

Upstream wavelength plan comparison

- Ed Harstead
- March 2017

WDM co-existence plans

Plan A guo_3ca_1_0117

Convergence option #1 (guo_3ca_1_0317)

- WDM co-existence for 25G & 50G.
- TDM co-existence for 100G.





TDM co-existence plans

Plan B harstead_3ca_1_0117

Convergence option #2 (guo_3ca_1_0317)





Compromise TDM/WDM plan

- 25G on USO: TDM co-existence
- 25G on US1:
 - WDM co-existence for 25G.
 - TDM co-existence for 50G &100G.



(harstead_3ca_1_0317)

Comparison: all plans

Letter budgetMDM budgetMDM for 256, 500 DM for 1000.MDM for 256, 500 DM for 10000.MDM for 256, 500 DM for 10000.MDM f	Element		Plan A guo_3ca_1_0117	Convergence option #1	Plan B harstead_3ca_1_0117	Convergence option #2	Compromise plan	
S2S port budgeInder S/US gap (about 12 nm): 0.02 BadvantageIn onIn		Co-existence 10G EPON:	WDM	WDM for 25G, 50G. TDM for 100G.	TDM	TDM	WDM for 25G. TDM for 50G, 100G. (1290 nm ONU)	TDM (1270 nm ONU)
256 pointComport 25/10 or 10/10 ONUS: On less filter in OLT Stream in Stream additional DMC streams additional Streams additional Office StreamsIn onIn onIn onIn onIn on257 ONDSupport DG upstreams additional DG receiver and StreamsIn onIn onIn onIn onIn onIn onIn on260 CT StreamsSupport DG upstreams additional DG receiver and StreamsIn onIn onI	25G power budget	Wider DS/US gap (about 12 nm): 0-0.2 dB advantage	no	no	yes	yes	no	no
25/25 ONIPotential use of uncooled DML: 33% optics costs avingsnonoyesnonoyes25G 017isupport 10G upstream, additional 10G receiver and 1280/1290 nm filterince<	25G power budget	To support 25/10 or 10/10 ONUs: One less filter in OLT (upstream): 0.5 dB advantage	no	no	yes	yes	no	yes
2S OLTsupport 10G upstream, additional 10G receiver and support 10G upstream, additional 10G receiver and 	25/25 ONU	Potential use of uncooled DML: 33% optics cost savings	no	no	yes	no	no	yes
25/50/000 OLTSrequires multi rate receiver (implementation risk?)no1006 OL256, 506, 1006556, 1006256, 506, 10061006 ONIRelaxed wavelength tolerance (3 nm vs. 2 nm): 25%noyesyesyesyesyesyes1006 OLT1260-1280 receiver sensitivity (implementation risk?)noyesyesyesyesyesyesyes1006 OLT250 upstream capacity shared with 10G (1G)no1006256, 506, 1006, 1006256, 506, 1006, 1006256, 506,	25G OLT	to support 10G upstream, additional 10G receiver and 1280/1290 nm filter	yes	yes	no	no	yes	no
100G ONURelaxed wavelength tolerance (3 nm vs. 2 nm): 25% transmitter cost savingsnoyesyesyesyes100G OLT1260-1280 receiver sensitivity (implementation risk?)noyesyesyesyesyesCapacity25G upstream capacity shared with 10G (1G)no100G25G, 50G, 010G25G, 50G, 010G550G, 100G25G, 50G, 010G25G, 50G, 010G25G, 50G, 010G25G, 50G, 010G100GOperationsIn PONs with no 25/10 ONUs, allow separate 10G OLTAlso25G, 50G, 01Cnono25G, 50G, 01Cno100G25G, 50G, 01G100G25G, 50G, 01G100G25G, 50G, 01Gno25G, 50G, 01Gno100G25G, 50G, 01G100G100G25G, 50G, 01G100G<	25/50/100G OLTs	requires multi rate receiver (implementation risk?)	no	100G	25G, 50G, 100G	25G, 50G, 100G	50G, 100G	25G, 50G, 100G
100G OLT1260-1280 receiver sensitivity (implementation risk?)InnoInyesInyesInyesInyesInyesCapacity5G upstream capacity shared with 10G (1G)no100G25G, 50G, 100G25G, 50G, 100G50G, 100G25G, 50G, 100GOperationsIn PONs with no 25/10 ONUs, allow separate 10G OLT Operato <	100G ONU	Relaxed wavelength tolerance (3 nm vs. 2 nm): 25% transmitter cost savings	no	yes	yes	yes	yes	yes
CapacitySG upstream capacity shared with 10G (1G)In onIn onSG SG, SG, SG, SG, SG, SG, SG, SG, SG, S	100G OLT	1260-1280 receiver sensitivity (implementation risk?)	no	yes	yes	yes	yes	yes
OperationsIn PONs with no 25/10 ONUs, allow separate 10G OLTyes25G, 50G OLTno25G OLTnoAll25G co-existence with GPON (US 1290-1330 nm). Improves the probability of a converged wavelength plan with ITU-T, driving higher volumes on common optics for lower costsnoyesyesnoFutureLeaves some or all of 1260-1280 nm for future use (when no DG EPON co-existence requirement)allsomenosomenono	Capacity	25G upstream capacity shared with 10G (1G)	no	100G	25G, 50G, 100G	25G, 50G, 100G	50G, 100G	25G, 50G, 100G
All25G co-existence with GPON (US 1290-1330 nm). Improves the probability of a converged wavelength plan with ITU-T, driving higher volumes on common optics for lower costsnoyesnoyesFutureLeaves some or all of 1260-1280 nm for future use (when no 10G EPON co-existence requirement)allsomenosomenono	Operations	In PONs with no 25/10 ONUs, allow separate 10G OLT	yes	25G, 50G OLT	no	no	25G OLT	no
Future Leaves some or all of 1260-1280 nm for future use (when no 106 EPON co-existence requirement) all some no no no	All	25G co-existence with GPON (US 1290-1330 nm). Improves the probability of a converged wavelength plan with ITU-T, driving higher volumes on common optics for lower costs	no	no	yes	yes	no	yes
	Future	Leaves some or all of 1260-1280 nm for future use (when no 10G EPON co-existence requirement)	all	some	no	some	no	no

