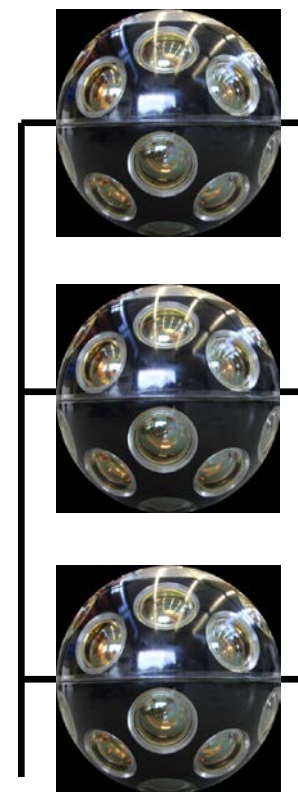
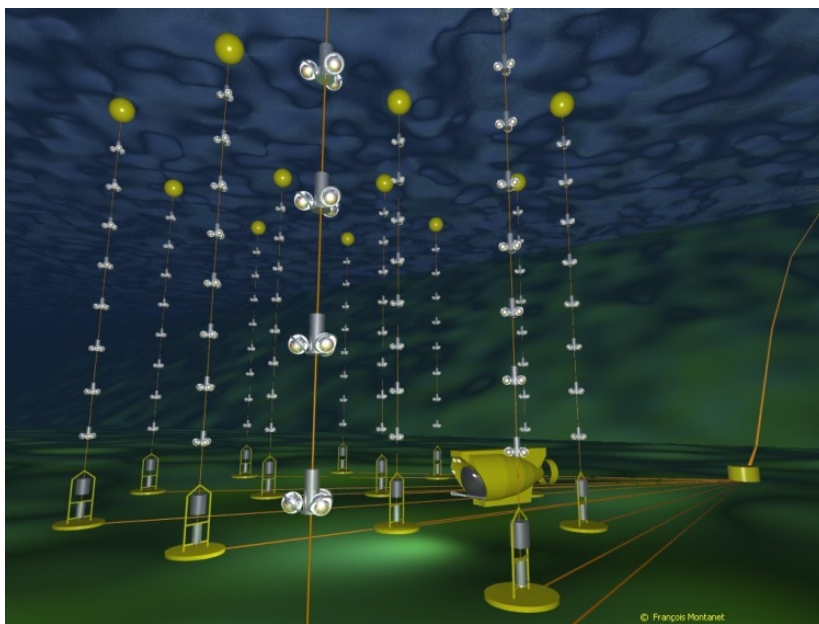




# PPM-DU:

## A three DOM Detection Unit in place of an Antares line



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by Jan-Willem Schmelling on behalf of the optical team.

# Contents.

- Optical network for PPM-DU
- Optical network for PPM-DOM vs PPM-DU vs phase I
- Current status
- Planning
- Conclusions
- Questions?

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# PPM-DOM > PPM-DU upgrade.

## Problem:

- PPM-DOM architecture was not build to accommodate 3 DOMS. Not possible to upgrade because of Saklay absence.

