

ODN Densification: The *Way Forward*

- **Cloud-On-The Ground With Total Fiber Visibility**
- **Safe, Easy Access In ISP, OSP, Data Center**
- **Horizontal and Vertical Integration of Passive/Active/Connectivity Devices**
- **Comprehensive Layer 0/1 solution for both wireless and wireline infrastructure**

*Re-imagining Today's Optical Networks Infrastructure
For Customers Quality Assurance and Management*

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INFRA

HET KENNISEVENT OVER COMPUTERRUIMTES, DATACENTERS EN CLOUD COMPUTING



2021

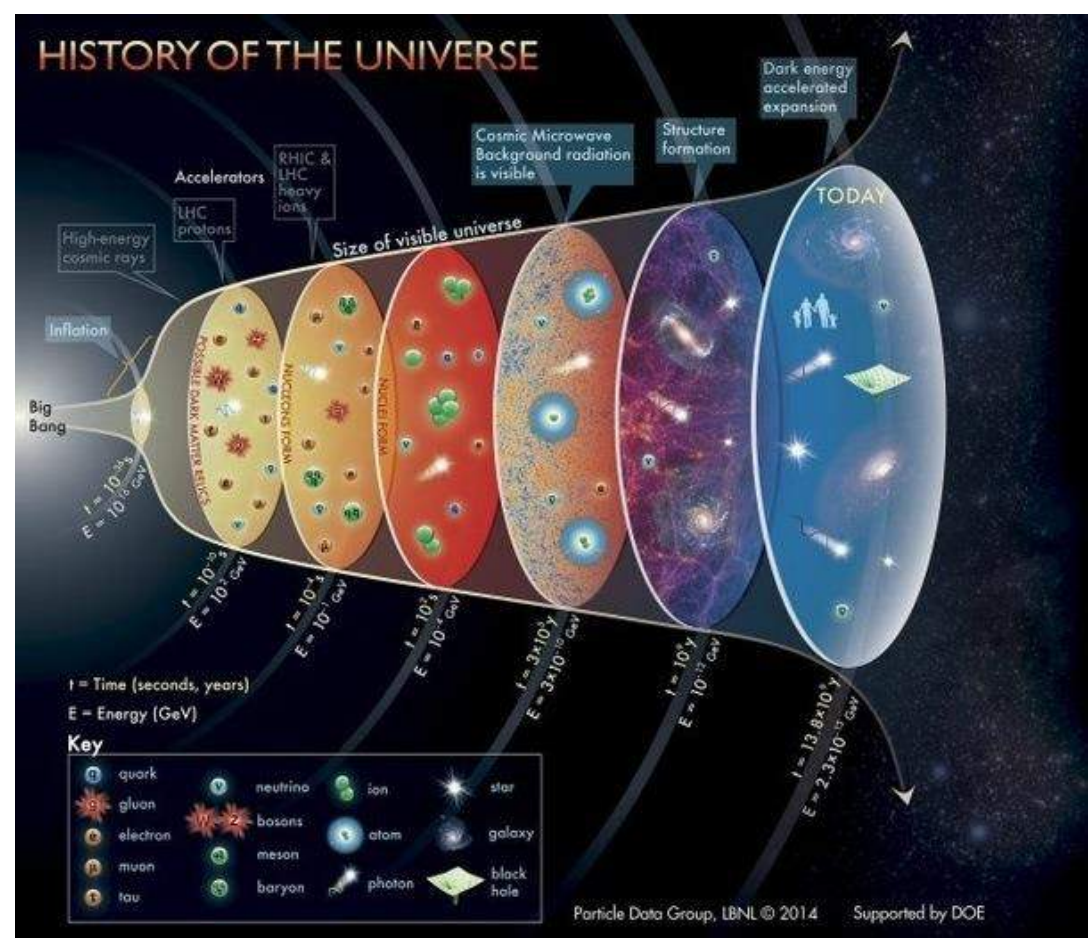
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1931 Congrescentrum | 's-Hertogenbosch

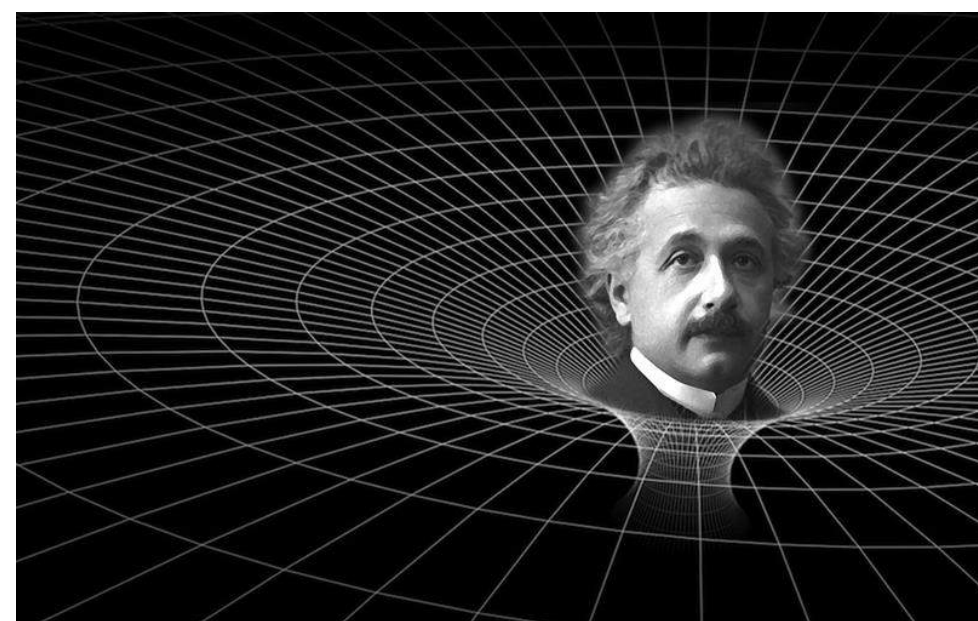
Agenda

- *Introduction: Finding Inspiration Everywhere*
- *Nature: Our Lead Engineering Effort*
- *Channeling Euclid and Mandelbrot: Network Layer-0/1 Basic Geometry*
- *In the field: High Density Fiber Management System*
- *In the field: Any Density Fiber Management System*
- *In the field: OSP Terminal*
- *NEW: Layer-0/1 Intelligence/Total Fiber Visibility For The ODN*
- *Summary*

