



The Great Compromise for WDM and TDM Coexistence in 100G EPON (IEEE 802.3ca)

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Background on 100G EPON (IEEE 802.3ca) Wavelength Options and WDM vs. TDM Coexistence

- **The debate for the 100G PON Wavelength Plan and support for either WDM “or” TDM Coexistence with 802.3av has been an open topic since the inception of the working group (September 2015)**
- **The WDM coexistence “Plan A” would define all four IEEE 802.3ca 100G EPON wavelengths to avoid the defined IEEE 802.3av 10G EPON upstream wavelength of 1270nm \pm 10 occupying 1260-1280 nm**
 - **From:** johnson_3ca_1a_0916 and harstead_3ca_1_0117 also known as “Proposed Wavelength Plan A”
 - **From:** zhang_3ca_1_1116 and harstead_3ca_1_0117 also known as “Cost Optimization Proposed for Plan A”
 - **From:** guo_3ca_1_0117 known as “Proposed Wavelength Plan A 2 nm wide”
- **The TDM coexistence “Plan B” would define one of the four IEEE 802.3ca 100G EPON wavelengths to overlap with the defined IEEE 802.3av 10G EPON upstream wavelength of 1270nm \pm 10 occupying 1260-1280nm**
 - **From:** harstead_3ca_2b_0916 and harstead_3ca_1_0117 also known as “Original Plan B”
 - **From:** zhang_3ca_1_1116 and harstead_3ca_1_0117 also known as “Modified Plan B (1)”
 - **From:** zhang_3ca_1_1116 and harstead_3ca_1_0117 also known as “Modified Plan B (2)”
- **All of the above mentioned proposals overlap with the defined IEEE 802.3ah “EPON” and G.984 “GPON” upstream wavelength plans**
 - **EPON:** IEEE 802.3ah 1310 nm \pm 50
 - **GPON:** G.984.2 1310 nm \pm 50 Regular wavelength band option, G.984.5 1310 nm \pm 20 Reduced wavelength band option, G.984.5 1310 nm \pm 10 Narrow wavelength band option
 - **Both Plan A and Plan B require EPON and GPON to not share the same fiber.**
- **The Committee Struggled Over the Selection of the Wavelength Plan Either: Plan A “or” Plan B because this also meant picking WDM “or” TDM.**
 - **“The Great Compromise is possibly a path to making a wavelength selection while also defining support for WDM and TDM”**

Objectives for The Great Compromise for TDM and WDM Coexistence in 100G EPON (IEEE 802.3ca)

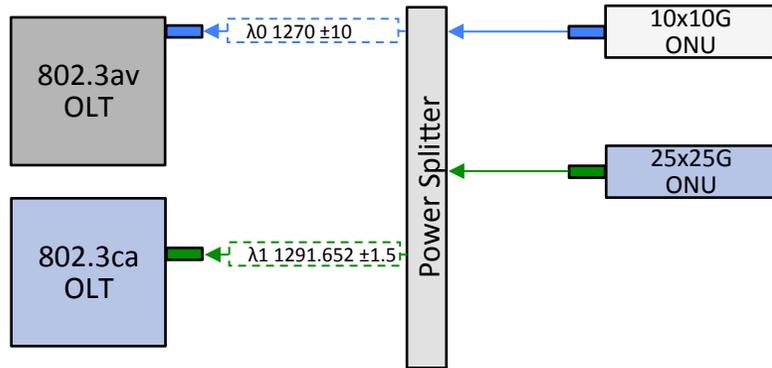
- The Compromise Uses Plan B (Modified Plan B) while “also” supporting both TDM “and” WDM Coexistence
- Defines support for both TDM and WDM coexistence in the IEEE 802.3ca standard to enable choice and flexibility for different operator deployment scenarios (See following slides for “The Great Compromise Deployment Scenarios”)
 - Instead of the committee picking either TDM or WDM we can define both
- Defines four upstream wavelengths using the Modified Plan B option for IEEE 802.3ca
 - Recall that the λ_0 , λ_1 , λ_2 , λ_3 wavelengths are different between Plan A “WDM” and Plan B “TDM”
 - This presentation uses “Modified Plan B” with upstream λ_0 1270 \pm 10, λ_1 1291.652 \pm 1.5, λ_2 1298.365 \pm 1.5, and λ_3 1305.148 \pm 1.5
 - Modifications to the exact wavelength values used in Plan B may change slightly moving forward
- The Great Compromise takes the best attributes from both Optical Plan A and Plan B:
 - Plan A (WDM Coexistence)
 - Enabled 25G x 25G capacity to be attained because there are no 10G ONUs sharing the wavelength
 - Allowed 10G EPON or XGS-PON OLTs to coexist with 802.3ca thus not requiring a forklift of those systems to initially deploy 802.3ca systems on the same ODN
 - What “The Great Compromise” does is allow for a delay in the use of those overlapping 802.3av/XGS lambdas until late in the 802.3ca deployment cycle e.g. when 100G ONUs are needed, and thus essentially the 802.3av wavelength could be the last one used
 - Plan B (TDM Coexistence)
 - Enables the use of 802.3av and 802.3ca to just four upstream wavelengths
 - Enables four wide channel (3 nm) wavelengths and this means lower cost compared to narrow channels
 - Use of 802.3av upstream wavelength 1260-1280 allows the fewest wavelengths in the ZDW 1300-1324 nm region
 - Enabled coexistence and backward compatibility with 10G EPON
 - The 802.3ca OLT could support 802.3av completely from the same chip, port, and single wideband 1260-1280 receiver if desired

