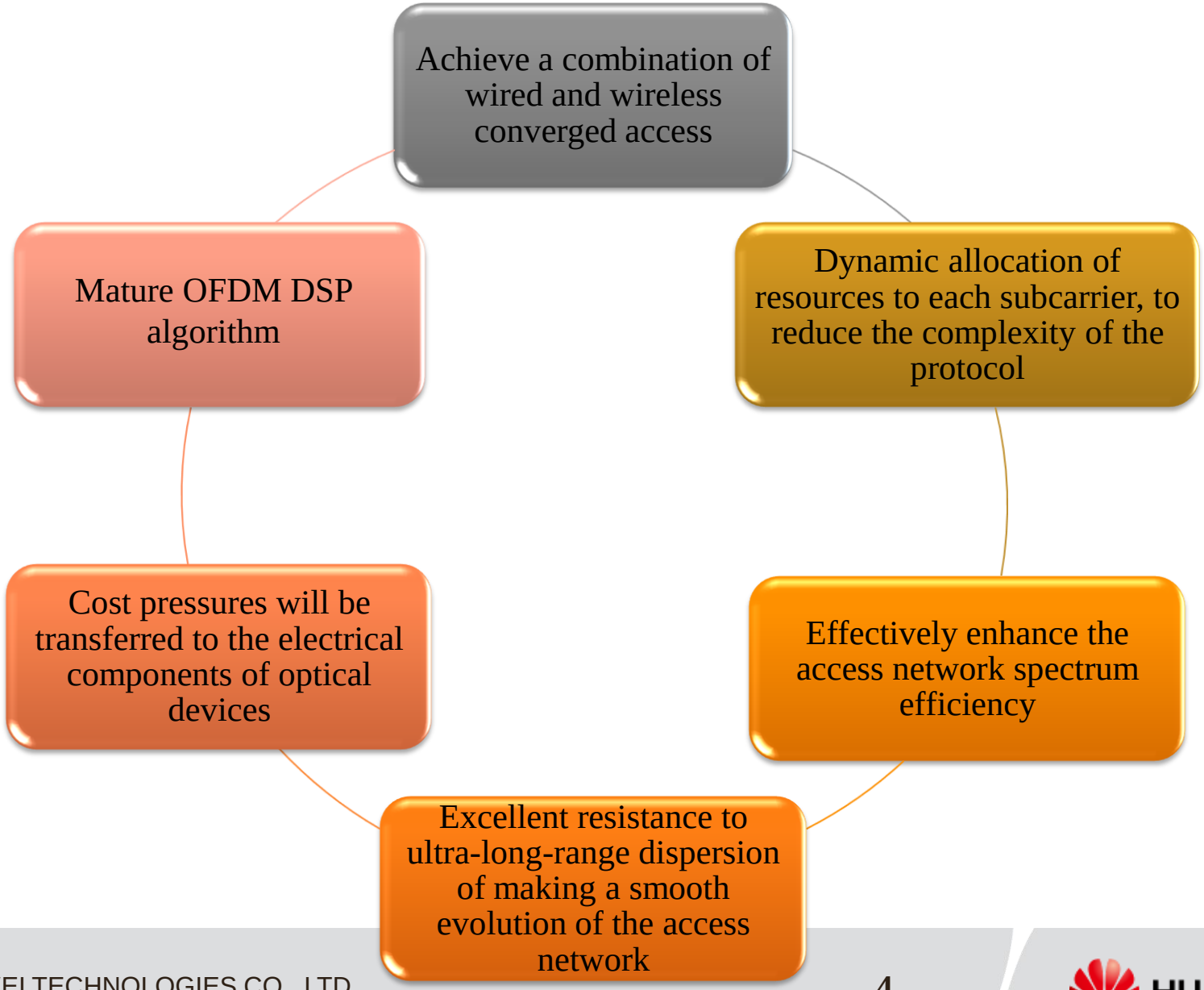
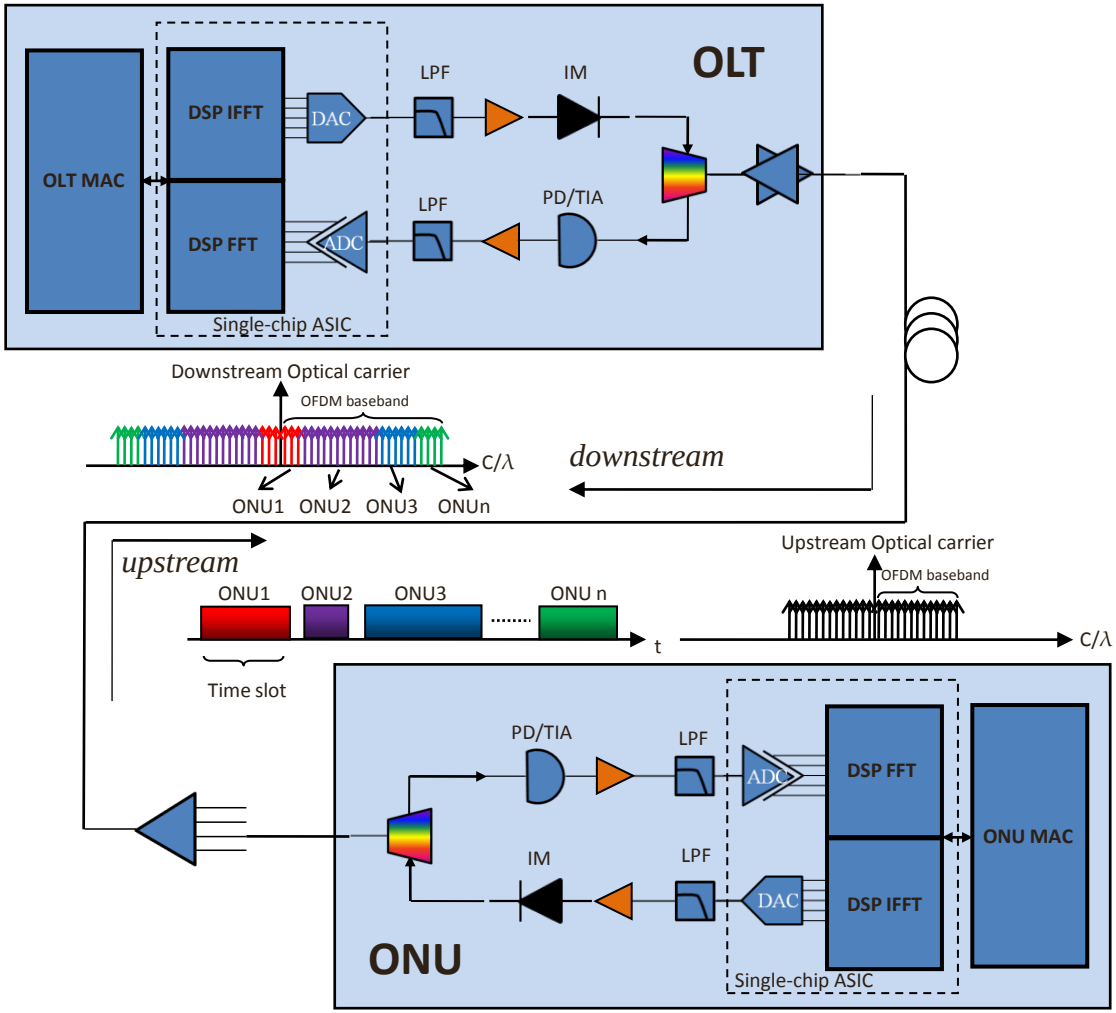
Characters of OFDM based Access Network