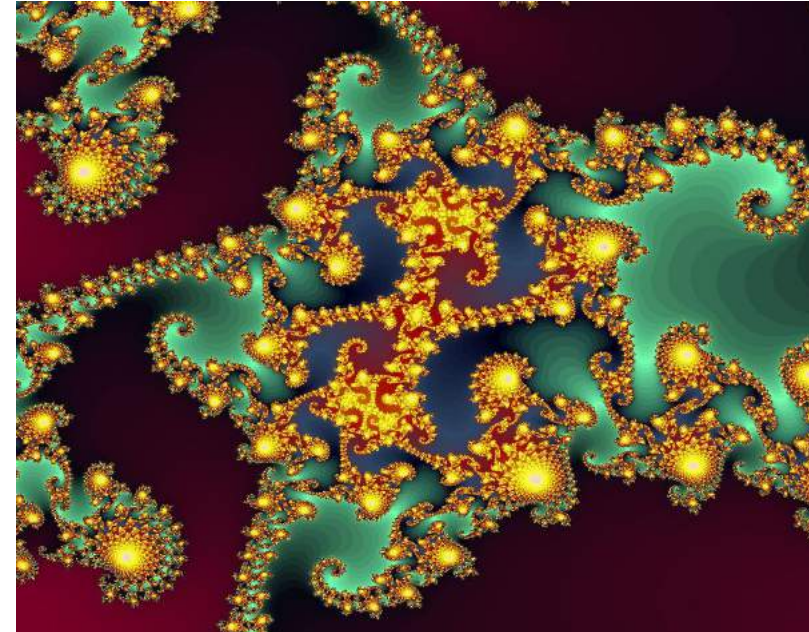




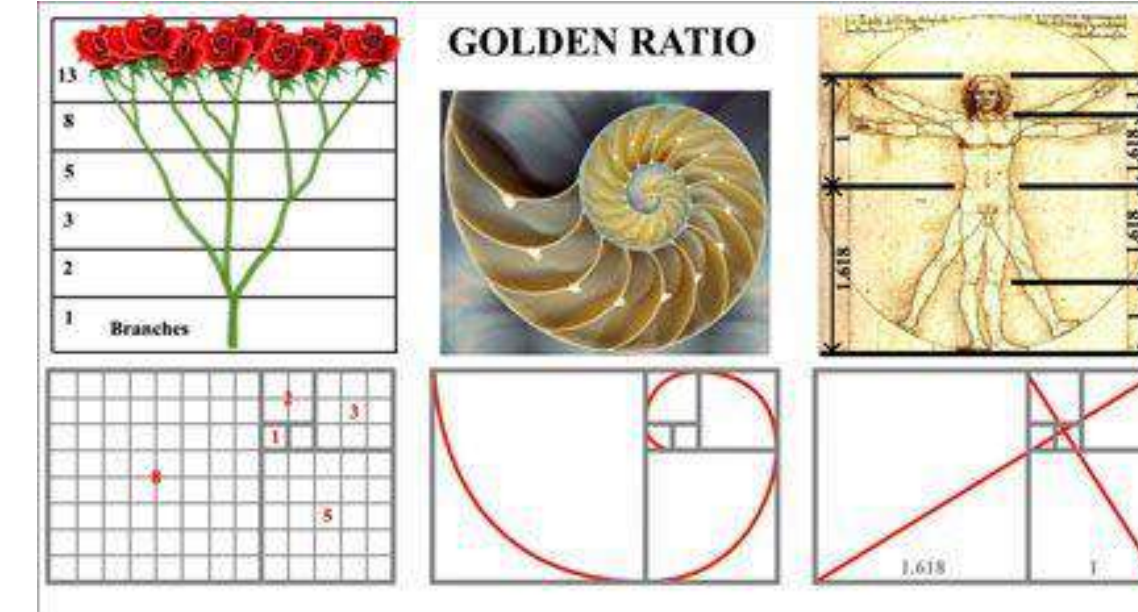
Big Bang Evolution



General Relativity



Fractal Geometry



Fibonacci Golden Rule

OE Signaling

OE Signaling

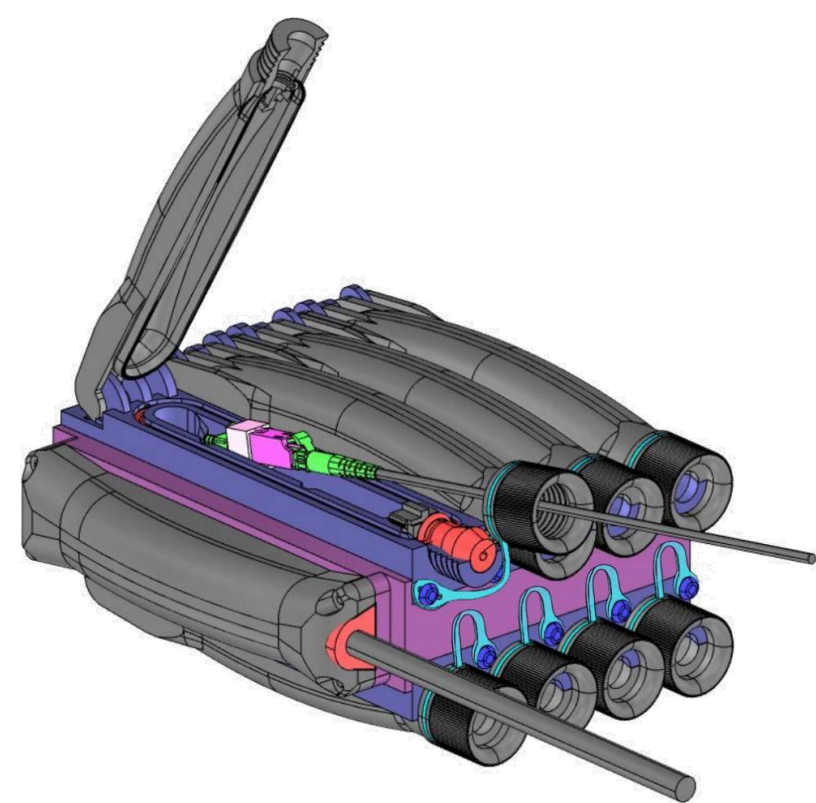
OE Signaling

OE Signaling

**ISP/OSP for Cloud on the Ground
A.I. and Great Civilization**



Peacock Geometry



Shell Geometry



User friendly Geometry

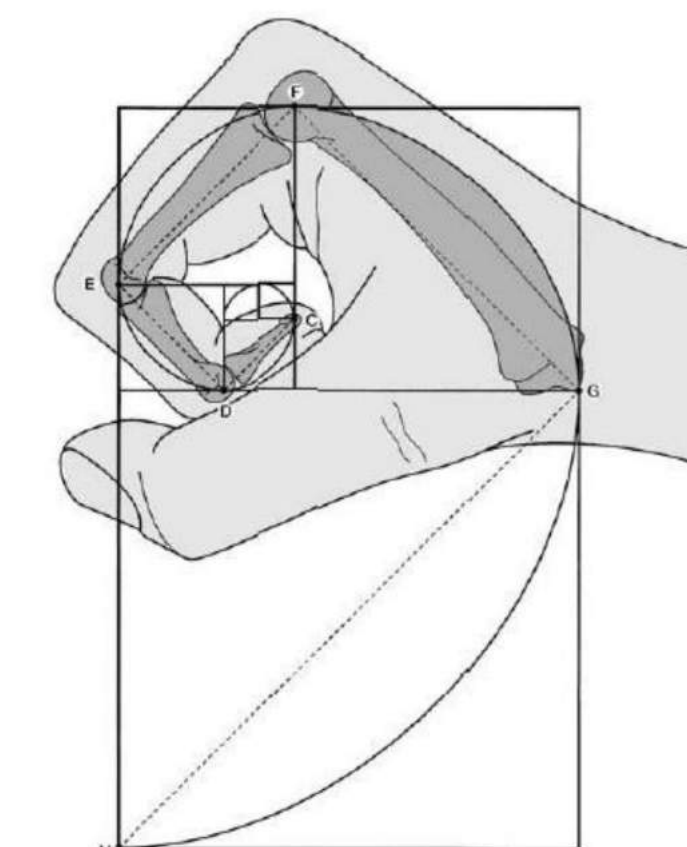
Introduction to PEACOC High Density Patch Panel



Features:

- Up to 144 LC connectors per 1RU (6 cassettes/modules of 24 LC)
- Unparalleled accessibility using PEACOC spreadable adapter technology
- Craft friendly design – even for “large hand” technicians
- Access to both front and rear side LC connectors at the same time
- Scalable in increments of 1RU for true “pay-as-you-grow” convenience
- Can be bundled in 2RU and 4RU sizes for even higher fiber count applications
- Pre-stubbed versions available
- Tested by Telcordia for compliance with GR-449 Issue 3, GR63 and Verizon TPR.9464 standards

Technology Evolution for High Density Panel



Human Hand Geometry

Nature: Our Lead Engineering Effort

By observing the natural world, we initiate the act of invention with the process of discovery

The solutions are everywhere around us just waiting to be revealed

***Why are we using nature's beauty to advance our technology?
Answer: It leads to a true space and time "geodesic"***

Platform with **E**nhanced **A**ccess for **C**ompact **O**ptical **C**onnectors
High Density Fiber Management System

Golden Ratio = Golden Mean = Divine Proportion

$\frac{.618..}{1} = \frac{1}{1.618..} = \frac{1.618..}{2.618..}$

$\frac{ab}{bc} = \frac{bc}{ac}$

$\frac{ab}{bd} = \frac{bd}{ad} = \frac{bc}{ac}$

$\frac{.618}{1.618}$

Fingers are in Golden Ratio Proportion

(“Da-vine”-Divine)

Fibonacci Series
1, 2, 3, 5, 8, 13, 21, 34, ...

Phylotaxis

Pyramid

Golden Rectangle nested inside Hexagon

3 Golden Rectangles nest inside Icosahedron

Architecture

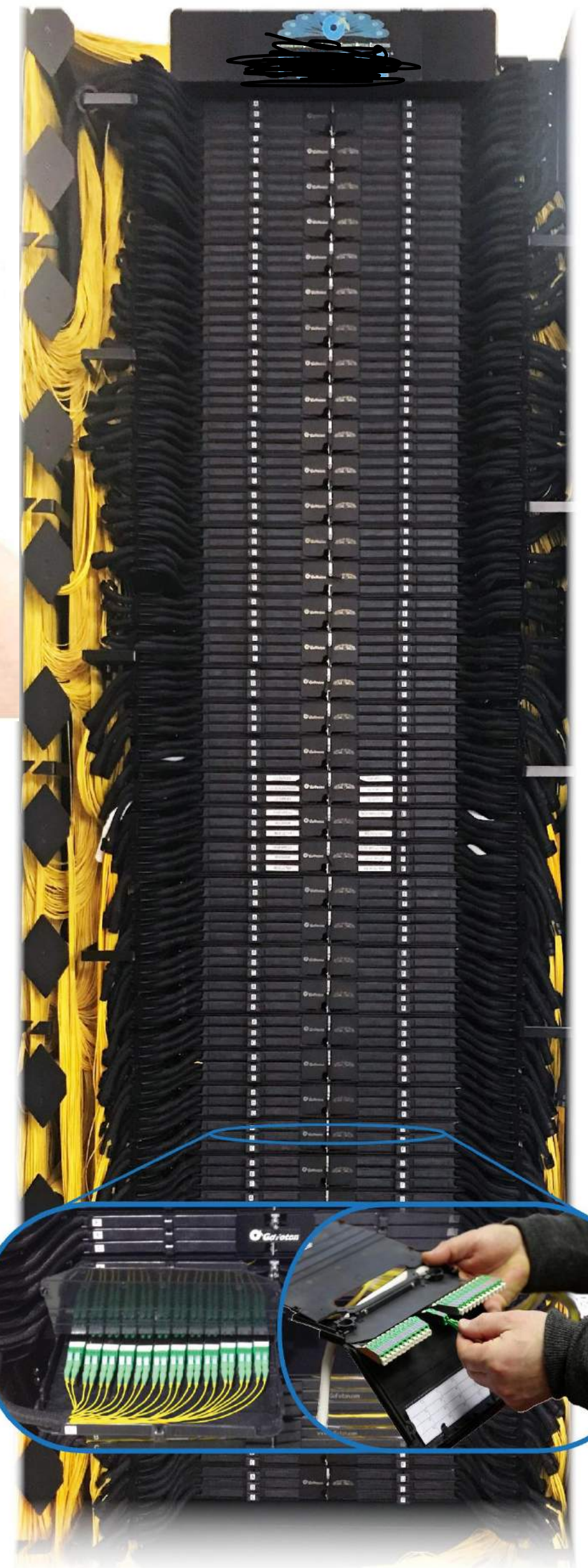
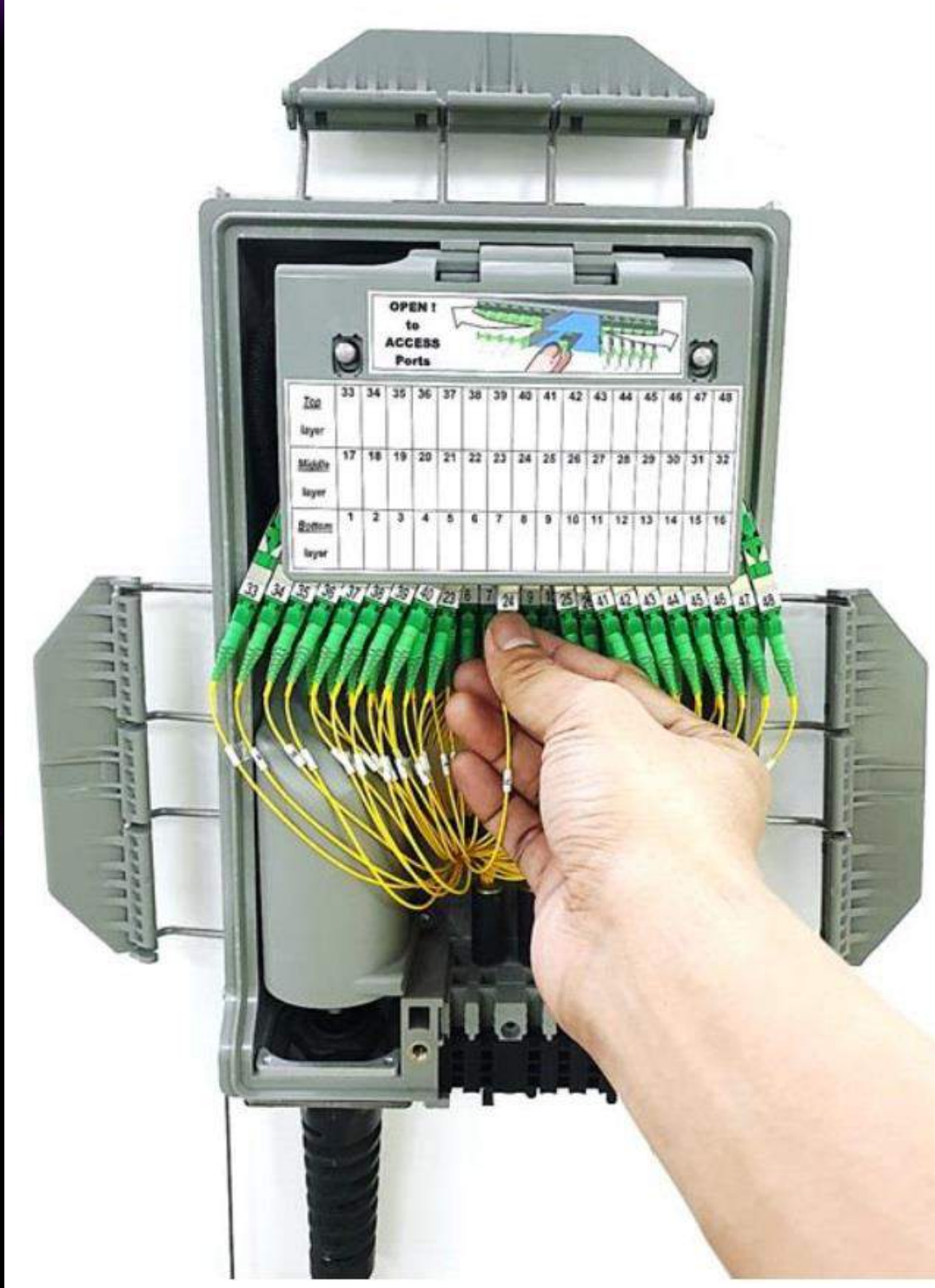
Art