The Great Compromise Deployment Scenario

Option 1a: WDM and TDM Scenarios use different upstream optics for 25x25G ONUs and 50x50G ONUs

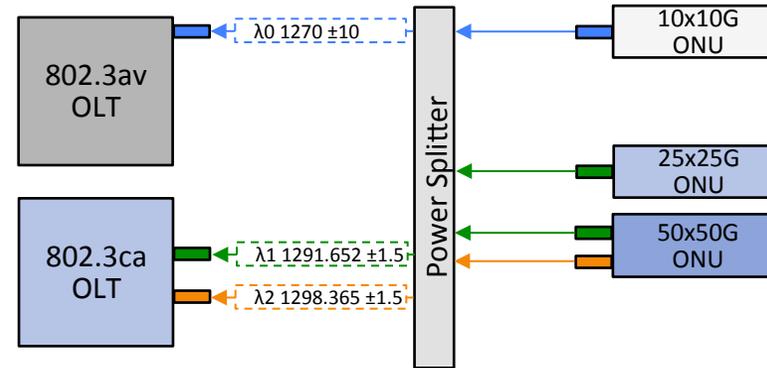
1st Gen 802.3ca – 25G-EPON

WDM Deployment Scenario



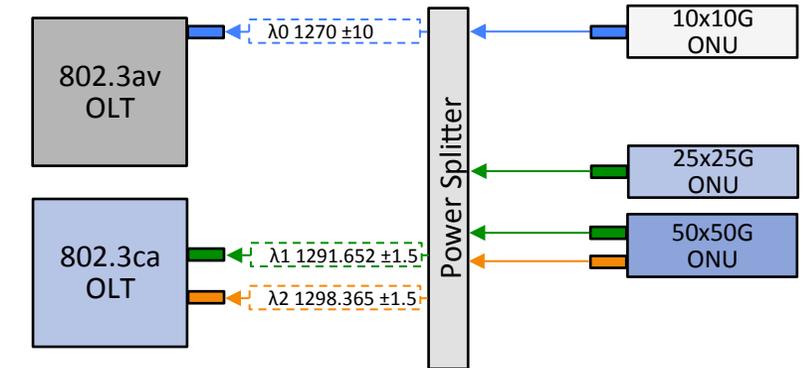
2nd Gen 802.3ca – 50G-EPON

WDM Deployment Scenario

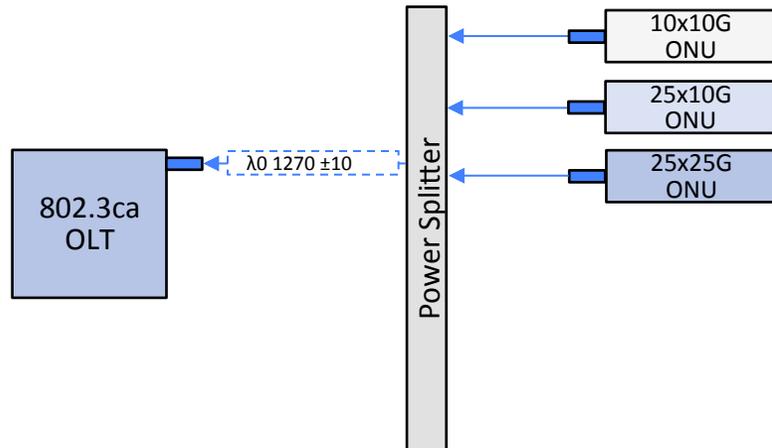


3rd Gen 802.3ca – 100G-EPON