## Solution:

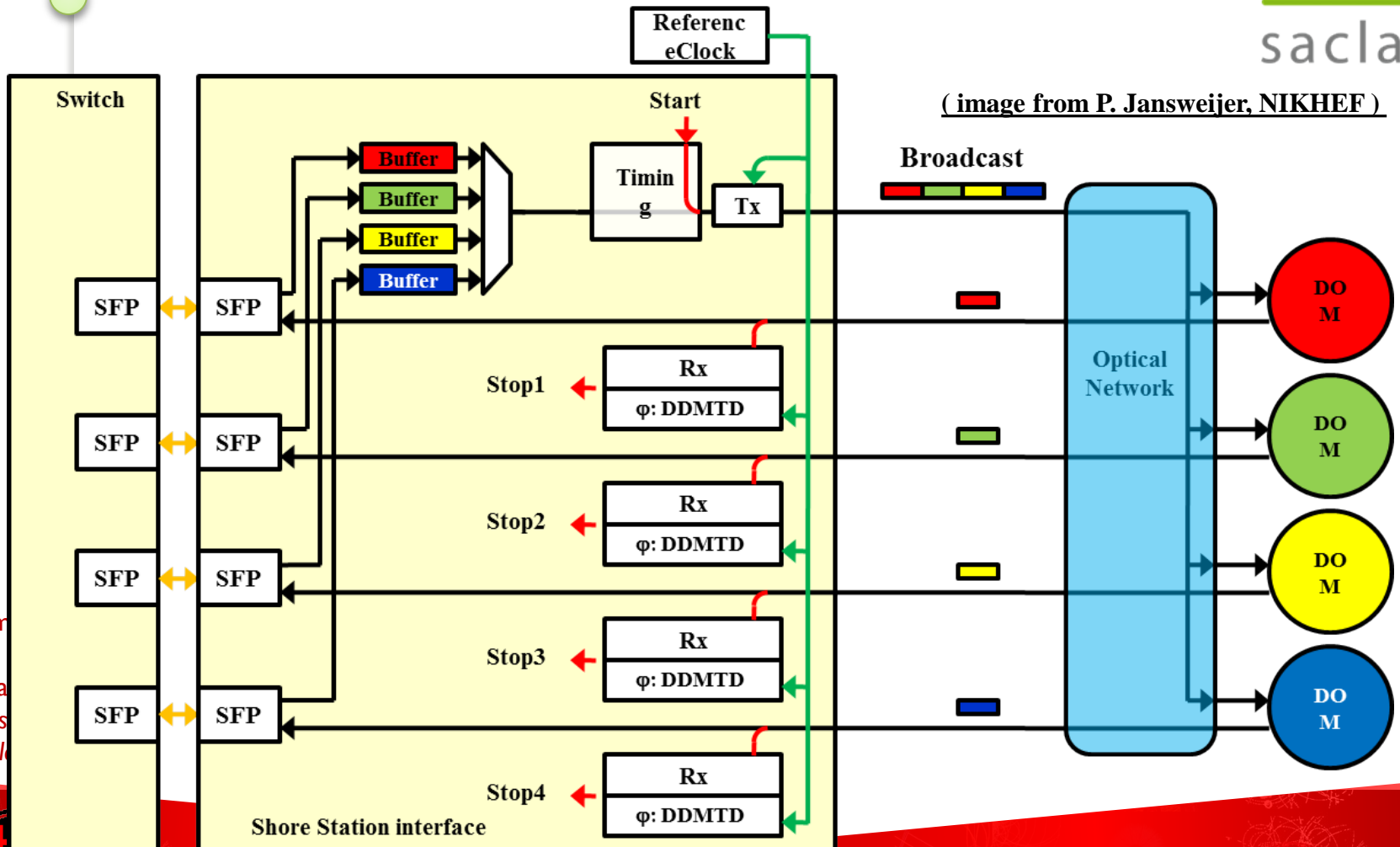
- Triple all the parts needed for dedicated DOM communication. In downstream and upstream direction.

## Result:

- Three PPM-DOM electrical shore stations,
- A dedicated optical shore station providing three channels.
- A optical network with very few similarities with the phase-1 network.

# Progress on BROADCAST for PPM-DU until December 2012

- IRFU Saclay : Yassir MOUDDEN, Frédéric CHATEAU, Frédéric LOUIS, Eric ZONCA, Hervé LE PROVOST, Bertrand VALLAGE, Shebli ANVAR
- University of Athens : Konstantinos MANOLOPOULOS