Spiral Nebulae

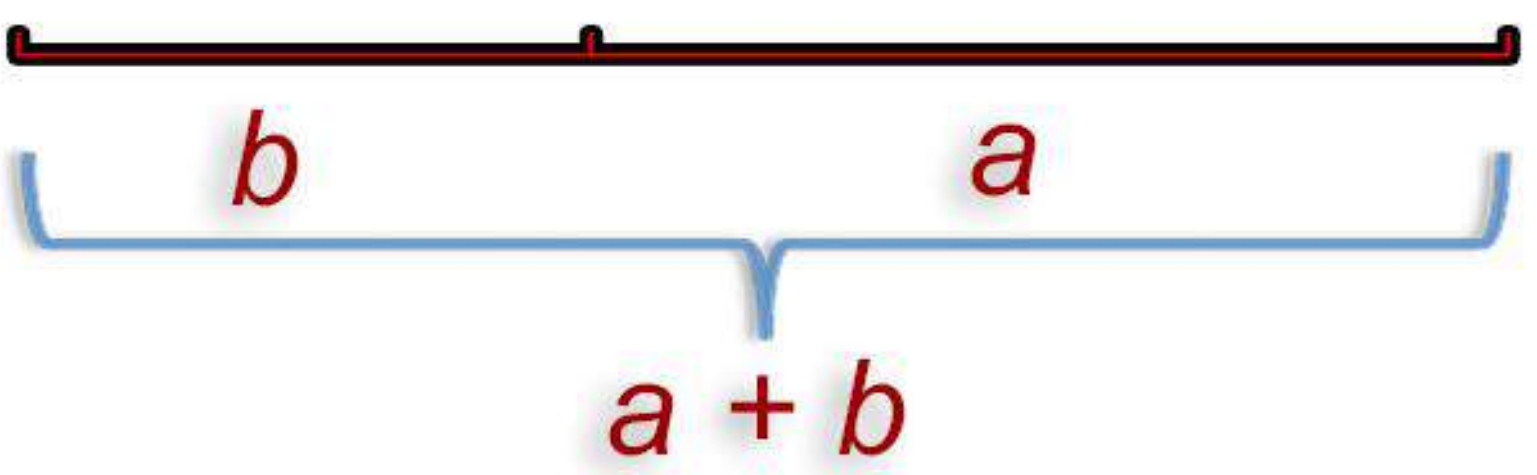
Nautilus Shell

Pine Cone

©John Fornuzzi



$a/b = (a+b)/a = 1.618.....$

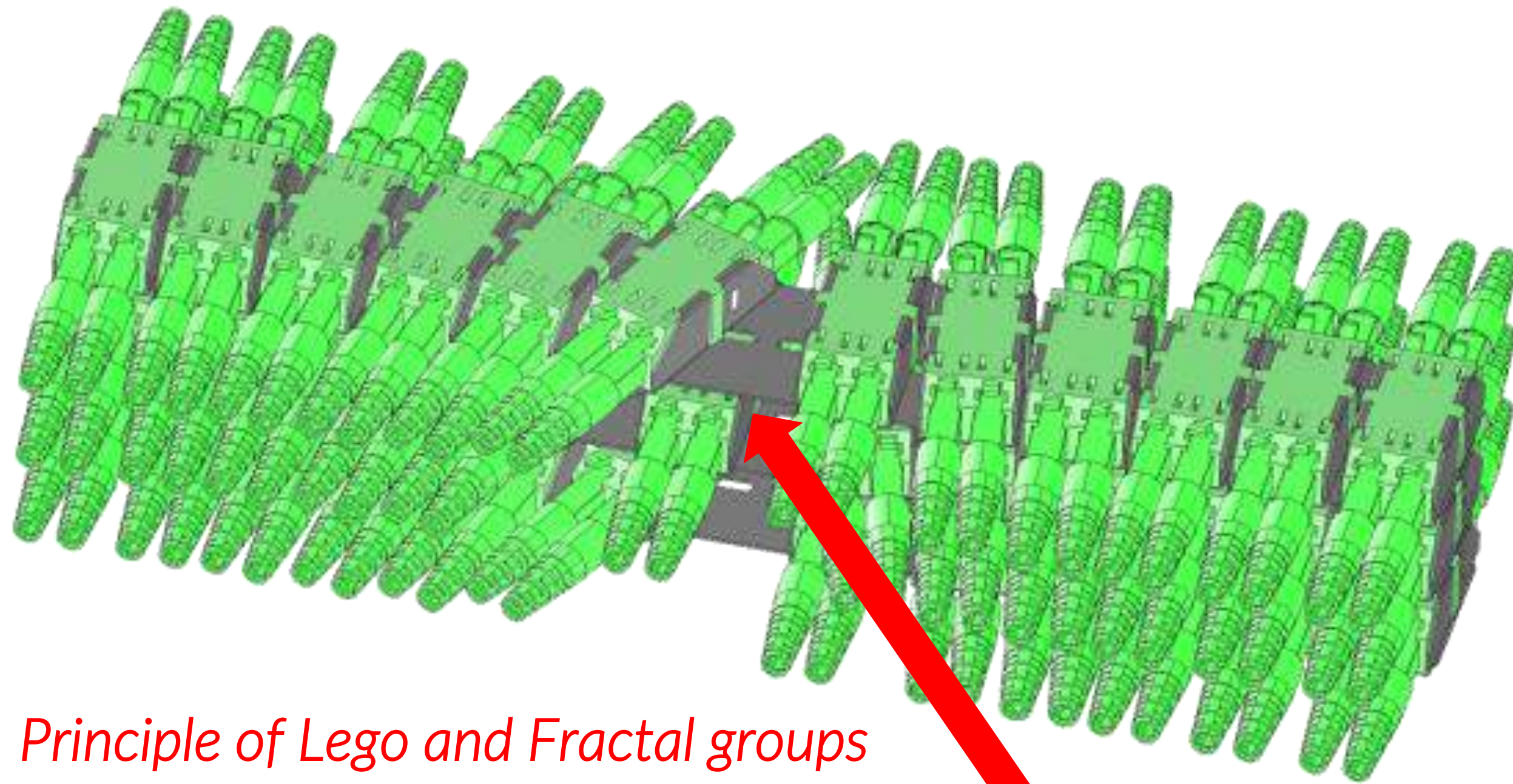


Platform with **Enhanced Access**
for **Compact Optical Connectors**
Technology development and evolution

Network Enhanced Manageable Optics
Any Density Fiber Management System



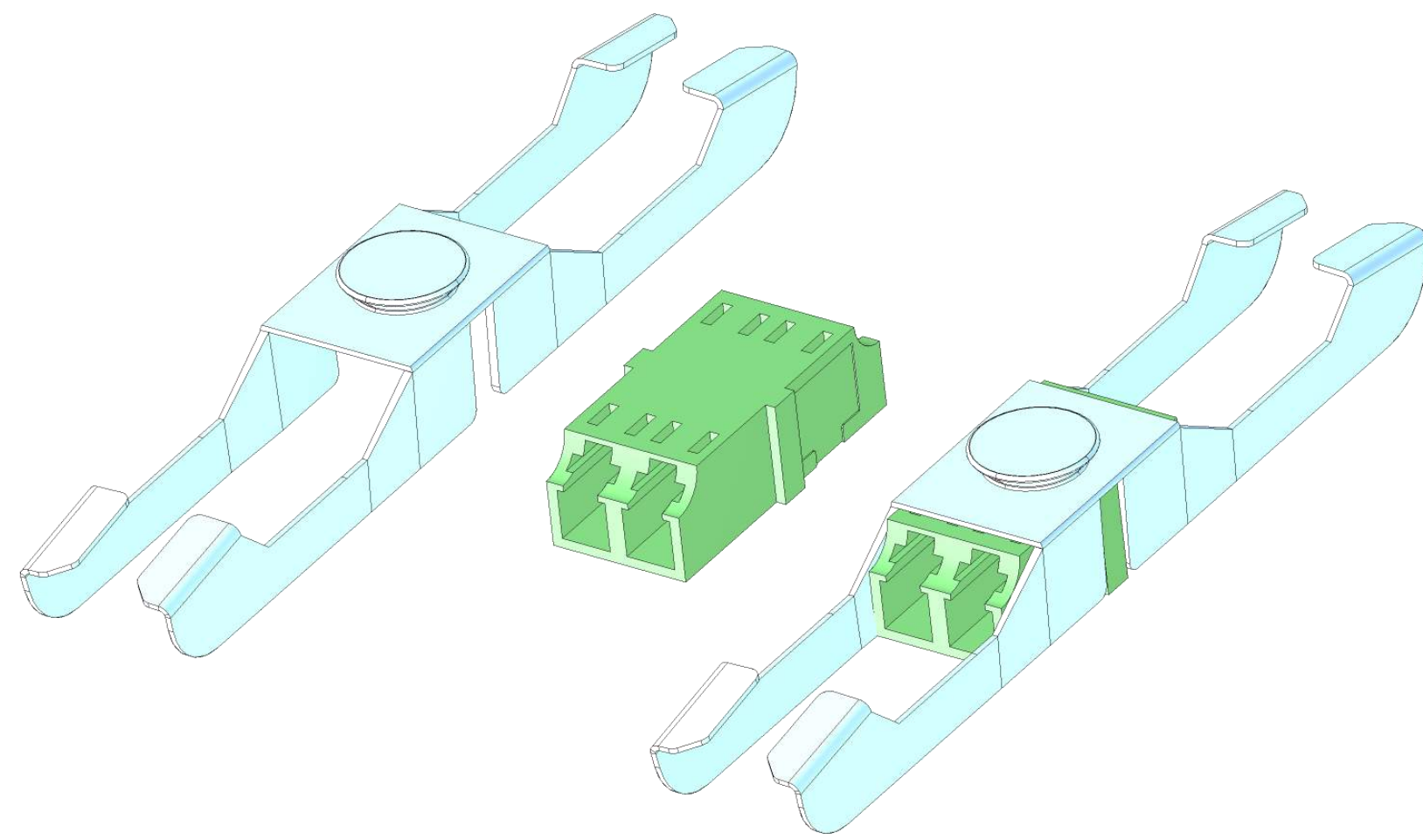
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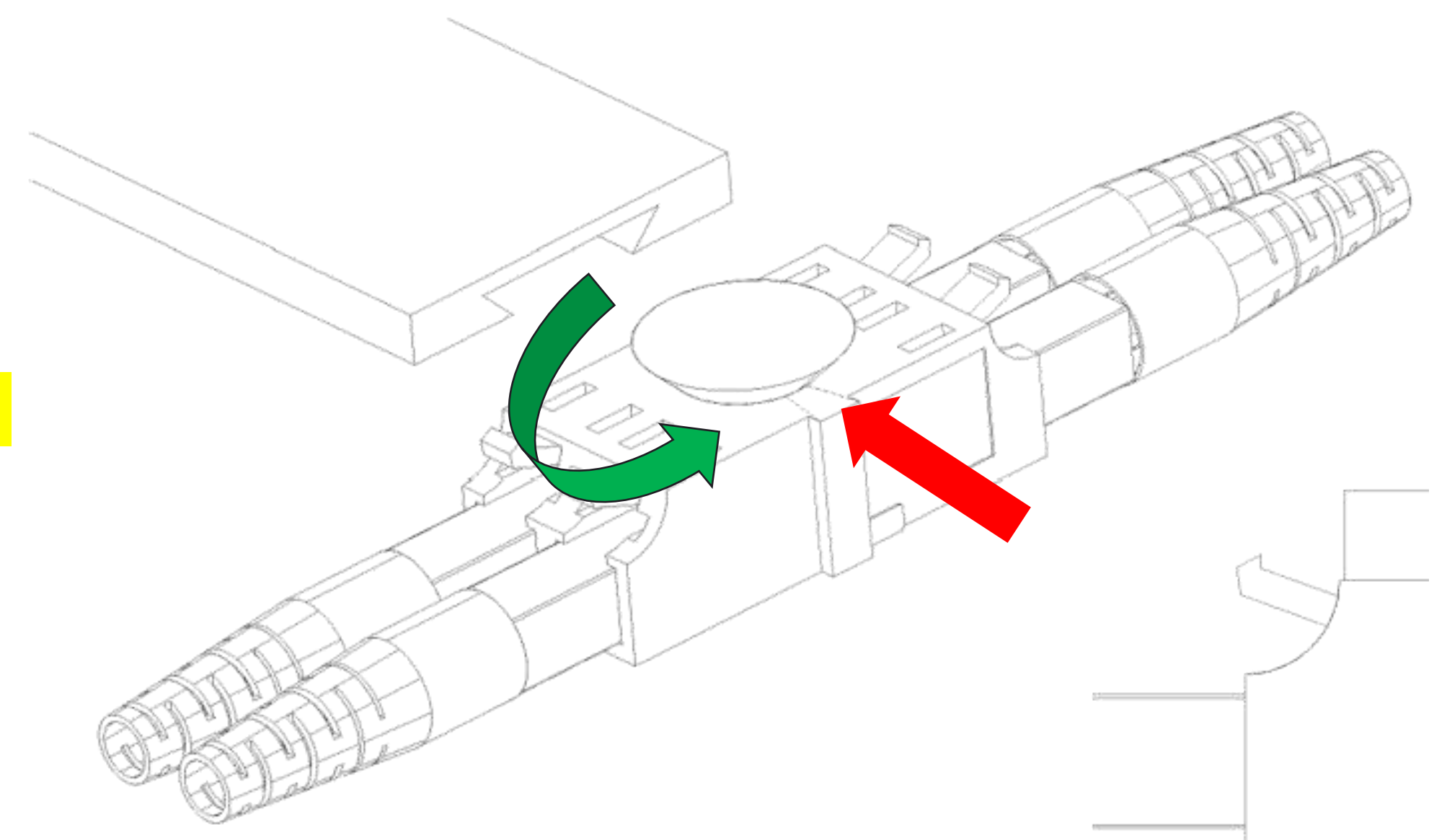
Principle of Lego and Fractal groups