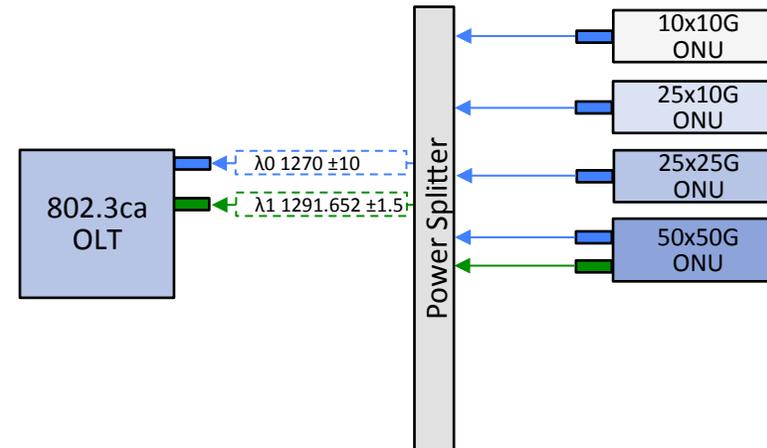
WDM Deployment Scenario



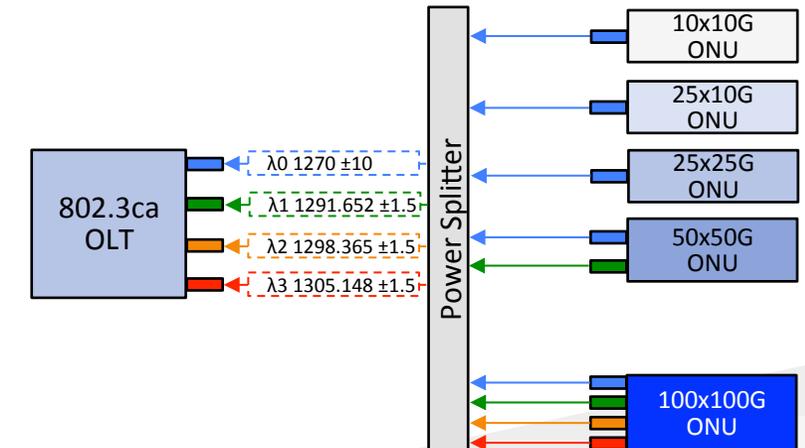
TDM Deployment Scenario



TDM Deployment Scenario



TDM Deployment Scenario

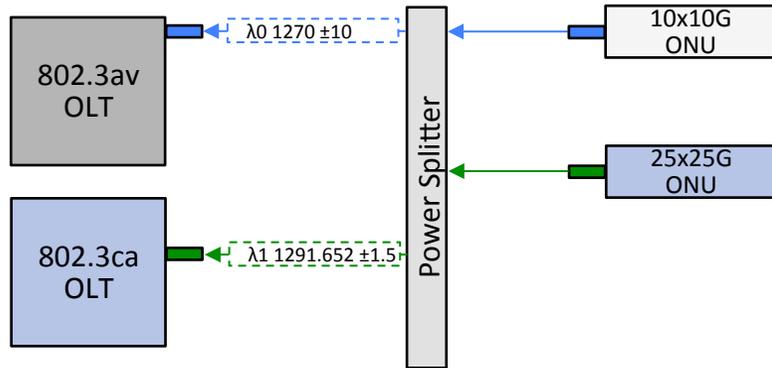


The Great Compromise Deployment Scenario

Option 1b: Adds 75x75G ONUs to WDM and TDM (benefit for WDM is it extends the service of 10G OLTs)