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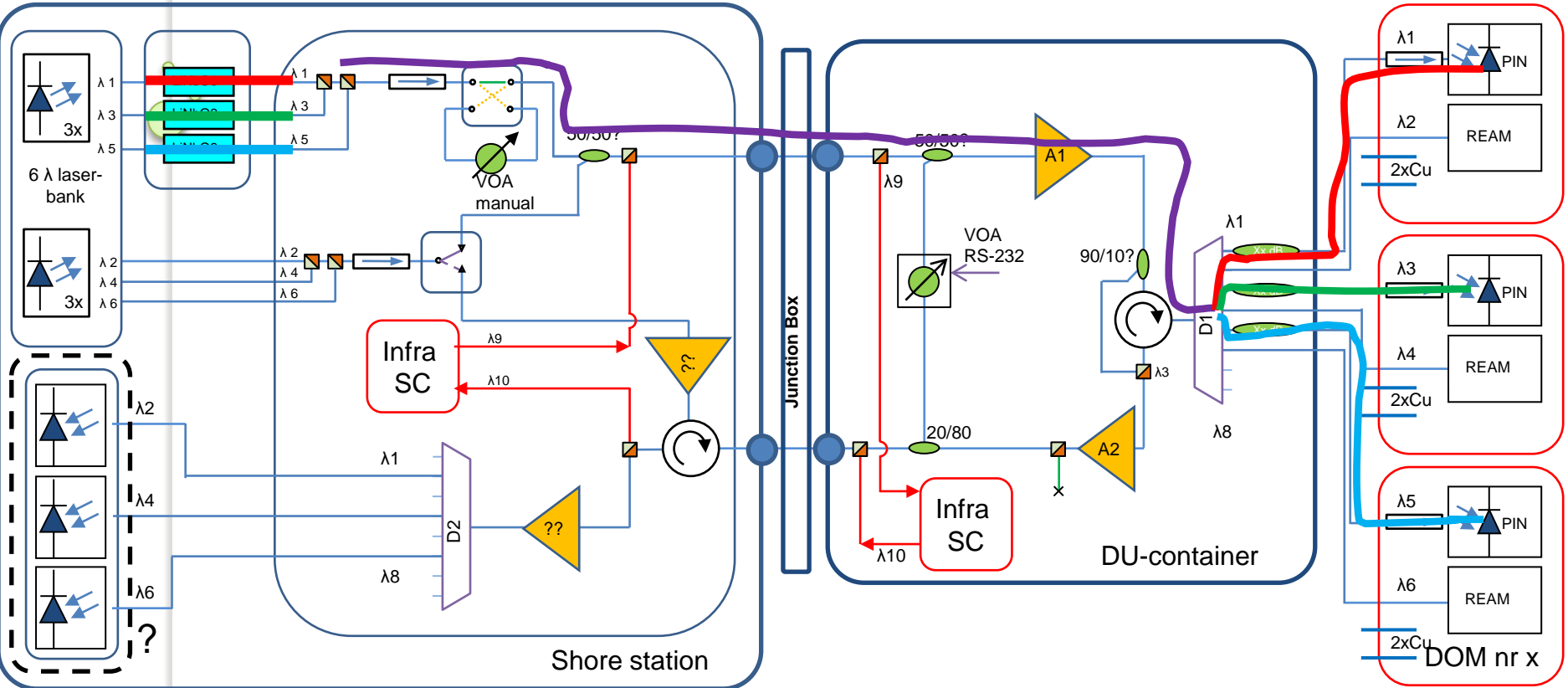
# Three DOM Slow Control distribution.

DOM Slow control distribution features:

- A point to point optical path to each DOM instead of one common path.
- Two fibers to each DOM.
- Each DOM is receiving two wavelengths: 1 for SC and 1 for DATA.
- Three modulators for Slow Control to each DOM individually.
- An extra attenuation is needed to protect the DOM PIN-diode.

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# Three DOM Slow Control distribution.



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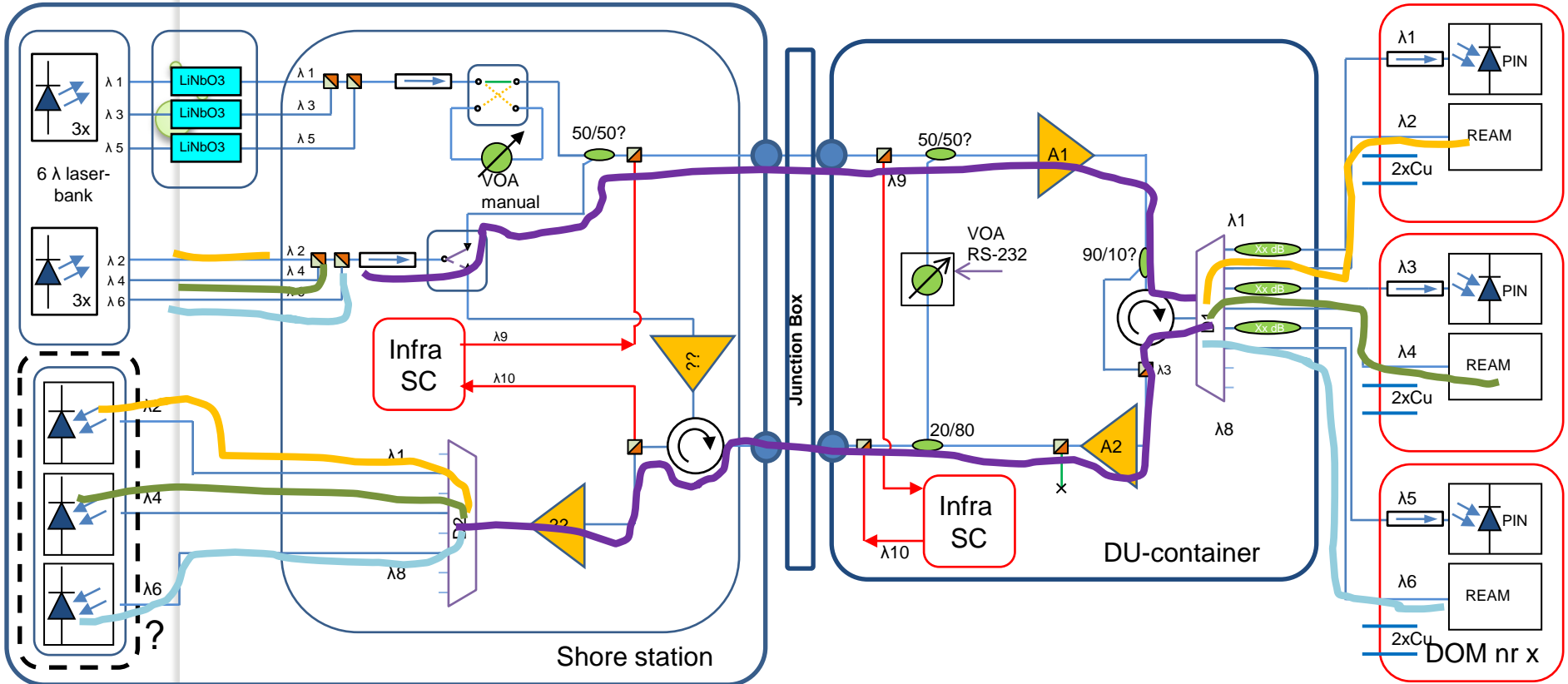
# Three DOM data upstream.