Simple adapter holding tracks:
Leveraging the symmetry!

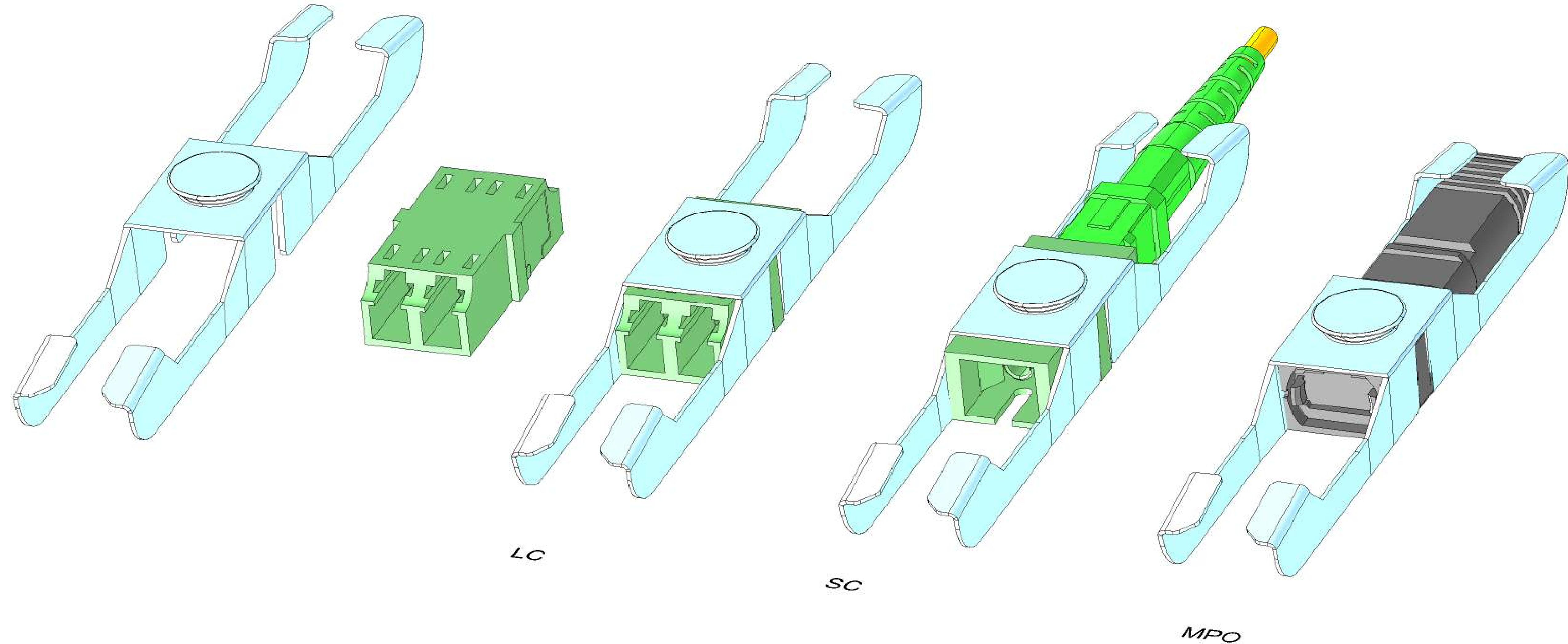


Rotation and Sliding to
compromise the mechanical
force-torque-stress



Easy epoxy bounding or plastic welding for any adapter

- **LC, SC, MPO can be mixed on the same track panel, possibly CS,**
- **NS and MDC require different adapter holder but share the same track**
- **The most advanced case: To have LC, SC, MPO, CS, MDC and SN friendly mixed on the same rail**



This Provides Any Density Fiber Management System

Features:

- Adapters safely and effortlessly spread apart using latest new flexible and scalable technology
- Scalable to truly “pay-as-you-grow” starting from 12 adapters (½ row) to a fully loaded 72 adapter panel (and anything in between!)
- Convenient port labelling on each adapter on both front and rear sides of the panel
- Available with a variety of options for cable management



Hardened Terminal for OSP Like a Clamshell



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OSP Shell Unit

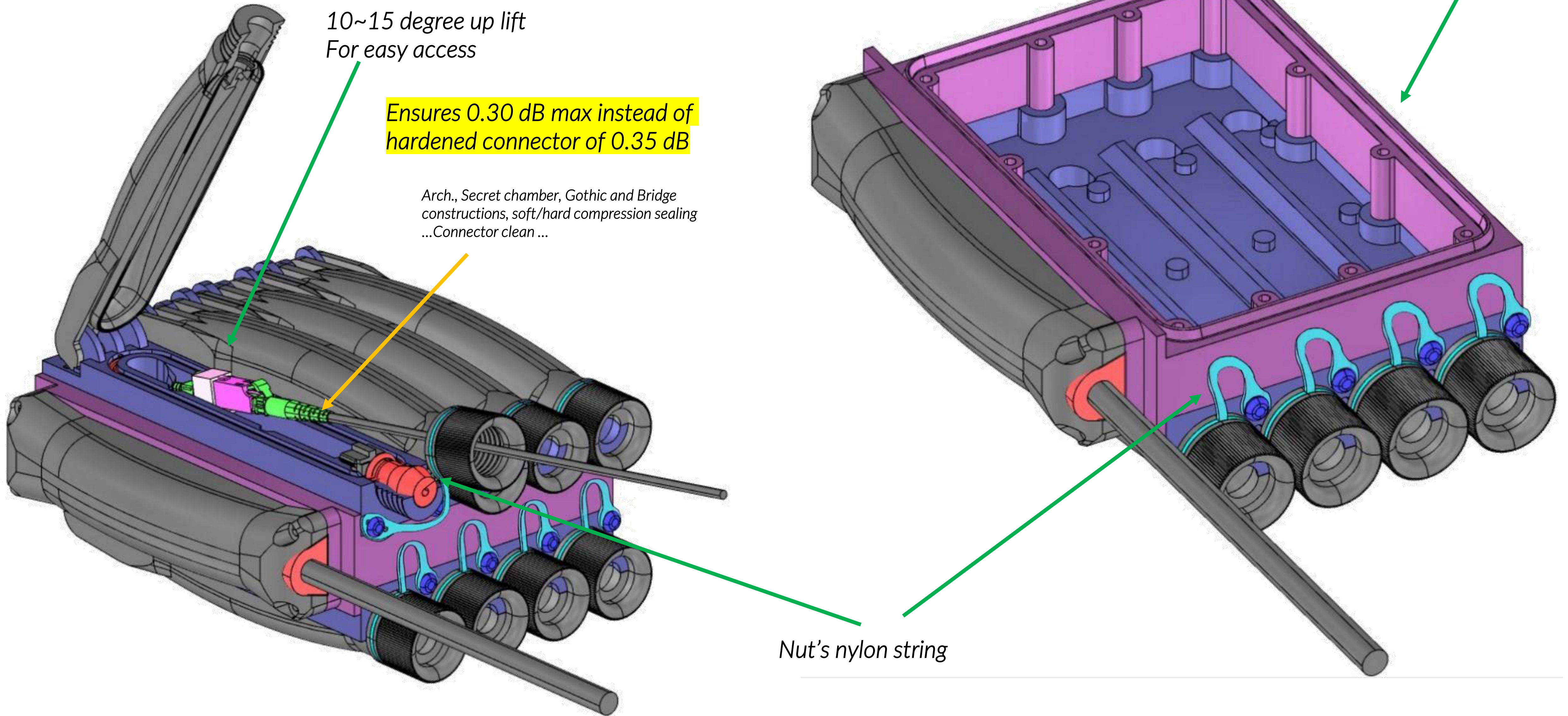
The universal base unit
With any passives