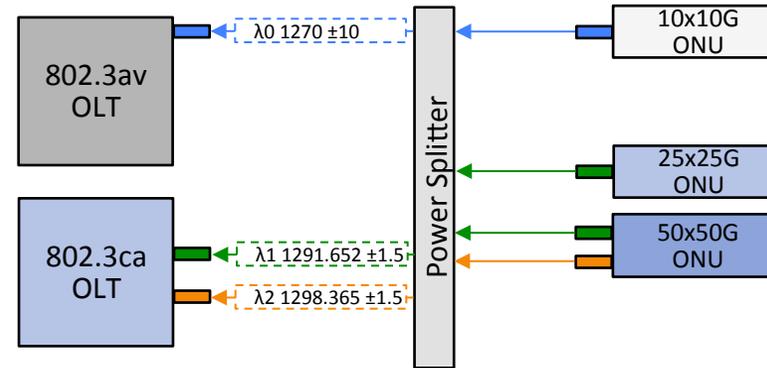
1st Gen 802.3ca – 25G-EPON

WDM Deployment Scenario



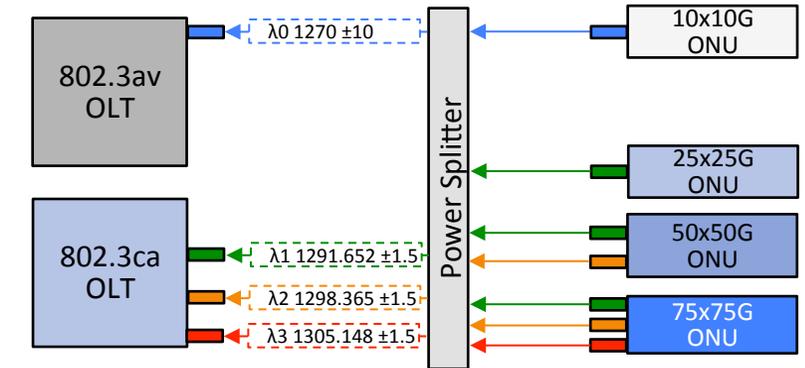
2nd Gen 802.3ca – 50G-EPON

WDM Deployment Scenario

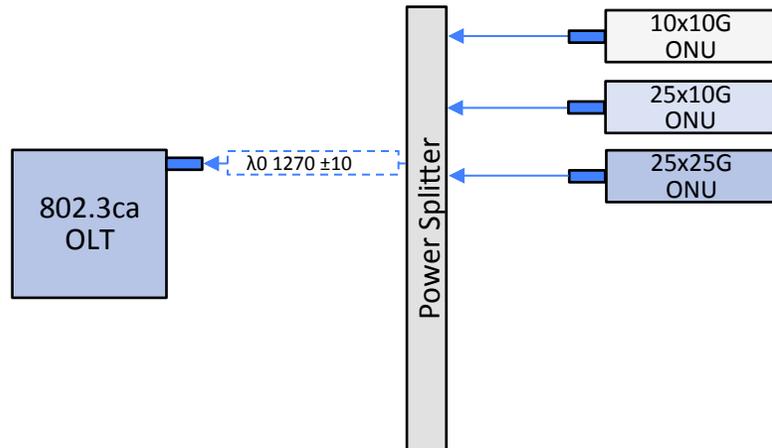


3rd Gen 802.3ca – 100G-EPON

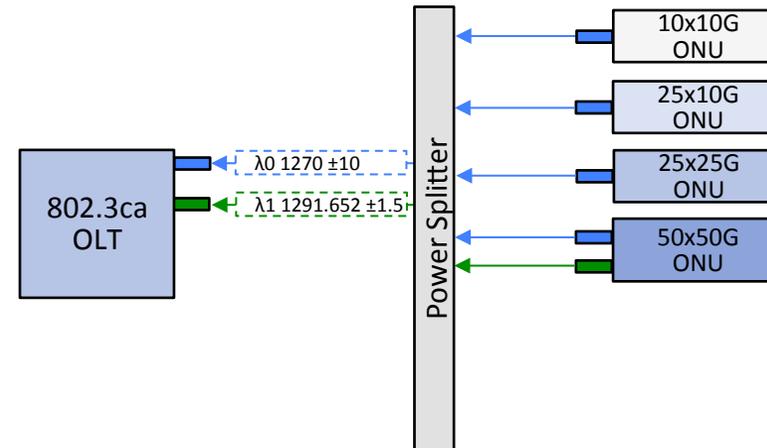
WDM Deployment Scenario



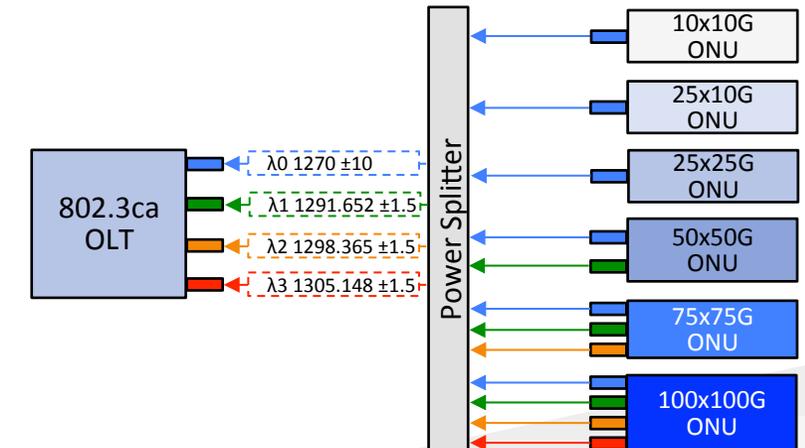
TDM Deployment Scenario



TDM Deployment Scenario



TDM Deployment Scenario



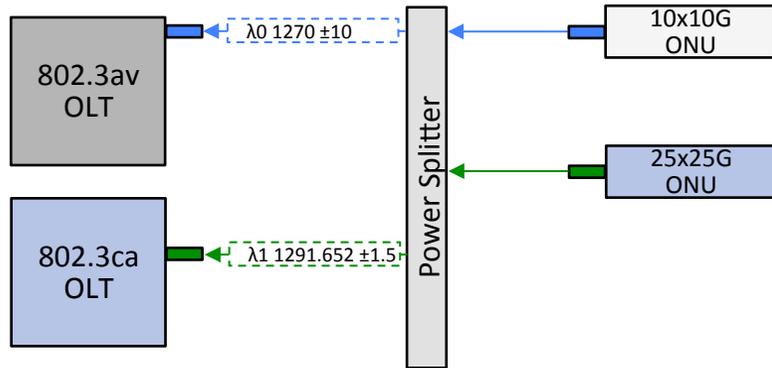
The Great Compromise Deployment Scenario

Option 2a: WDM and TDM Scenarios have an option to use the same 25x25G “and” 50x50G ONUs

TDM uses Wideband Rx “or” 2 channel Rx in 802.3ca OLT in 1st and 2nd Gen Deployments