DOM upstream path features:

- A point to point optical path from each DOM to shore, similar to phase 1
- Each DOM is receiving two wavelengths: 1 for SC and 1 for DATA.
- In the DU container the functionality for the optical timing remains.

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# Three DOM data upstream.



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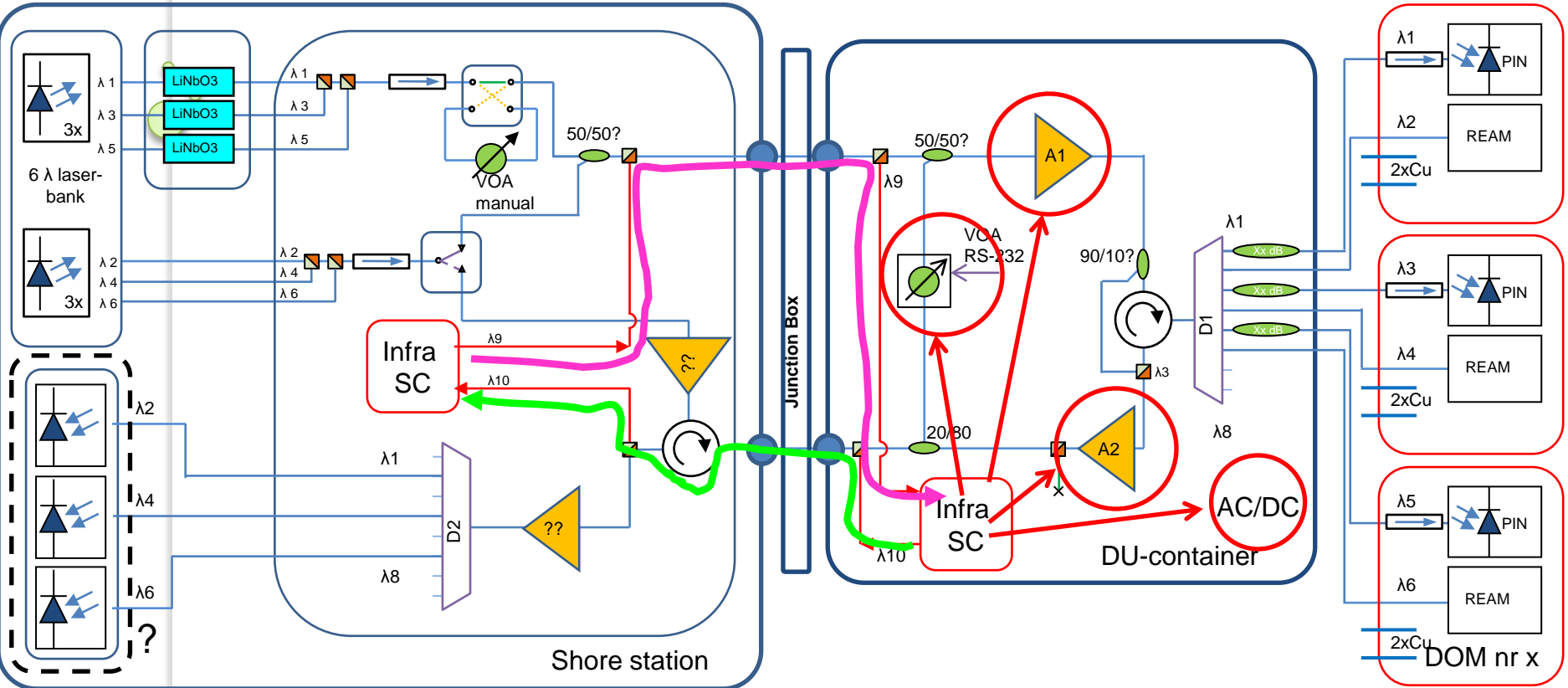
# Infrastructure Slow Control.