10~15 degree up lift
For easy access

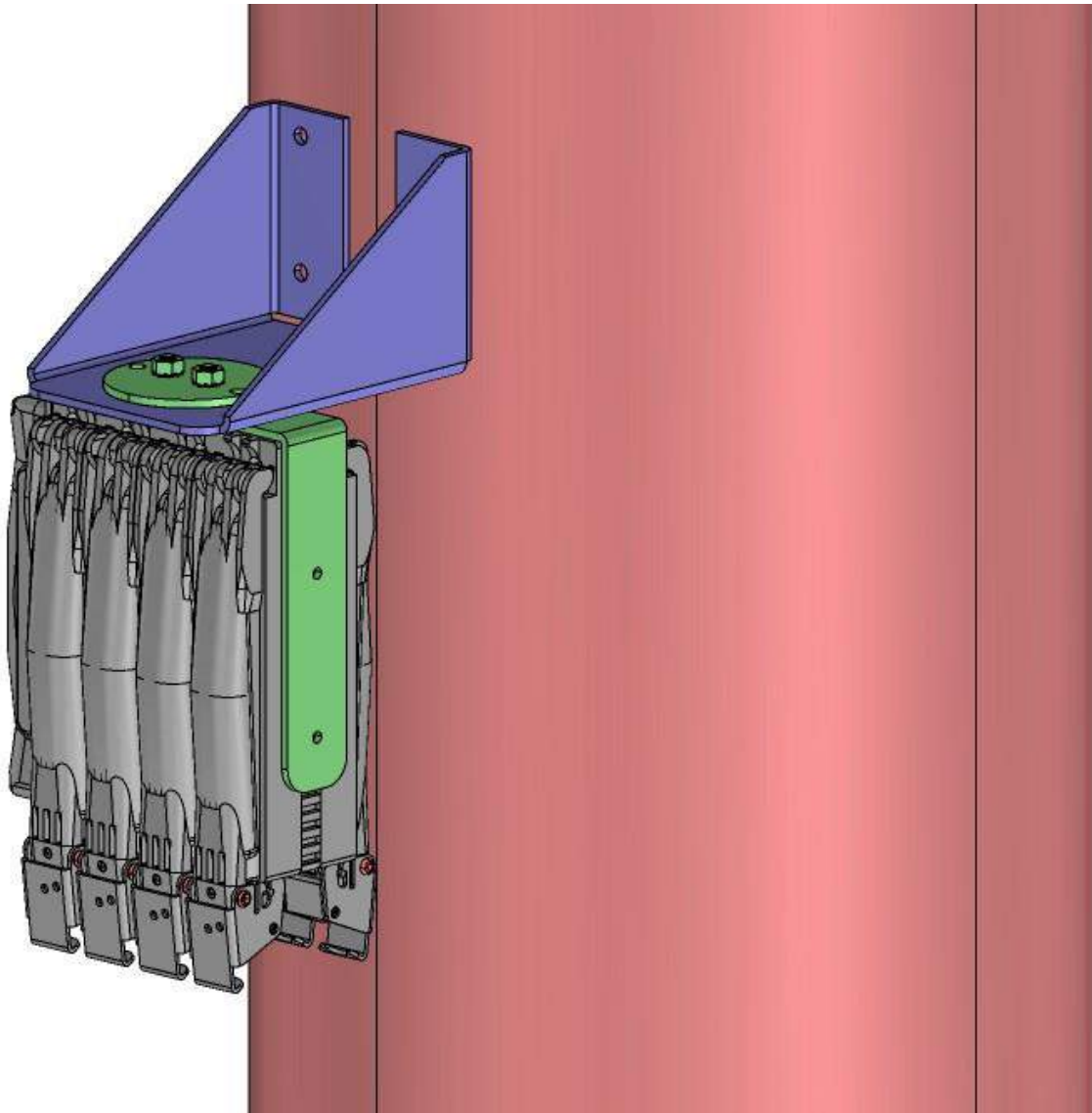
Ensures 0.30 dB max instead of
hardened connector of 0.35 dB

Arch., Secret chamber, Gothic and Bridge
constructions, soft/hard compression sealing
...Connector clean ...

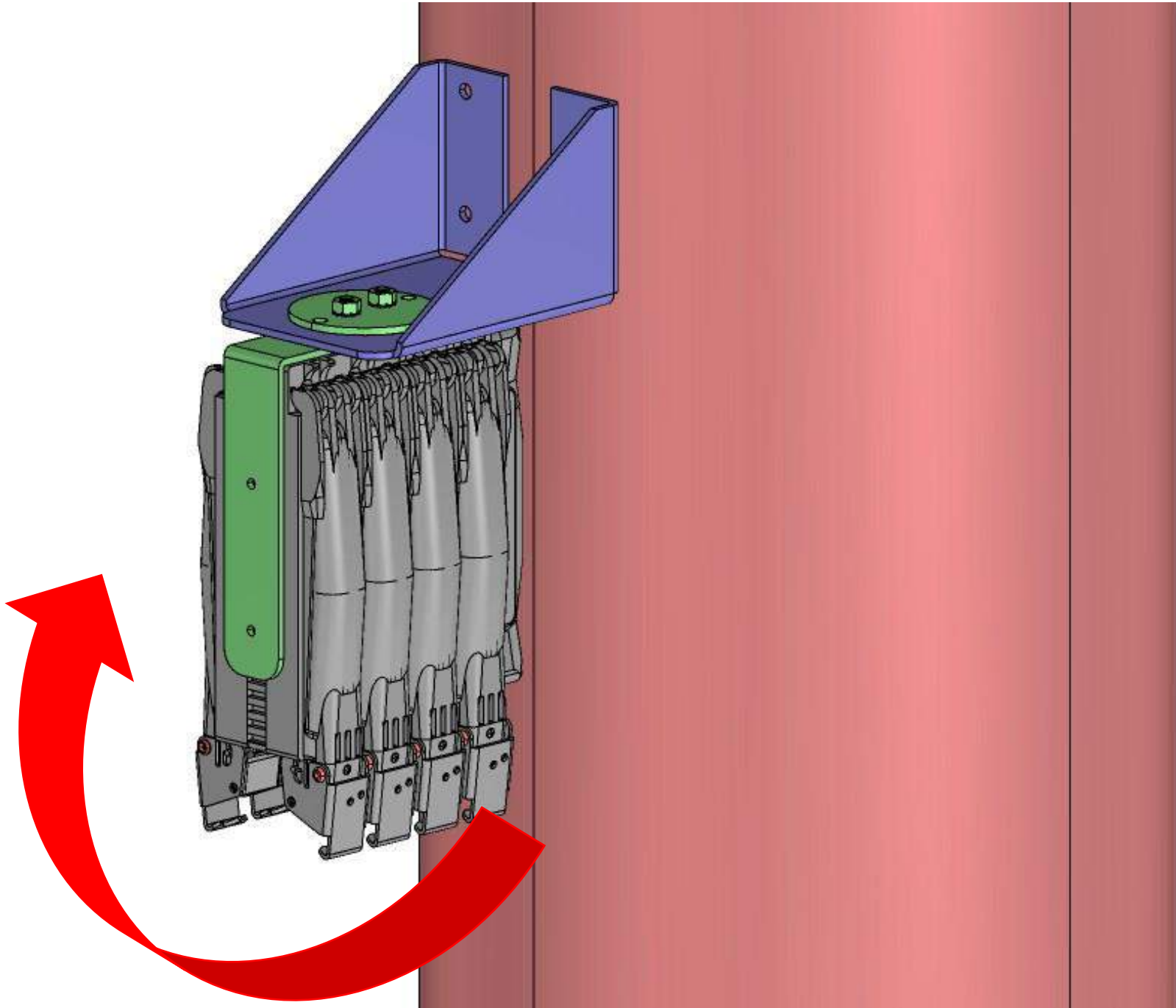
Nut's nylon string



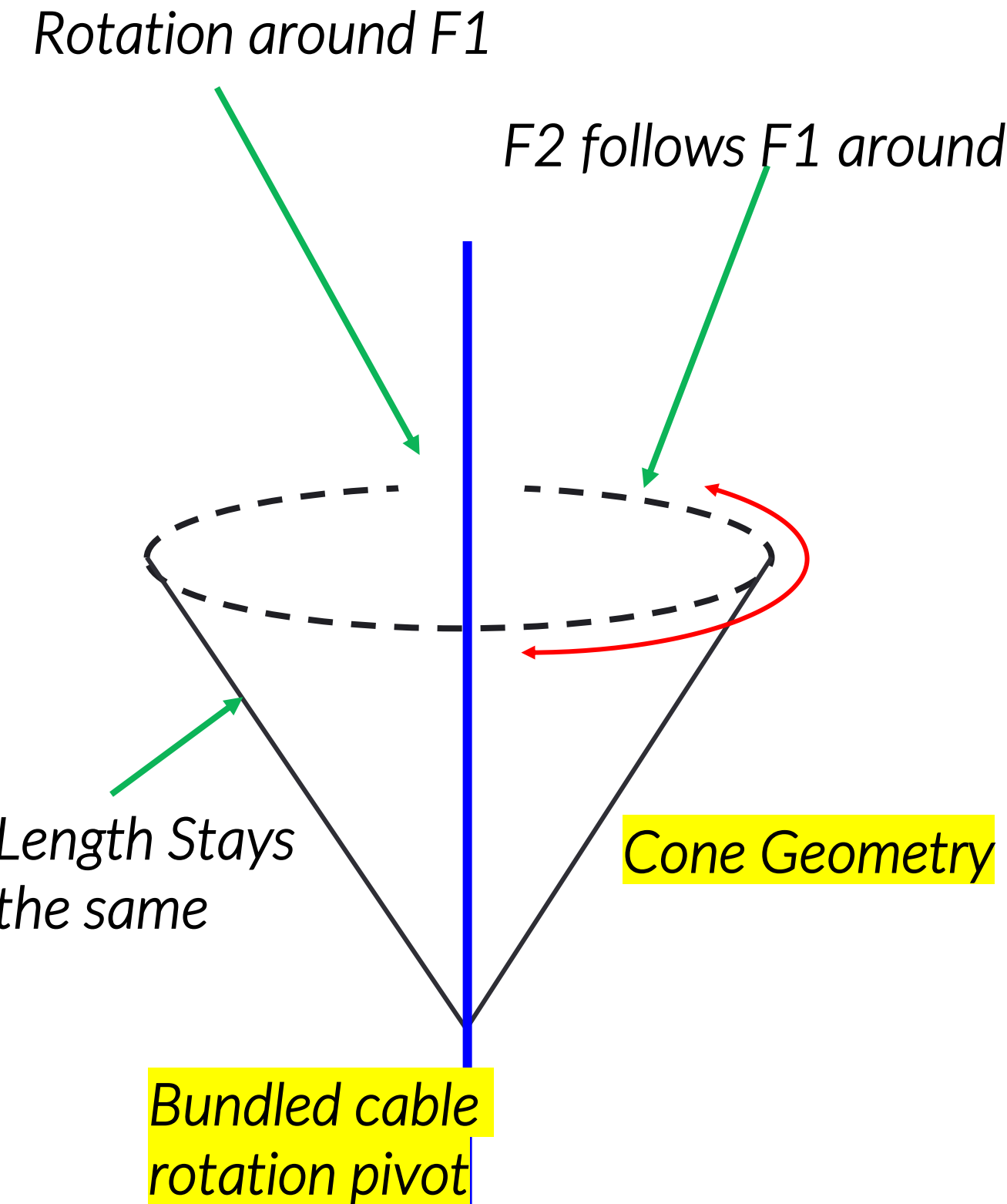
Pole-Mount 8-Ports, simplex, duplex, MPO Helicopter Symmetry Super Easy Access