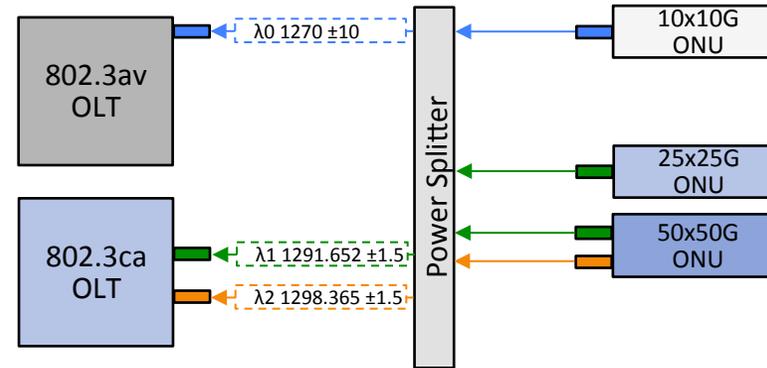
1st Gen 802.3ca – 25G-EPON

WDM Deployment Scenario



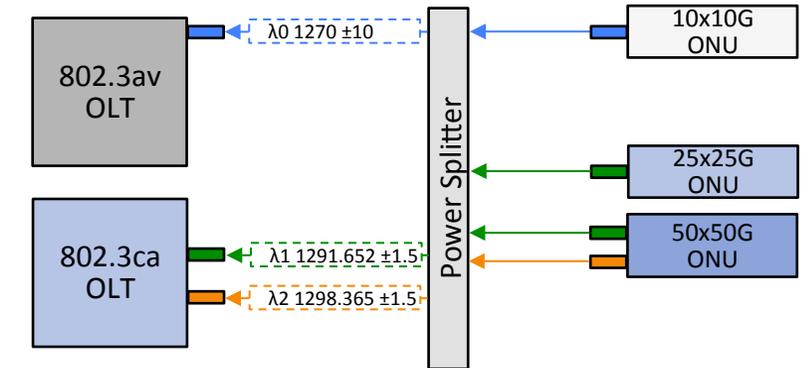
2nd Gen 802.3ca – 50G-EPON

WDM Deployment Scenario

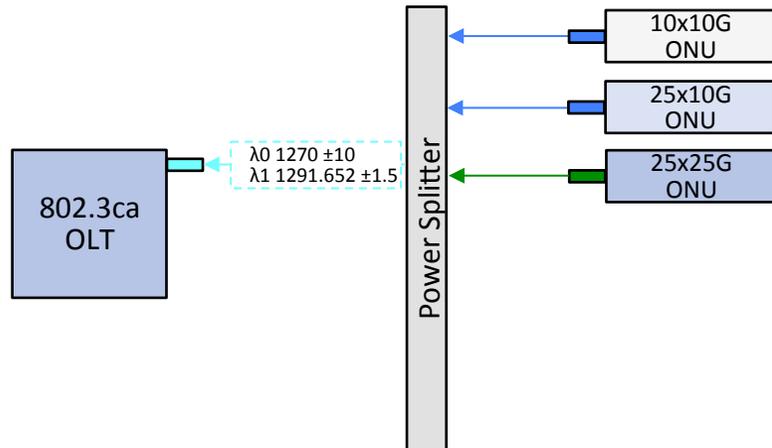


3rd Gen 802.3ca – 100G-EPON

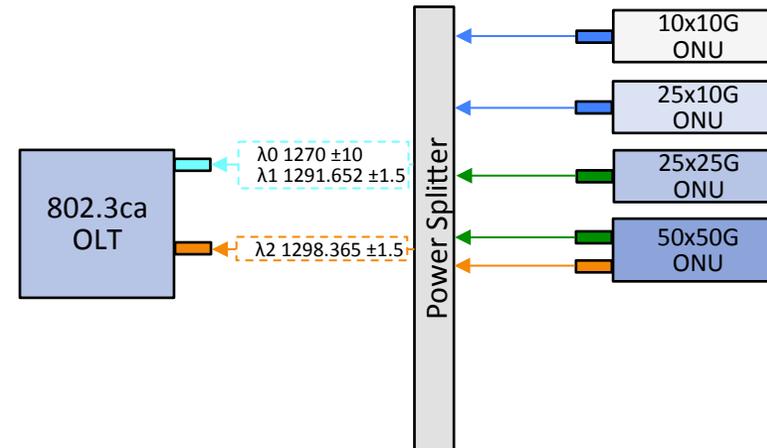
WDM Deployment Scenario



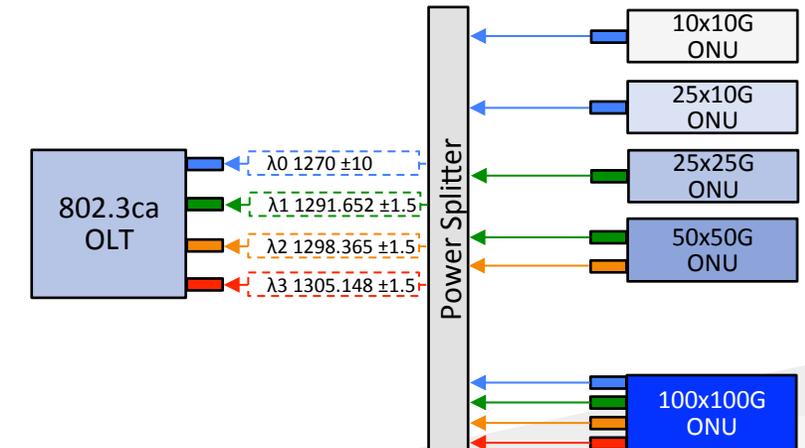