A System Architecture&Technology of OFDM



- **Single band OFDM arch ***
- D/S:
  - Data rate: >= 40Gbps
  - Conjugate symmetry IFFT in order to just use one piece DAC in transmitter
  - OFDM field modulation(mQAM)
  - 10G$^+$ optical component(EML/DML)
  - SOA/EDFA
  - 25G$^+$S/s DAC/ADC
  - DSP algorithms for OFDM
- U/S:
  - Data rate: >=10Gbps
  - 2.5G$^+$ optical component
  - SOA/EDFA
  - 10G$^+$S/s DAC/ADC

**Figure 1-1---A single-band OFDM-TDMA PON baseline architecture defined in Clause 1.1, NG-PON2 White Paper Contribution: OFDM-PON Architecture and Technology -2011*

Power Budget

ODN Class (OFDM-PON) - Downstream*		N1
Tx MIN	dBm	10
Tx MAX	dBm	12
Rx SEN	dBm	-21
Rx OVERLOAD	dBm	-2
Maximum optical path penalty	dB	2
Attenuation range	dB	14-29

ODN Class (OFDM-PON) - Upstream*		N1
Tx MIN	dBm	5
Tx MAX	dBm	8
Rx SEN	dBm	-26
Rx OVERLOAD	dBm	-6
Maximum optical path penalty	dB	2
Attenuation range	dB	14-29

Power Budgets defined in 10G-EPON* *

	PRX10, PR10 (EPON PX10 class compatible)	PRX20, PR20 (EPON PX20 class compatible)	PRX30, PR30 (EPON PX20+ class compatible)
Minimum loss	5 dB	10 dB	15 dB
Maximum loss	20 dB	24 dB	29 dB

How to increase power budget and get cost down?

**Table 10-1--- Power budgets defined in Clause 1.10, NG-PON2 White Paper Contribution: OFDM-PON Architecture and Technology -2011*

***Table 75-1---Power budgets defined in Clause 75, IEEE Std 802.3av™ -2012*

Major Challenges of OFDM-PON

◆**Maturity analysis of technology**

- ✓ Algorithms for OFDM
- ✓ High speed ADC/DAC (25G+/10G+)
- ✓ 10G optical transmitter
- ✓ 10G optical receiver
- ✓ 40G+ MAC

◆ **High cost**

- ✓ Reuse 10G optical component.
- ✓ Multi-band OFDM modulation instead of single-band OFDM modulation.
- ✓ Cost of high speed DAC/ADC is high.

◆ **Power budget is insufficient**

- ✓ Optimize the PAPR of OFDM.
- ✓ Use optical amplifier (SOA/EDFA) at OLT/ONU to improve the power /receiver sensitivities.
- ✓ Powerful DSP algorithms.
- ✓ Multi-wave aggregation, reduce the data rate per channel.