Infrastructure Slow Control features:

- Dedicated control channel for infrastructure control Tx and Rx.
- Independent of the items it does control (no EDFA deadlock).
- Full control of EDFA's.
- Full monitoring features of AC/DC converter possible.
- Variable Optical Attenuator (VOA) control for timing activation or calibration.
- Based on off-the-shelf components.
- As much as possible Ethernet based (no manpower for building dedicated electronics).
- Components are NOT suitable for phase-1, i.e. lifetime  $\ll 15$  years, power consumption and reliability.

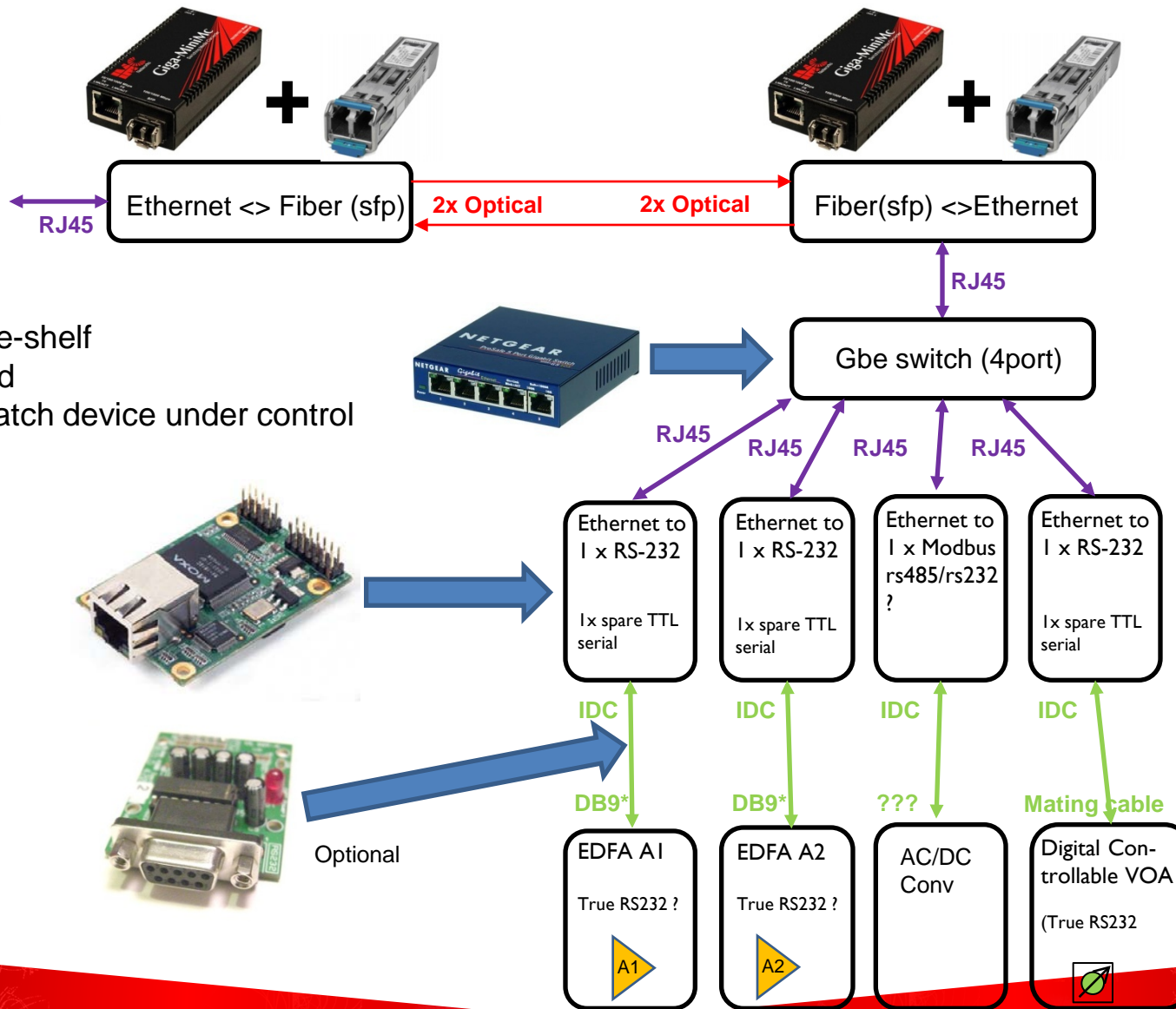
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# Infrastructure Slow Control.