TDM Deployment Scenario



TDM Deployment Scenario



TDM Deployment Scenario

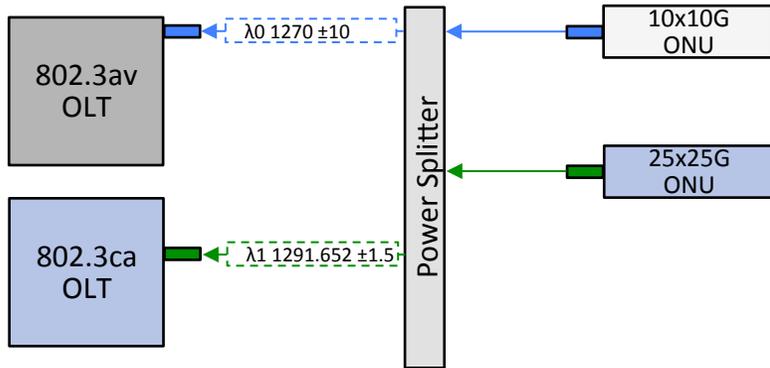


The Great Compromise Deployment Scenario

Option 2b: Adds 75x75G ONUs to WDM and TDM (same optics for both scenarios)

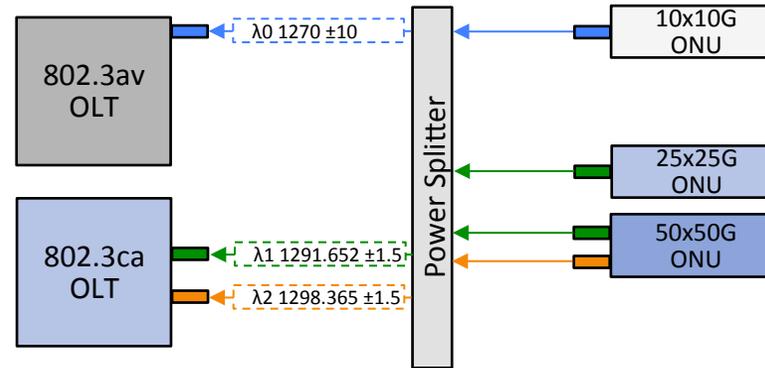
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WDM Deployment Scenario



