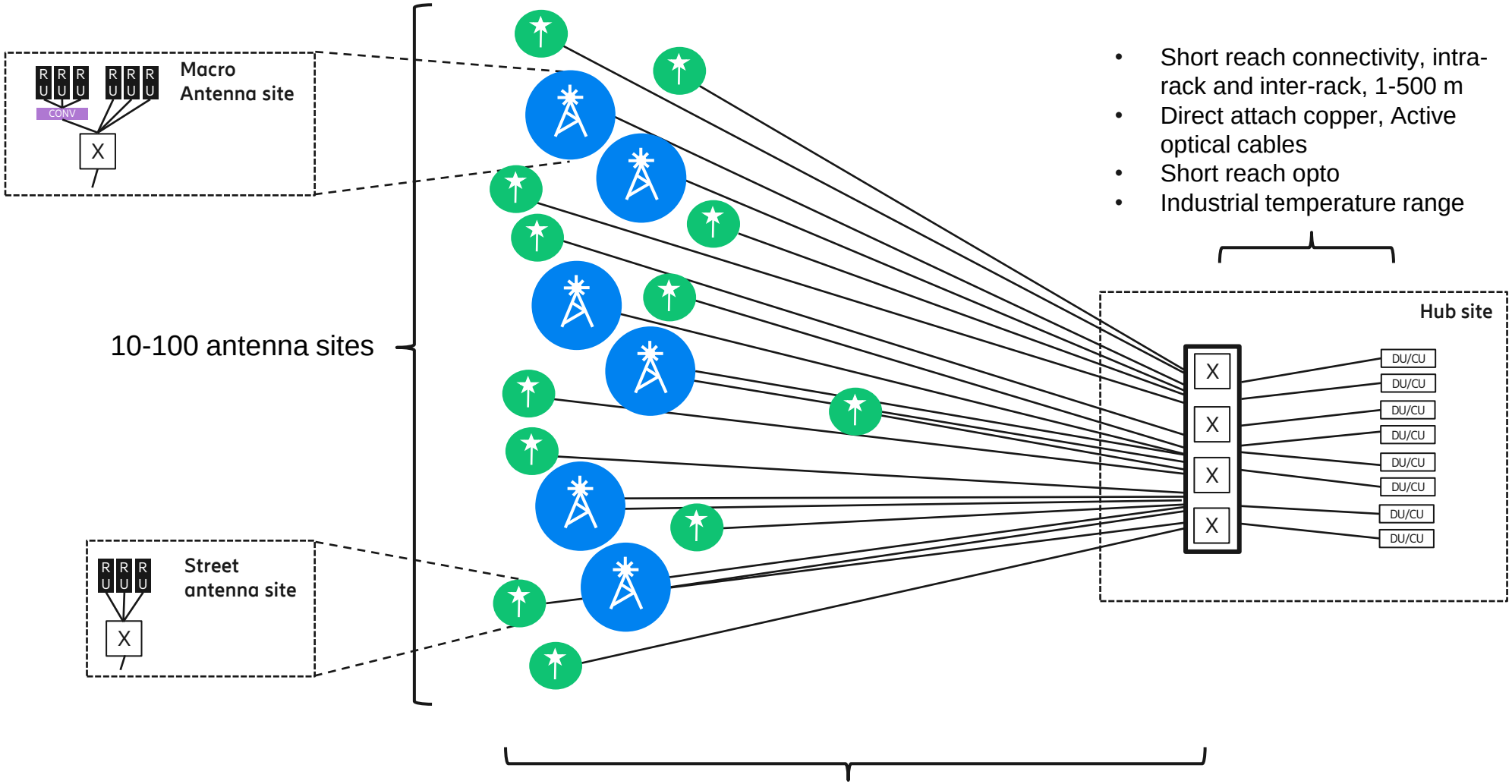
Consideration of a Auto Negotiation for Optical link training

Ulf Parkholm

Overview

- Presentation of current and future Central Ran deployment for mobile transport
- Considerations for Optical Auto Negotiation

CRAN network



- Short reach connectivity, intra-rack and inter-rack, 1-500 m
- Direct attach copper, Active optical cables
- Short reach opto
- Industrial temperature range

- 1-15 km fiber (possibly up to 30 km in the future)
- Fiber a scarce resource, use of BiDi likely
- 25G – 100G optical modules, even higher bandwidths in the future (50G-R1,100G-R1, 100G-R2, 200G-R4, 400G-R8 etc.)
- Industrial temperature range

Source:

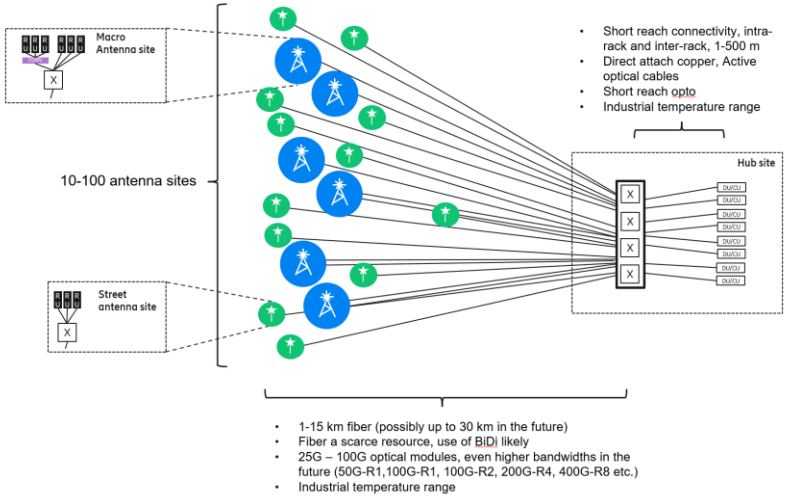
[Packet fronthaul design choices]

Baseband, Transport equipment and Radios, generations loosely corresponding with advances in Serdes and Optical technology advances

Brown field installation is the norm, maintaining generation interoperability is key

Due to the many times difficult installation locations, e.g. mast tops, roadless country. Zero touch installation of especially radio equipment is highly desired

A Baseband would be in control of handshaking the maximum needed bit rate to a specific site or Radio



Auto Negotiation

Background on Ethernet AN/LT

- **Ethernet AN/LT 1st developed in 10GBASE-KR project with link training in CL72 and Autoneg in CL73**
  - CL72/136/162 LT require the link to operate in point-point as two end stations
  - CL136/162 Control/status fields are transmitted with DME (Differential Manchester Encoding) at 1/8 the Baudrate followed by PRBS13Q as PAM4 training pattern
  - Proposed Optics-LT leverages CL136/162 training.

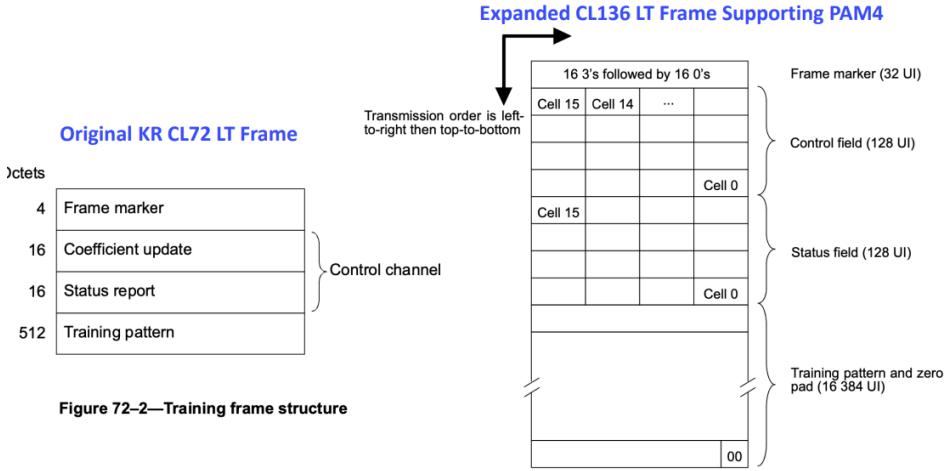
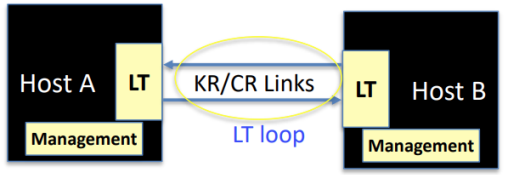


Figure 72–2—Training frame structure

Figure 136–3—Training frame structure



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Propose to further investigate adding not just Link training but also Auto Negotiation to optical links

Building upon the proven combination of Auto Neg / Link Training provided in an CR/KR setting

Table 73–2— DME page timing summary

	Parameter	Min.	Typ.	Max.	Units
T1	Transition position spacing (period)	3.2 –0.01%	3.2	3.2 +0.01%	ns
T2	Clock transition to clock transition	6.2	6.4	6.6	ns
T3	Clock transition to data transition (data = 1)	3.0	3.2	3.4	ns
T4	Transitions in a DME page	51	—	100	—
T5	DME page width	338.8	339.2	339.6	ns
T6	DME Manchester violation delimiter width	12.6	12.8	13.0	ns

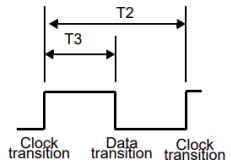

Figure 73–4—DME page transition timing

73.5.3.1 Manchester violation delimiter

A violation is signaled as shown in Figure 73–5.