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# Infrastructure Slow Control.



- All parts off-the-shelf
- Ethernet based
- Interface to match device under control

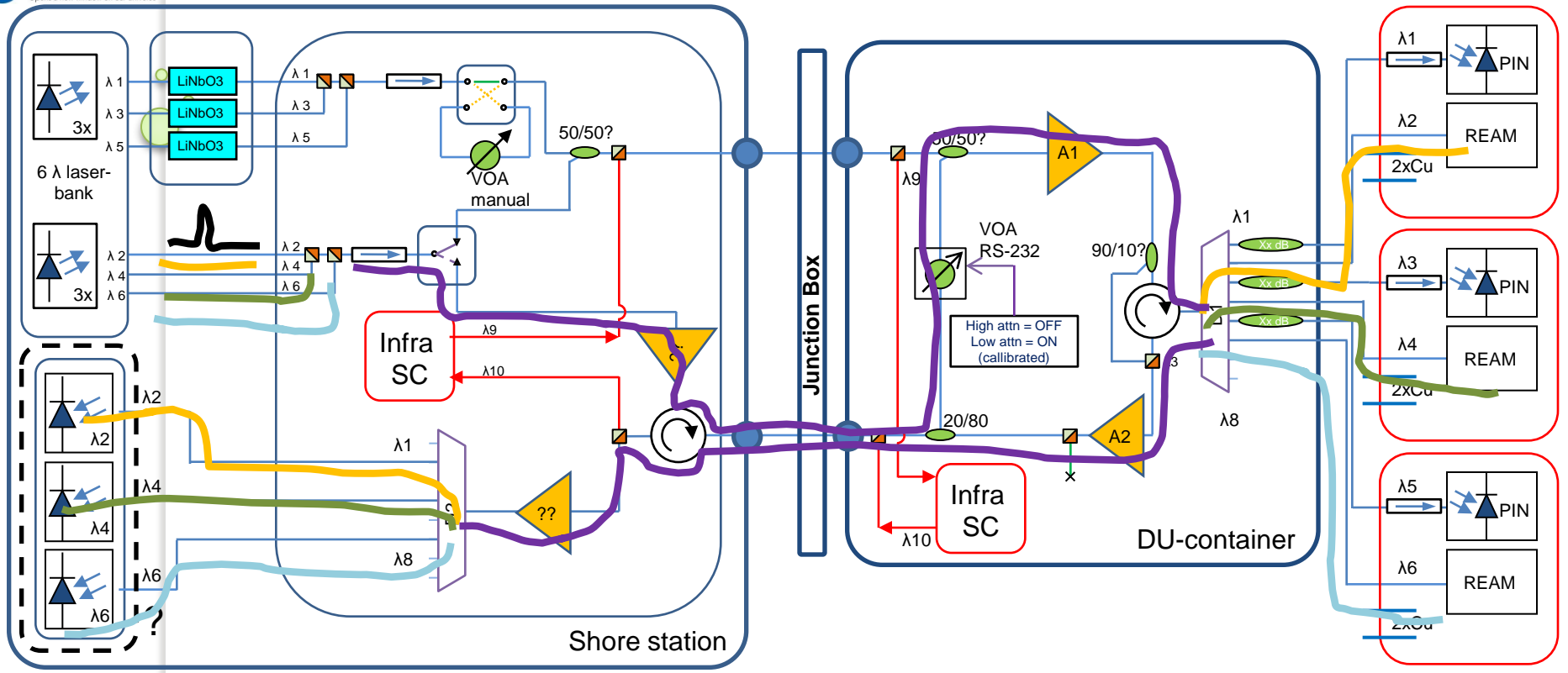
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# Optical time calibration.