Thank you

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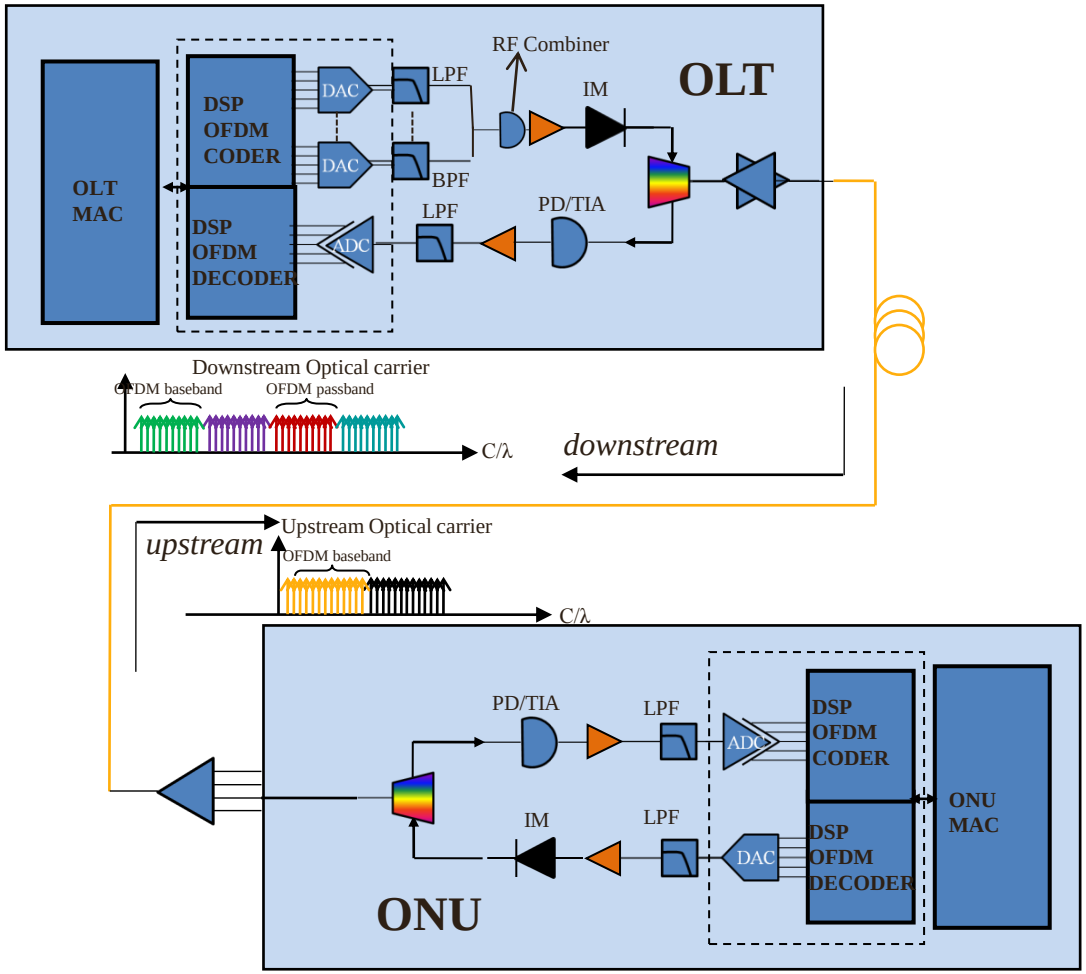
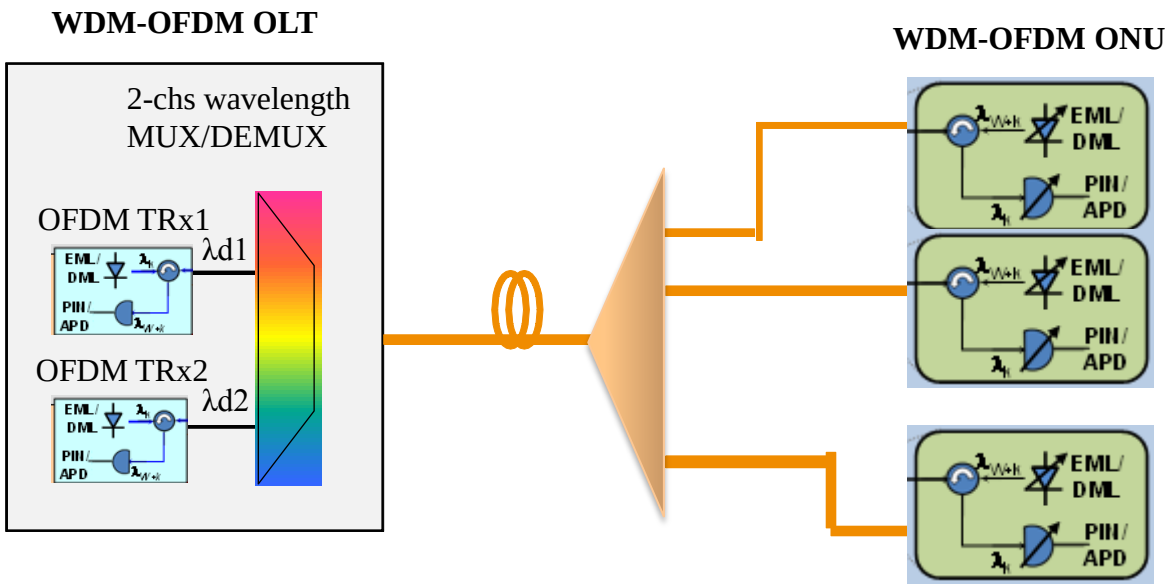
Appendix



One possible extension sys. arch

- D/S:
  - Multi-band architecture(4 bands),
  - 5GS/s DAC/ADC
- U/S:
  - Multi-band architecture(2 bands)
  - 2.5GS/s DAC/ADC
- The main purpose of this extension architecture is to reduce the cost of high speed DAC/ADC though the use of multi-band technology and low speed ADC/DAC. However there are still issues,
  - RF combiner leads to relatively high complexity.
  - Power budget is tight for 1:32 splitter and 20km distance.

Appendix (cont.)



Another possible extension

- D/S:
  - Multi-wave architecture(2 wavelength)
  - 10G optical component(EML/DML)
  - 15GS/s DAC/ADC
  - MUX/DEMUX
- U/S:
  - Single-wave architecture
  - 2.5G optical component
  - 10GS/s DAC/ADC

➢ This extension arch is to use multi-wave transmission to increase the power budget; however, MUX/DEMUX introduces relatively higher cost.