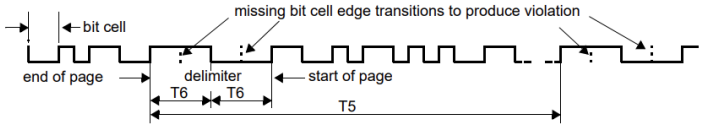

Figure 73–5—Manchester violation

- T1 through T6 update to reflect 1/8 of baud rate of 100Gbps or 1/16 at of 200Gbps
- To allow for a common AN across 100Gbps and 200Gbps

Table 73–4—Technology Ability Field encoding

Bit	Technology
…	
A15	200GBASE-KR4 or 200GBASE-CR4
A16	100GBASE-KR1 or 100GBASE-CR1
A17	200GBASE-KR2 or 200GBASE-CR2
A18	400GBASE-KR4 or 400GBASE-CR4
~~A16~~A19 through A21~~A22~~	Reserved

Option: Reinterpret existing technology in an optical context

Option: Add new Technology applicable to Optical technology

Optics Link Training to Manage FEC and Pre-coder Modes

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- **Managing inner FEC on/off has been hot topic since adoption of motion #9 in July with the task force exploring all options dambrosia_3dj_optx_01a_230829**
- **Options for managing FEC modes and pre-coder on/off**
  - Option-I Manually configuring both modules into inner FEC on/off and manage precoder on/off
  - Option-II Mechanisam based on parallel detect (receiver would toggles between Inner FEC on/off) and manually mange pre-coder on/off
    - Define a CMIS register "InnerFECoff" where either host A or B may request Inner FEC On/Off
    - Remote module would have to have capability for parallel detect turn inner FEC on/off
    - If after X amount of time inner FEC is not turned off then local module will go back to inner FEC mode
    - For any reason (may include unacceptable FLR or corrected FEC code words) either hosts may remove the inner FEC Off capability
  - Option-III Based on proven DME link training in CL136/162
    - Provides a nicer method for inner FEC control - Required for DJ to make progress
    - Provides a method for pre-coder on/off – Required for DJ to make progress
    - Optics link training – The DME method can also provide optics LT if we want to take advantage of it now or in future (powerful tool that require time to fully develop) – Is it needed for DJ PMDs?

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- Option-IV Based on proven DME Auto Negotiation in CL 136/162
  Provides a future proof method for negotiation of parameters such including iFEC control but not limited to

How to Leverage Ethernet LT for FEC Modes and Optics Training

- **This proposal defines mechanisam for inner FEC/pre-coder control and Optics-LT on a single optical segment based on 802.3 CL136/162**
  - Proposal makes minor modification to CL136/162 to support Optics-LT by segmenting optical link as another CR/KR point-point link
    - Approach keeps the current CR/KR adaptation model where receiver control the transmitter FFE taps or presets
  - Proposal assumes 100G/200G C2M-AUI links maybe get trained either by in-band/out-band method
  - Optics DME/training can be driven by recovered clock from the host or the module reference clock
  - After the optical link is trained (inner FEC on/off, pre-coder on/off, or transmit tuning) CDR/DSP in the module switches to mission/pass-through mode.

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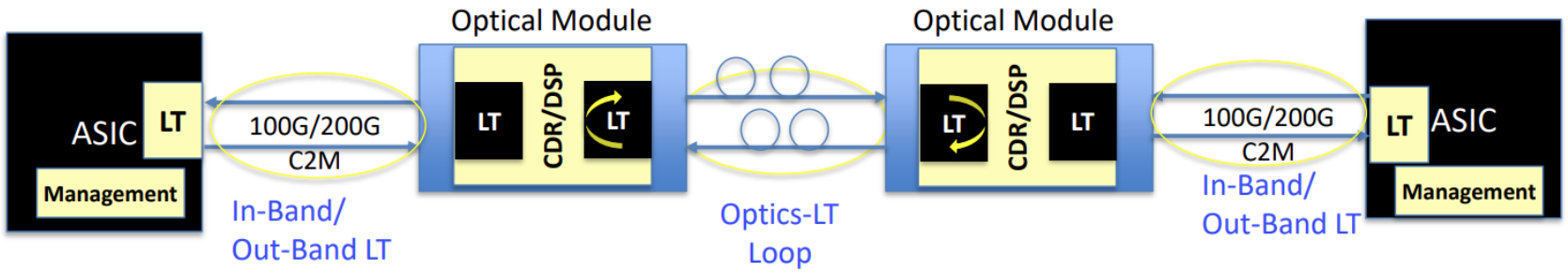

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- Auto Negotiation following the same concept as presented in, ghiasi_3dj_01a_2309, supporting Optics-AN by segmenting the optical link as another CR/KR poit-to-point link

- Building upon the proven CR/KR standard Ethernet technology of Auto negotiation
  - Future proof method to allow for additional information to be negotiated between peer-ends, both applicable for host's and Optics
  - Minimizes manual configuration errors
  - Adds another tool in the toolbox to debug falling links
    - Error visibility and isolation, in between the Optical and PCS/MAC link up indication

THANKS