## Optical time calibration

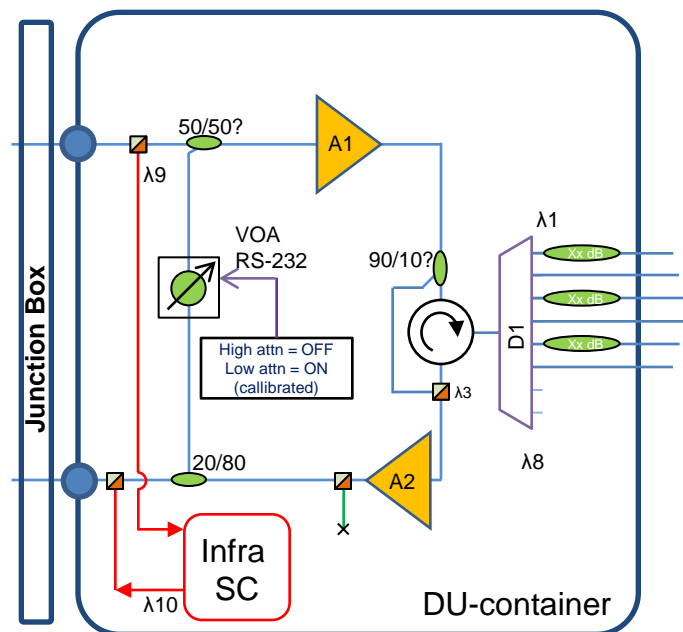
- The initial optical time calibration concept for PPM-DOM worked in lab, no in-situ.
- Currently less priority to develop a new/modified approach because we lack manpower and time in the planning.
- The distance between the three DOMs is known > less need for optical time calibration because the roundtrip timing does work.
- Sub sea parts still provides timing calibration feature based on the PPM-DOM concept
- Optical power level tuning > digital VOA
  - Tuning necessary to balance the wavelengths for the EDFA.
  - The fixed attenuation as in de PPM-DOM did not work, adjustment is needed.
- No timing pulse modulator for shore station.  
(can be swapped/borrowed from PPM-DOM?)

# Optical time calibration.



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# DU-container.



## DU-container

- No OFM (Optical Fanout Module) available in VEOC.
- VEOC connected to DU-container using a penetrator.
- All the hardware in container at the bottom of the DU.
- Based on Antares design where possible
- Cooling of EDFA's and infrastructure SC should be taken care of.

# PPM-DOM vs PPM-DU vs Phase-I

|                         | PPM-DOM | PPM-DU | Phase-I |
|-------------------------|---------|--------|---------|
| Nr of DOMs              | 1       | 3      | Lot's   |
| SC/broadcast feature    | no      | no     | yes     |
| Nr of ch per EDFA/fiber | 2       | 6      | 40/80?  |
| Input Fibers per DOM    | 2       | 2      | 1       |
| Bi-directional part     | no      | no     | yes     |
| Optical timing          | no      | maybe  | needed  |
|                         |         |        |         |