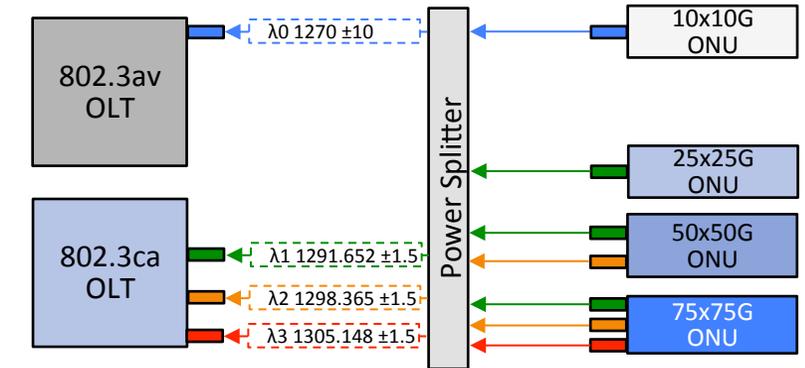
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WDM Deployment Scenario

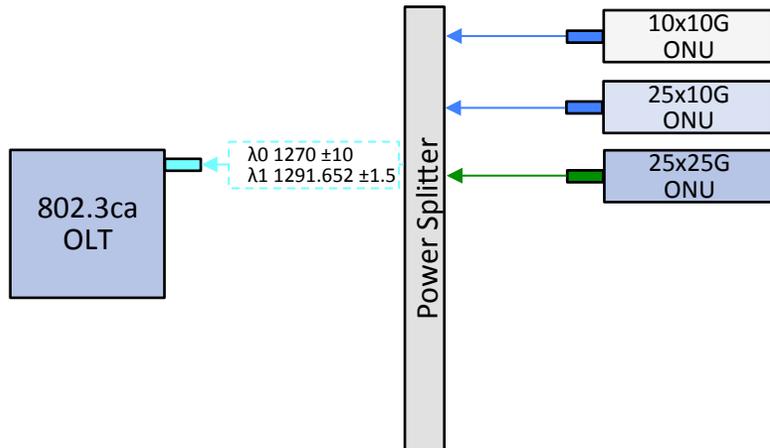


3rd Gen 802.3ca – 100G-EPON

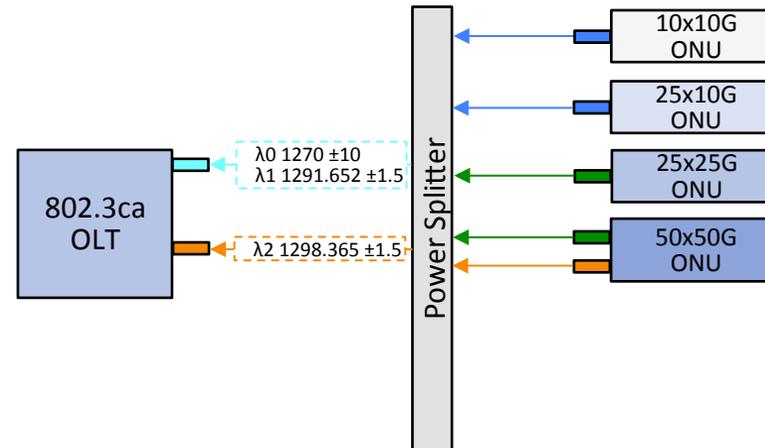
WDM Deployment Scenario



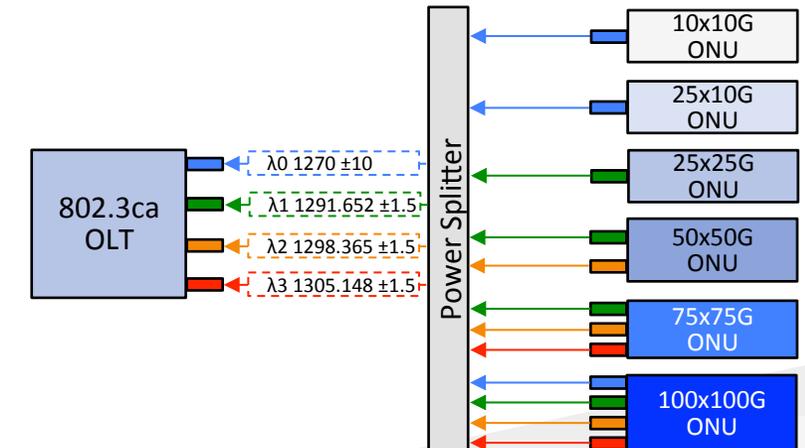
TDM Deployment Scenario



TDM Deployment Scenario



TDM Deployment Scenario



The Great Compromise Conclusions

1. **The Compromise Uses Plan B (Modified Plan B) while “also” supporting both TDM “and” WDM Coexistence**
2. **The Compromise takes the best attributes from both Plan A and Plan B optical plans:**
 - Enabled 25G x 25G capacity to be attained because there are no 10G ONUs sharing the wavelength
 - Allow for a delay in the use of those overlapping 802.3av/XGS lambdas until late in the 802.3ca deployment cycle e.g. when 100G ONUs are needed, and thus essentially the 802.3av wavelength could be the last one used
 - Enables four wide channel (3 nm) wavelengths and this means lower cost compared to narrow channels
 - Use of 802.3av upstream wavelength 1260-1280 allows the fewest wavelengths in the ZDW 1300-1324 nm region
3. **The Compromise Allows the 802.3ca Task Force to define support for both TDM and WDM to enable flexibility for operator use cases and deployment scenarios while keeping the permutations low for the industry**
 - WDM enables operators to keep legacy 10G OLTs deployed
 - TDM enables operators to keep 10G ONUs deployed while serving all customers from 802.3ca OLT
4. **The Compromise Supports Several Deployment Scenarios**
 - Option 1a:
 - WDM and TDM Scenarios use different upstream optics for 25x25G ONUs and 50x50G ONUs
 - Option 1 bifurcates both the 25x25G and 50x50G ONU market because the optics are different
 - Option 1 when TDM is deployed allows lambda 0 to be used for 10x10G, 25x10G, and 25x25G ONUs this should have positive benefits on ONU costs (Require removal of 10G OLTs)
 - Option 1 when WDM is chosen the forklift / removal of the 802.3av 10G OLTs may be delayed until 100G ONUs are deployed (that would use lambda 0)
 - Option 2a:
 - TDM Scenario has an option to use the same 25x25G “and” 50x50G ONUs as used in the WDM Scenario