We can expand into two or three units on the pole in 110~120 degree



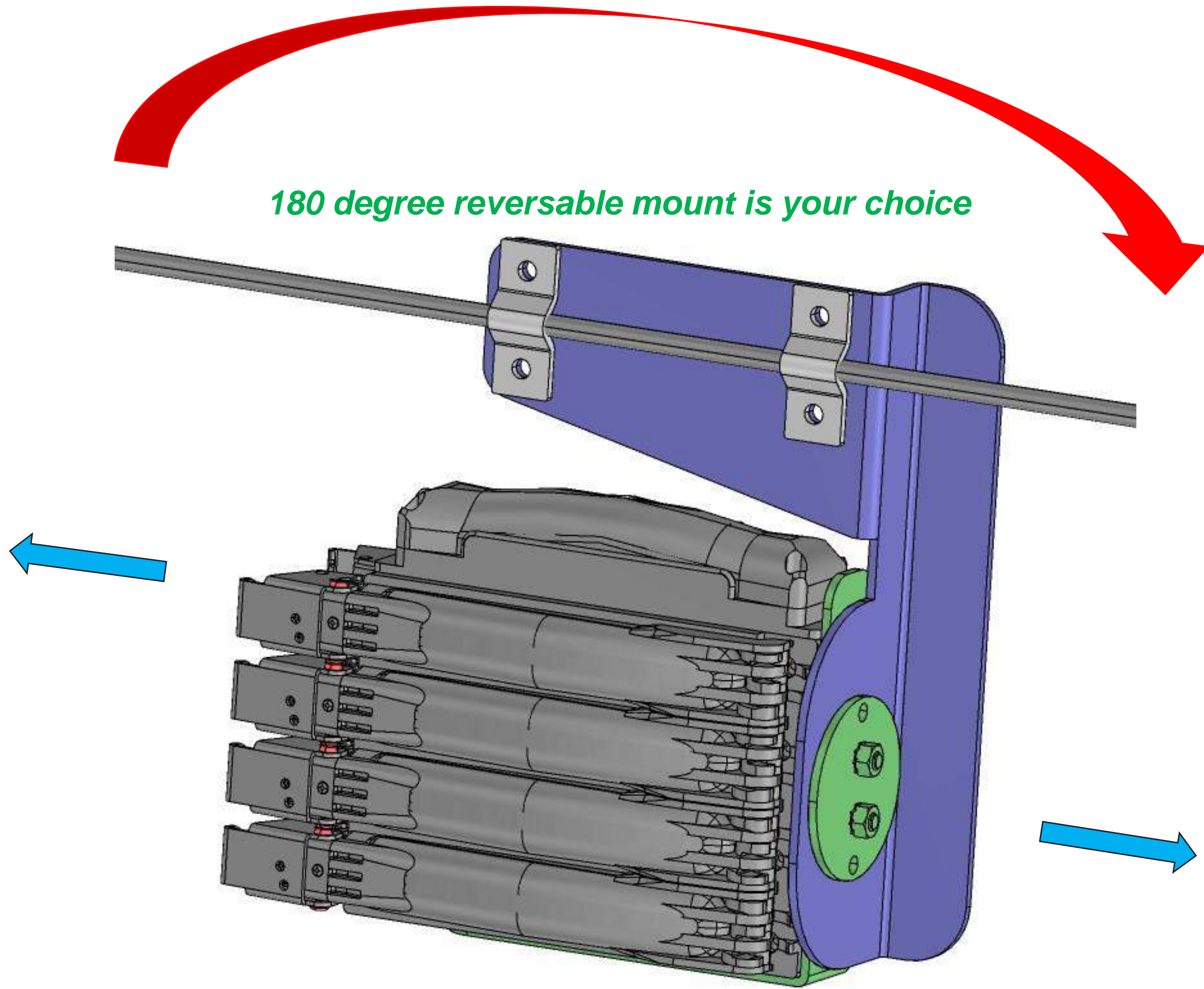
We can optimize the pivot around the F1 if it is needed



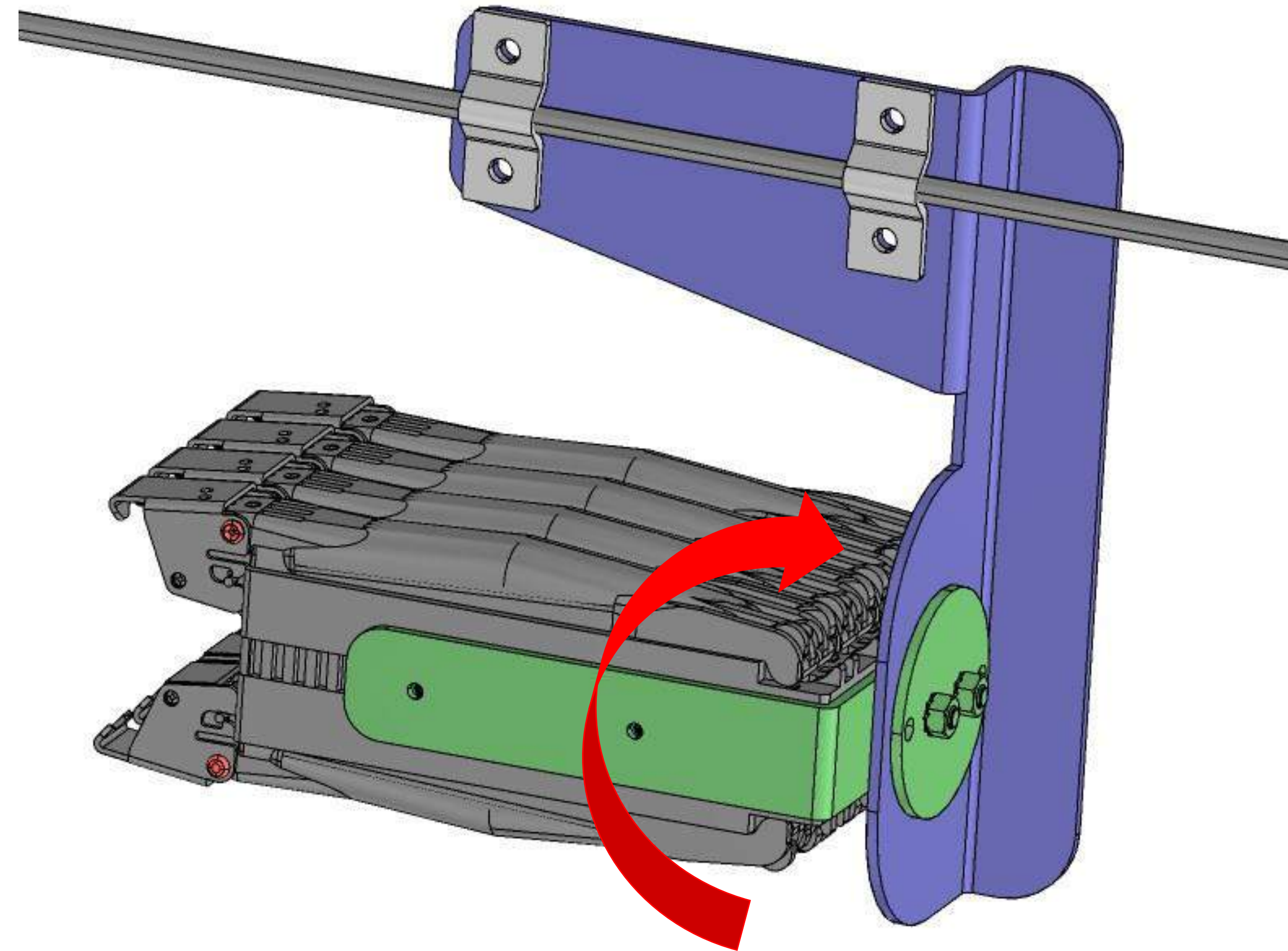
Strand-Mount 8-Ports, simplex, duplex, MPO