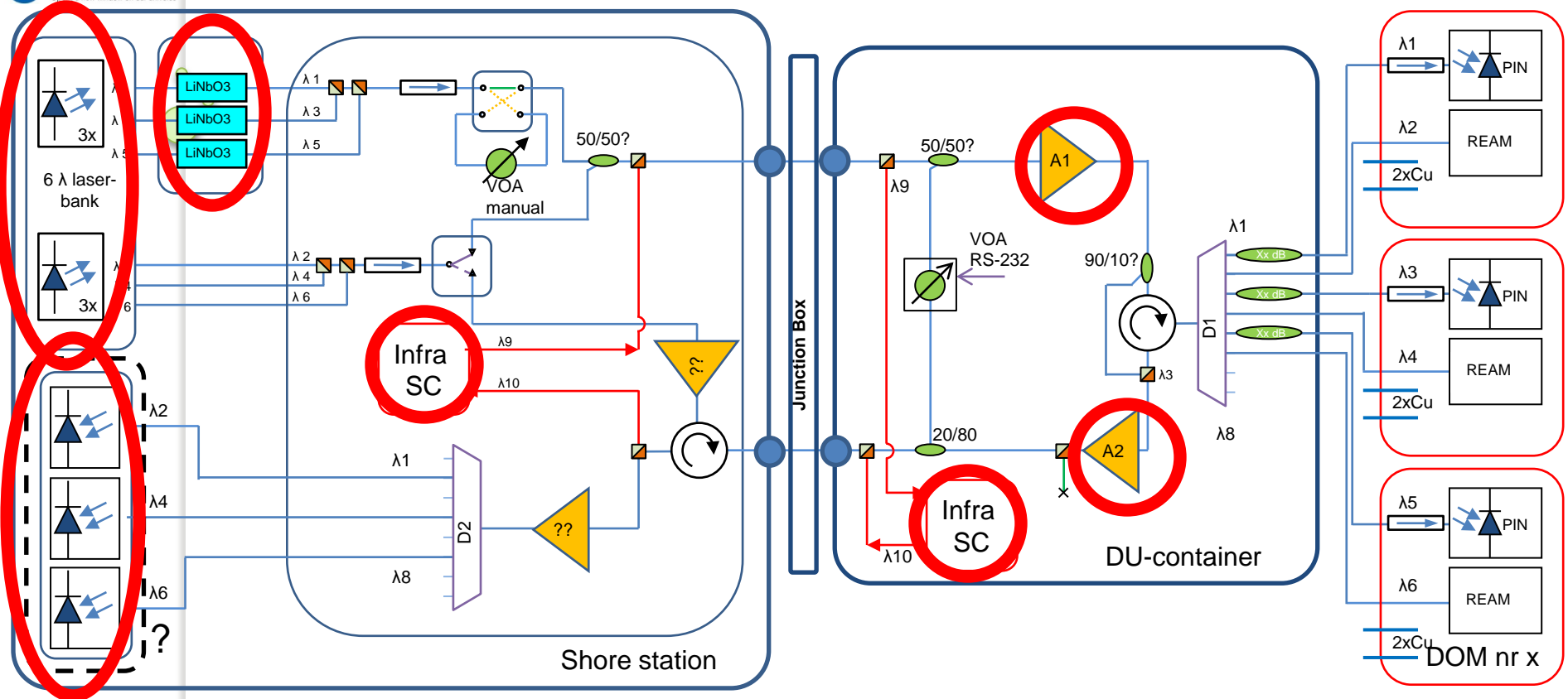
**Red is not tested/verified!**

# PPM-DU Component availability.

|   | Location  | Available?              |
|---|-----------|-------------------------|
| All passive optics                                | Shore+sea | Yes                     |
| Digital Variable Optical Attenuator (VOA)         | sea       | yes                     |
| Optical switches shore station                    | shore     | Yes                     |
| Infrastructure Slow Control parts(electrical)     | sea       | Yes                     |
| Long distance SFP modules for infra. Slow control | Shore+sea | <b>Exp wk 5 2013</b>    |
| 6 channel laser source                            | Shore     | <b>Exp wk 6 2013</b>    |
| 3 channel optical receiver stage                  | Shore     | <b>Exp wk 10 2013</b>   |
| 1 channel Optical modulator stage                 | Shore     | <b>Exp wk 13 2013</b>   |
| 3 channel optical modulator stage                 | shore     | <b>Lead time 12 wks</b> |
| Optical amplifiers (EDFA)                         | sea       | <b>Exp wk 7 2013</b>    |
| DOM optics (PIN-diode + REAM)                     | sea       | Yes                     |



# PPM-DU Component availability.



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# Planning for PPM-DU optics.

|   |           |
|---|-----------|
| Basic DOM readout via optical interface (not PPM-DU optical network).     | DONE      |
| Start building the full optical test bench for PPM-DU                     | Early Feb |
| Evaluate the modulator option for 3 ch (test 1 modulator)*                | Early Feb |
| Test the infrastructure slow control setup                                | DONE      |
| Implement the infrastructure slow control in full PPM-DU network test bed | End March |
| PPM-DU optical test bed ready for three DOM tests*                        | End April |

\*The 1 channel modulator needs to be tested before the upgrade to a 3 ch optical modulator stage can be started. This date strongly depends on the test outcome and the lead time of the modulators.

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# Conclusions.

- PPM-DU optical network is defined and accepted.
- A solution for the SC/broadcast distribution has been found > results in a delay in the planning.
- Power supply for three DOMS based on Antares power system
- A infrastructure slow control system with more features will be implemented
- Infrastructure slow control based on Ethernet off-the-shelf components with limited lifetime  $\ll 15$  years.
- PPM network has few similarities with KM3NeT phase-I.
- As a result of manpower and planning the optical time calibration is put on low priority.
- Lead times of optical components are long (10-12 weeks)

# The END.

- Questions?



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