Comparison WDM co-existence plans

		Plan A guo_3ca_1_0117	Convergence option #1	Compromise plan	
Element	Co-existence 10G EPON:	WDM	WDM for 25G, 50G. TDM for 100G.	WDM for 25G. TDM for 50G, 100G. (1290 nm ONU)	
25G power budget	Wider DS/US gap (about 12 nm): 0-0.2 dB advantage	no	no	no	
25G power budget	To support 25/10 or 10/10 ONUs: One less filter in OLT (upstream): 0.5 dB advantage	no	no	no	
25/25 ONU	Potential use of uncooled DML: 33% optics cost savings	no	no	no	
25G OLT	to support 10G upstream, additional 10G receiver and 1280/1290 nm filter	yes	yes	yes	
25/50/100G OLTs	requires multi rate receiver (implementation risk?)	no	100G	50G, 100G	
100G ONU	Relaxed wavelength tolerance (3 nm vs. 2 nm): 25% transmitter cost savings	no	yes	yes	
100G OLT	1260-1280 receiver sensitivity (implementation risk?)	no	yes	yes	
Capacity	25G upstream capacity shared with 10G (1G)	no	100G	50G, 100G	
Operations	In PONs with no 25/10 ONUs, allow separate 10G OLT	yes	25G, 50G OLT	25G OLT	
All	25G co-existence with GPON (US 1290-1330 nm). Improves the probability of a converged wavelength plan with ITU-T, driving higher volumes on common optics for lower costs	no	no	no	
Future	Leaves some or all of 1260-1280 nm for future use (when no 10G EPON co-existence requirement)	all	some	no	

NOKIA

Comparison TDM co-existence plans

Element		Plan B harstead_3ca_1_0117	Convergence option #2	Compromise plan	
	Co-existence 10G EPON:	TDM	TDM	TDM (1270 nm ONU)	
25G power budget	Wider DS/US gap (about 12 nm): 0-0.2 dB advantage	yes	yes	no	
25G power budget	To support 25/10 or 10/10 ONUs: One less filter in OLT (upstream): 0.5 dB advantage	yes	yes	yes	
25/25 ONU	Potential use of uncooled DML: 33% optics cost savings	yes	no	yes	
25G OLT	to support 10G upstream, additional 10G receiver and 1280/1290 nm filter	no	no	no	
25/50/100G OLTs	requires multi rate receiver (implementation risk?)	25G, 50G, 100G	25G, 50G, 100G	25G, 50G, 100G	
100G ONU	Relaxed wavelength tolerance (3 nm vs. 2 nm): 25% transmitter cost savings	yes	yes	yes	
100G OLT	1260-1280 receiver sensitivity (implementation risk?)	yes	yes	yes	
Capacity	25G upstream capacity shared with 10G (1G)	25G, 50G, 100G	25G, 50G, 100G	25G, 50G, 100G	
Operations	In PONs with no 25/10 ONUs, allow separate 10G OLT	no	no	no	
All	25G co-existence with GPON (US 1290-1330 nm). Improves the probability of a converged wavelength plan with ITU-T, driving higher volumes on common optics for lower costs	yes	yes	yes	
Future	Leaves some or all of 1260-1280 nm for future use (when no 10G EPON co-existence requirement)	no	some	no	

NOKIA

Summary

- Upstream and downstream wavelength plans can be optimized separately
- Comparisons between (various) WDM co-existence and TDM co-existence upstream wavelength plans are presented
- The compromise TDM-WDM plan can support both the delineation of 10G/25G of WDM co-existence and the lower cost implementation of TDM co-existence.
- The compromise plan compares pretty favorably to pure WDM and pure TDM co-existence plans in each case

USO wavelength tolerance: 7 nm

- Proposed in zhang_3ca_1_0317 as a cost reduction: should be quantified
- It could It could apply to
 - Convergence option #1
 - Plan B
 - Convergence option #2
 - Compromise TDM/WDM plan
- Comparison:

USO wavelength tolerance					
Parameter	2-3 nm	7 nm	20 nm		-2
Uncooled DML?	No	No	possible		
25G ONU laser cost	Highest	Medium	Lowest		
SOA+PIN performed solution set of the set of	SOA+PIN performance relative to 2-3 nm (approximate)		-1.5 dB		bon