Helicopter Symmetry

180 degree reversable mount is your choice



Normal mount position

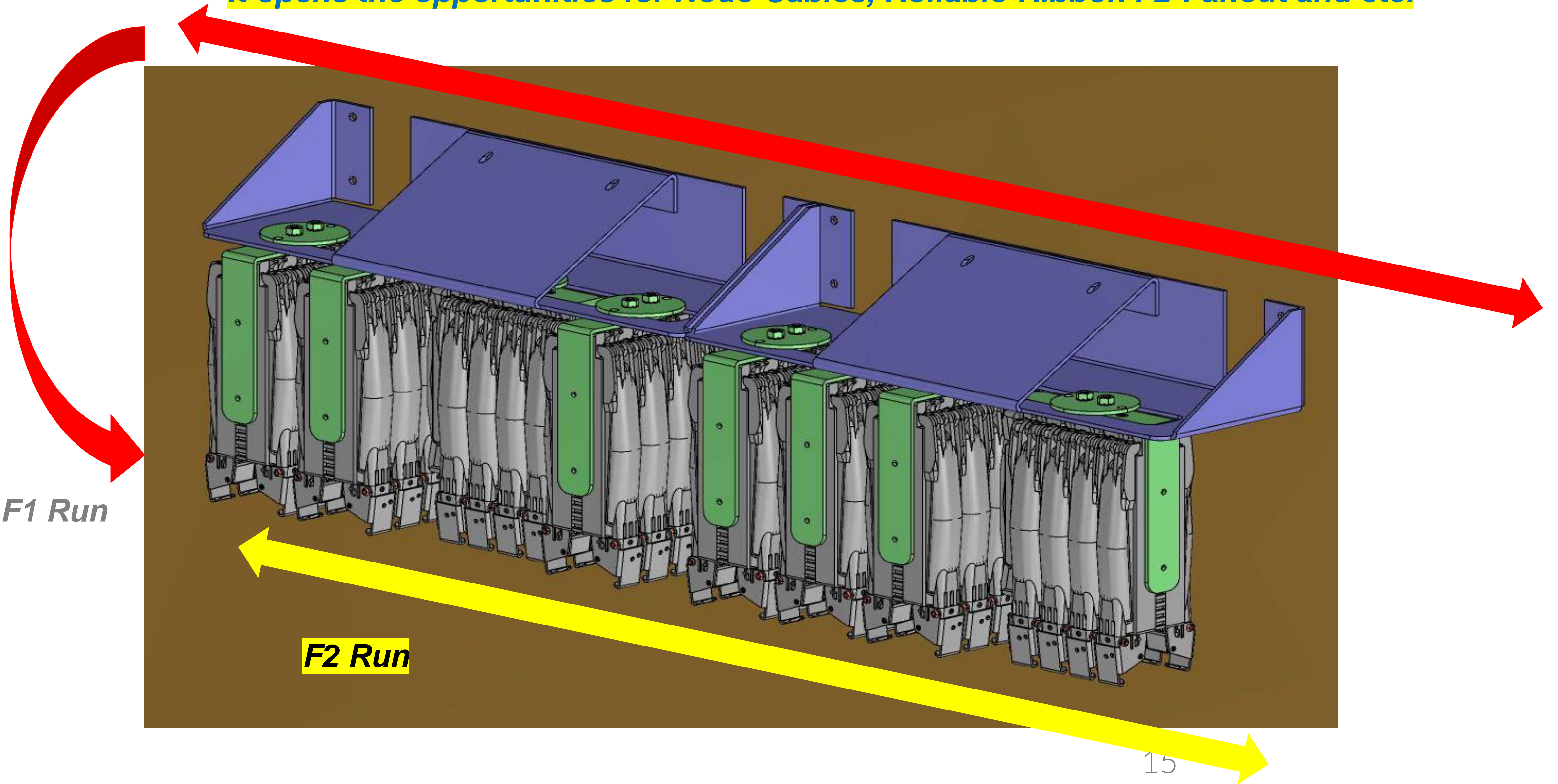


Duo-Size access position

MDU-Wall-Mount, 8-Ports, simplex, duplex, MPO,

With any combination with F1/F2 in NEMO mechanics

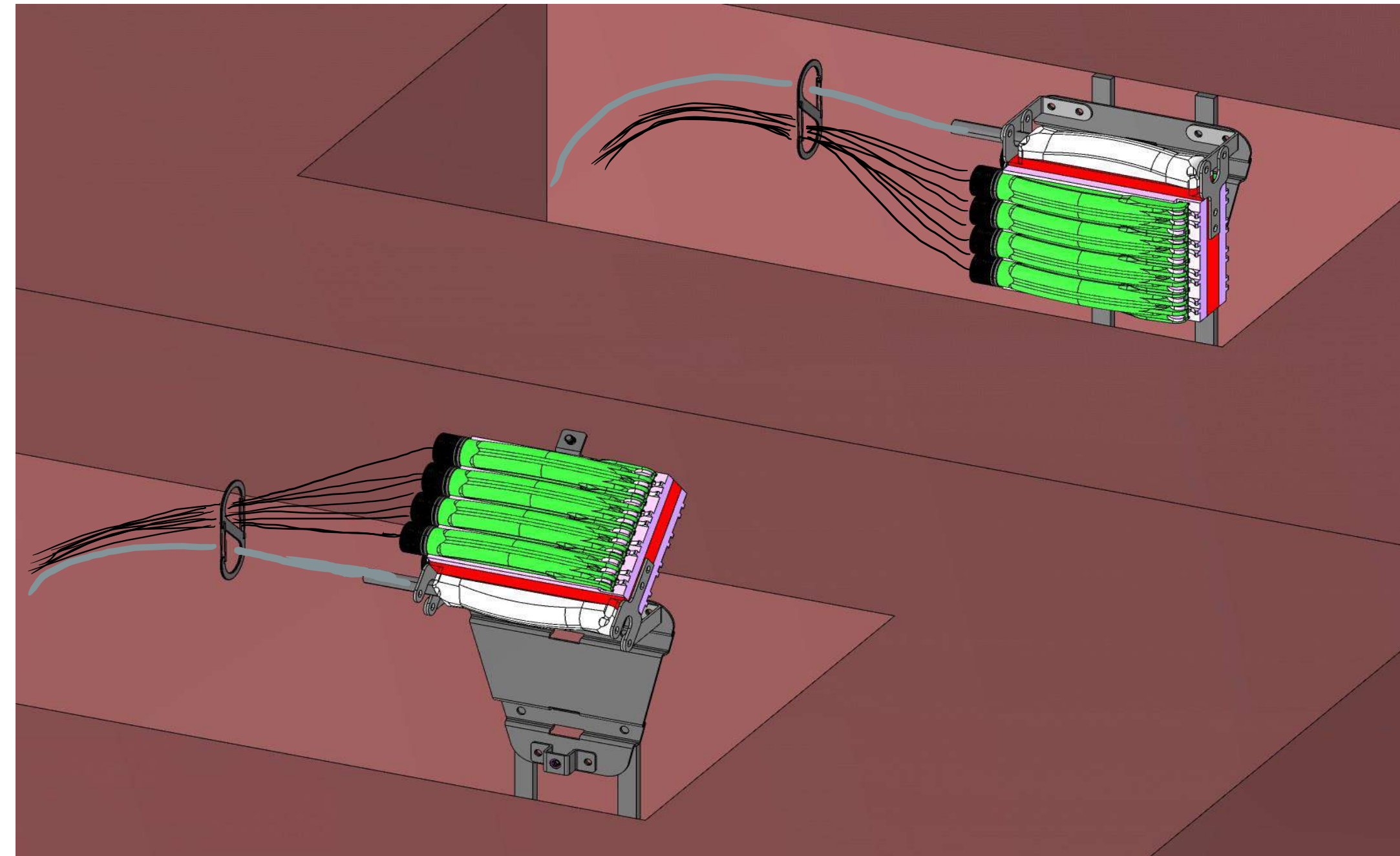
It opens the opportunities for Node-Cables, Rollable-Ribbon F2-Fanout and etc.