 - TDM uses Wideband Rx “or” 2 channel Rx in 802.3ca OLT in 1st and 2nd Gen Deployments
 - Option 2 keeps the ONU market for 25x25G and 50x50G large because they are used in TDM or WDM Scenarios
 - Option 2 keeps the 10G ONU market alive by supporting 10x10 and 25x10 ONUs (10x10 ONUs used in TDM or WDM Scenarios)
 - Optional support for 75x75G ONUs was covered for TDM or WDM if desired by the Task Forces
5. **The Working Group Needs to Study the Deployment Scenarios and Options of the Compromise Proposal**

- **This contribution illustrates methods to support both TDM “and” WDM coexistence with 802.3av when using modified plan B optical plan as proposed by harstead_3ca_1_0117 as zhang_3ca_1_1116 Modified Plan B (1) or (2)**
- **This contribution shows different deployment scenarios that the task force could consider defining in the specification and/or allowing the market place to decide (Option 1a, 1b, 2a, and/or 2b)**
- **The 802.3ca Task Force should consider straw polls and motions for the following:**
 1. Adoption of Modified Plan B (1) or Modified Plan B (2)
 2. Adoption of both TDM and WDM coexistence methods with 802.3av
 3. Adoption of 802.3ca OLT optional use of a wideband receiver for λ_0 and λ_1
 4. Adoption of 802.3ca OLT optional use of dual receivers using λ_0 and λ_1
 5. Adoption of 802.3ca OLT optional use of a single interface with Tx 1577nm 802.3av 10G, Tx λ_0 802.3ca 25G, and Rx λ_0 of 10G or 25G using TDM operations
 6. Adoption of 802.3ca OLT optional use of a single interface with Tx 1577nm 802.3av 10G, Tx λ_0 802.3ca 25G, and use of dual receivers λ_0 and λ_1 for TDM operations
 7. Adoption of 802.3ca OLT optional use of a single interface with Tx 1577nm 802.3av 10G, Tx λ_0 802.3ca 25G, and use of dual receivers λ_0 10G and λ_1 25G WDM operations
 8. Adoption of 50G OLT and ONU alternative optical configuration
 9. Adoption of a 75G ONU optional deployment use case and let the market decide its viability
 10. Adoption of some or all of these deployment scenarios as use cases in the specification

Thank You
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