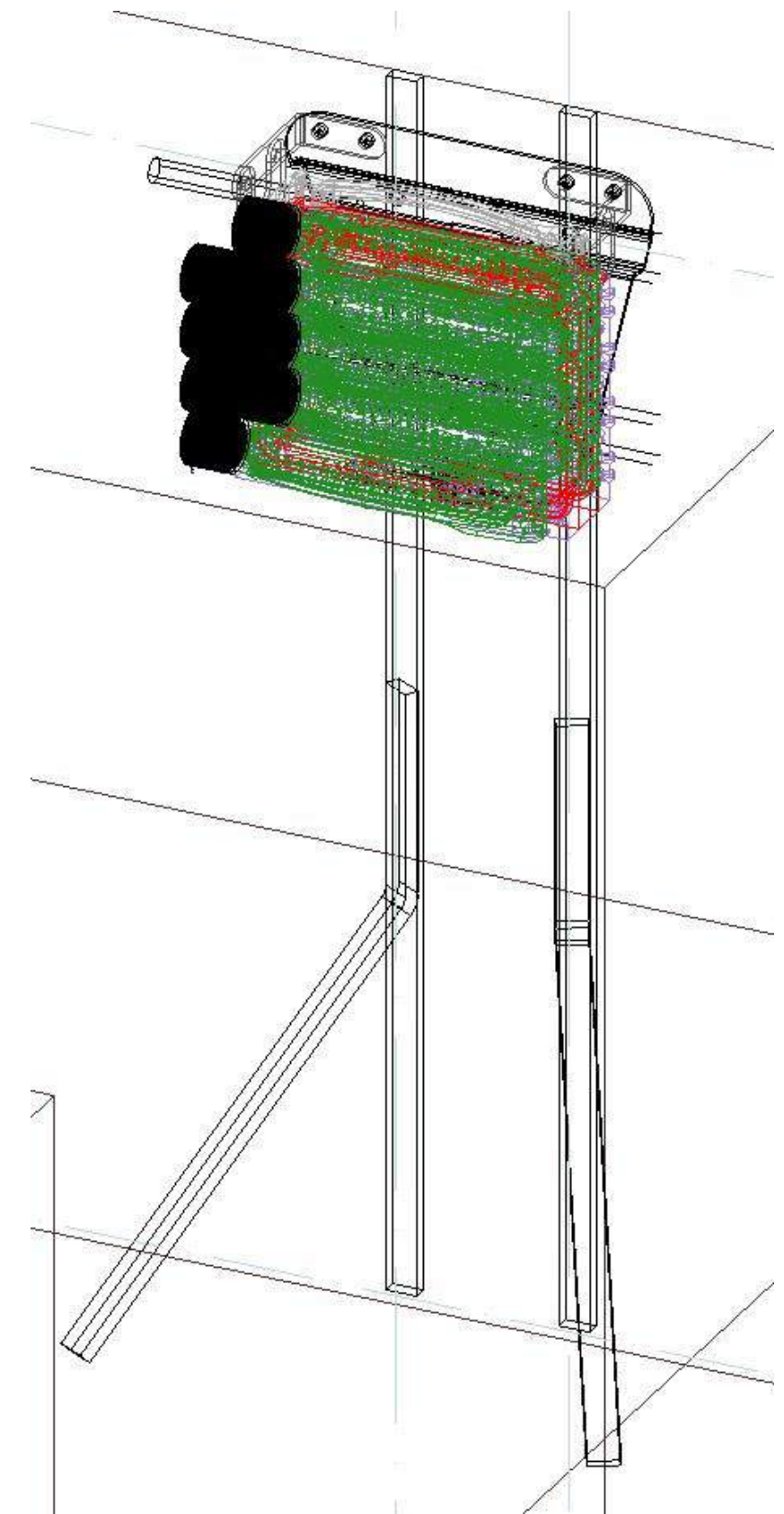
F1 Run

F2 Run

Handhole / Manhole Mount or without mount at all



Hang on Stand



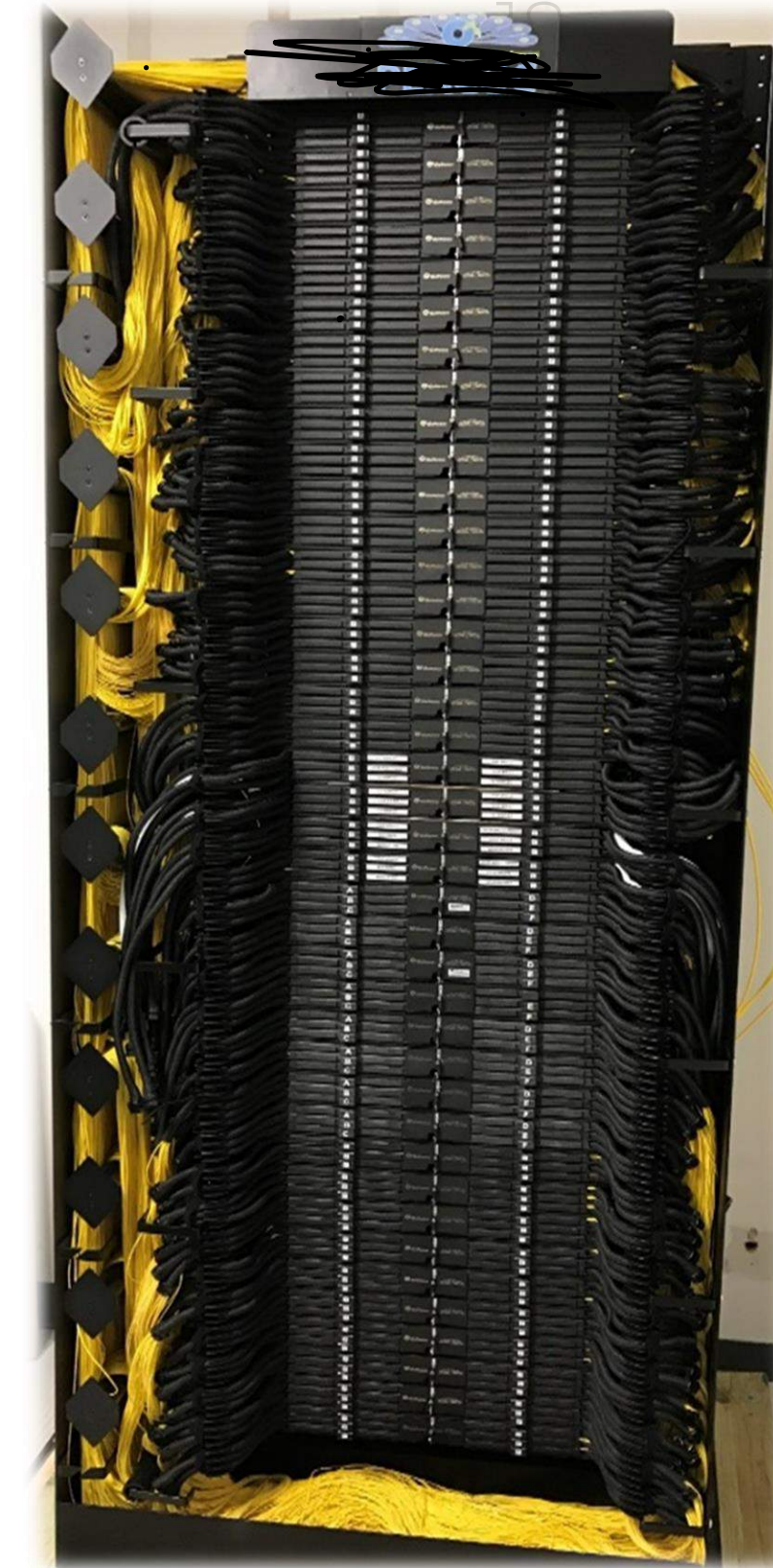
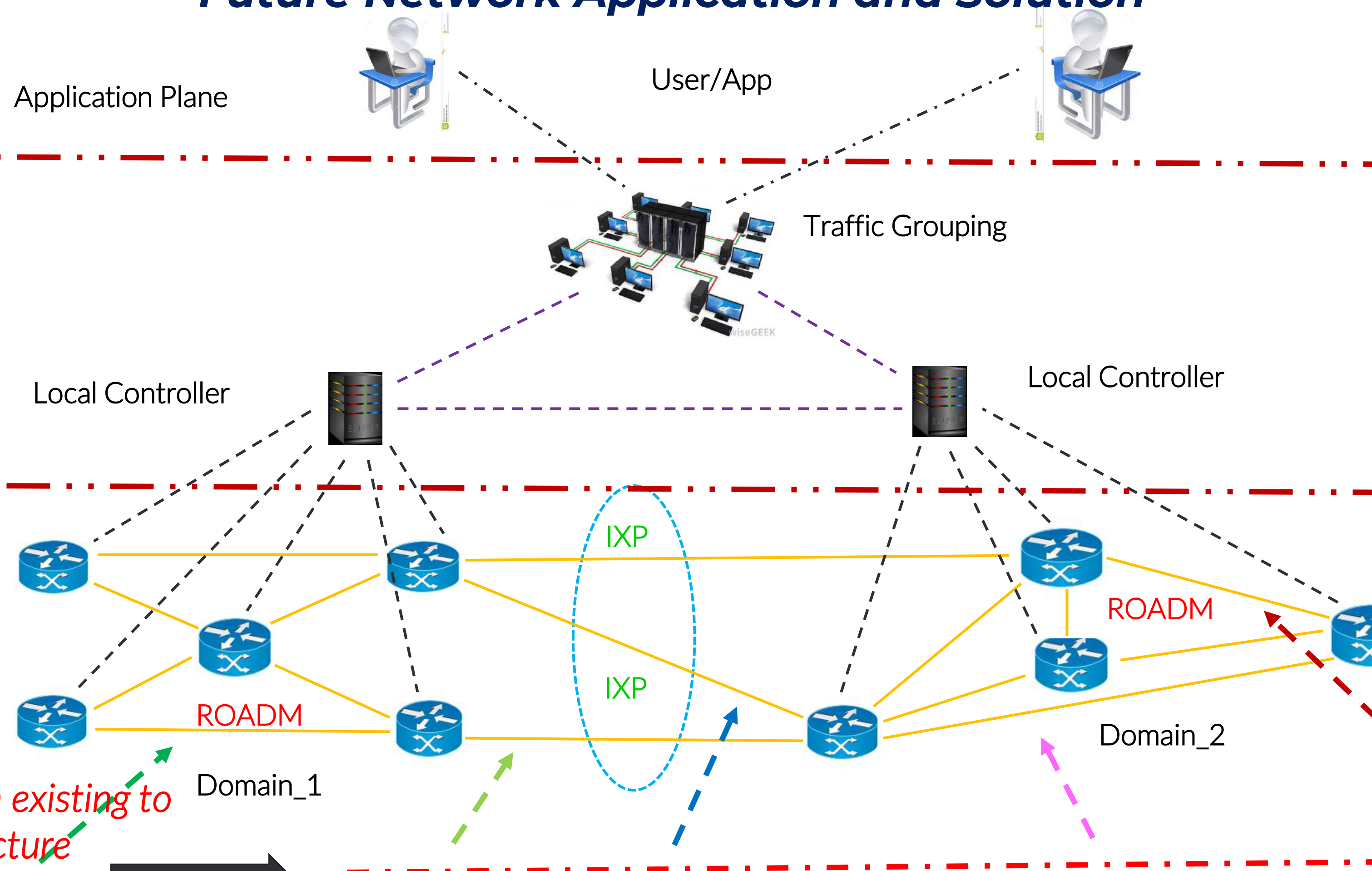
***“Cloud on the Ground”
NEW Technology
Intelligent Fiber Management System***



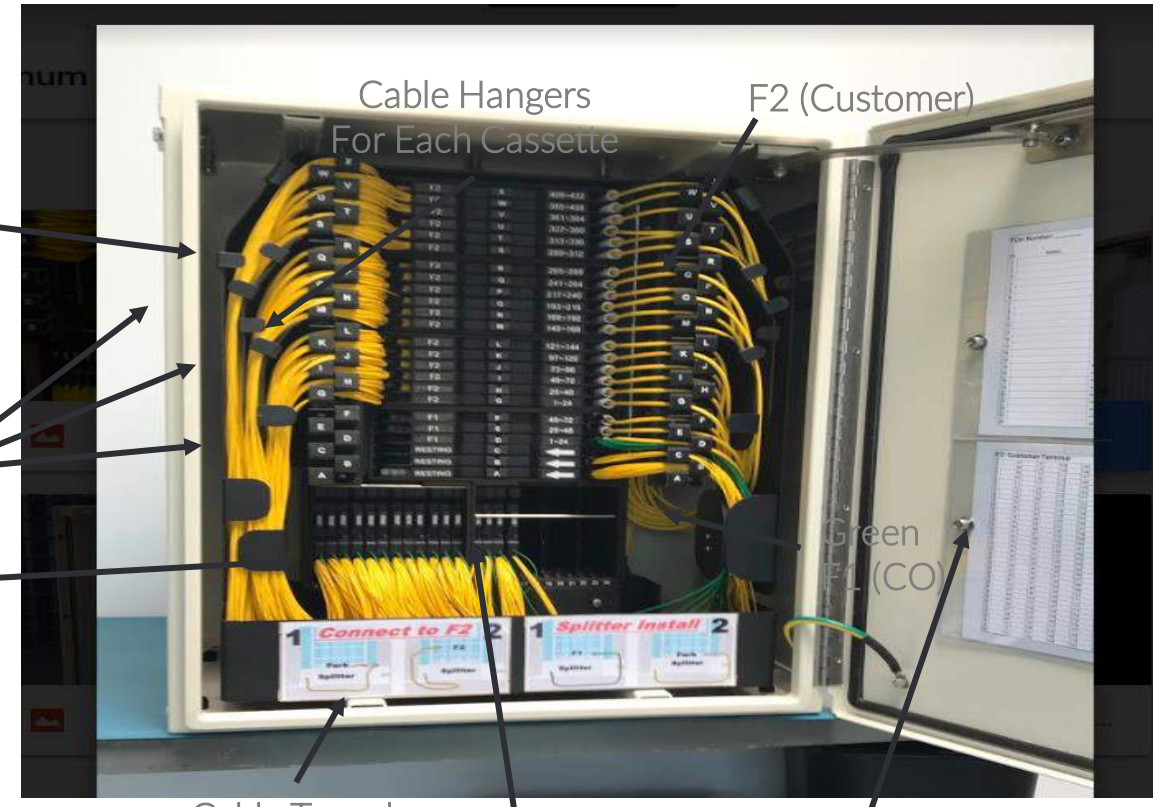
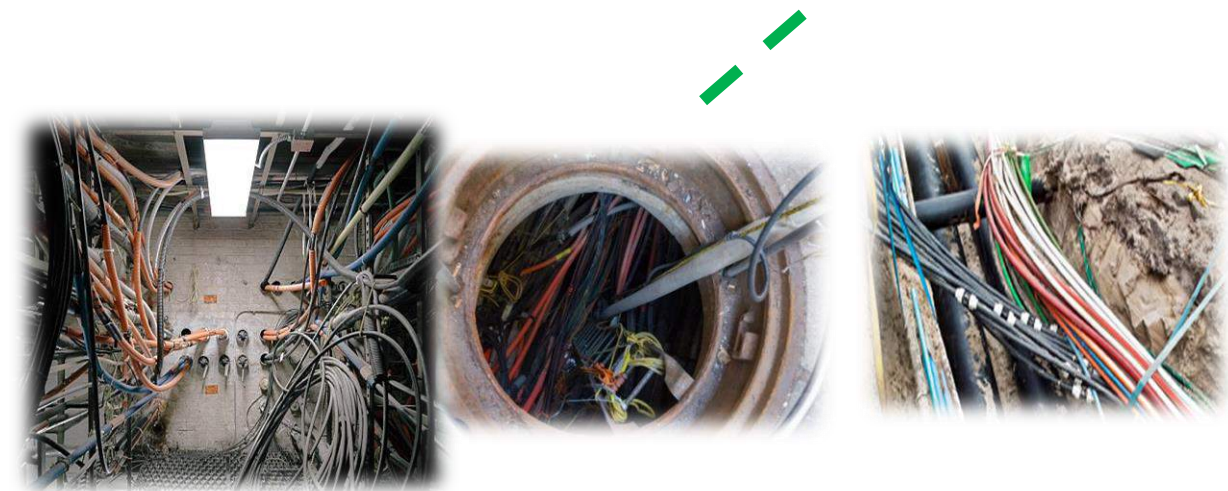
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Network Architecture Proposal for Future 5G Network Expansion

Future Network Application and Solution



Line of separation from existing to future network architecture

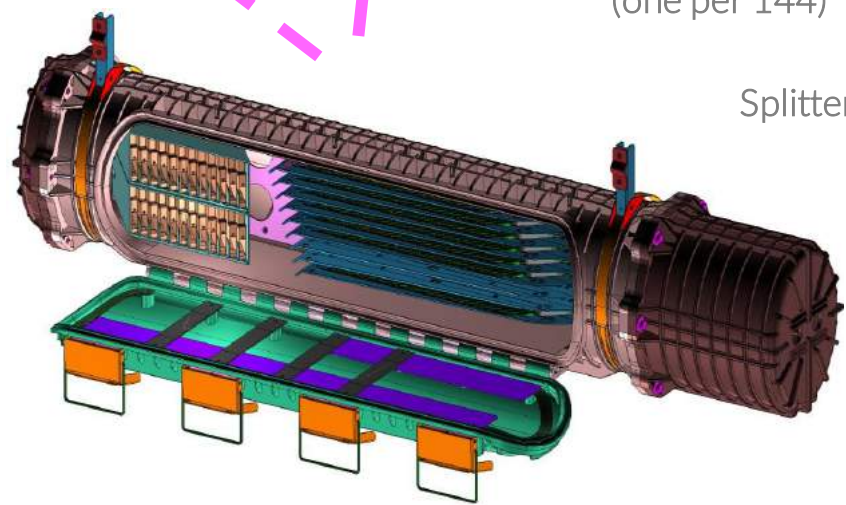
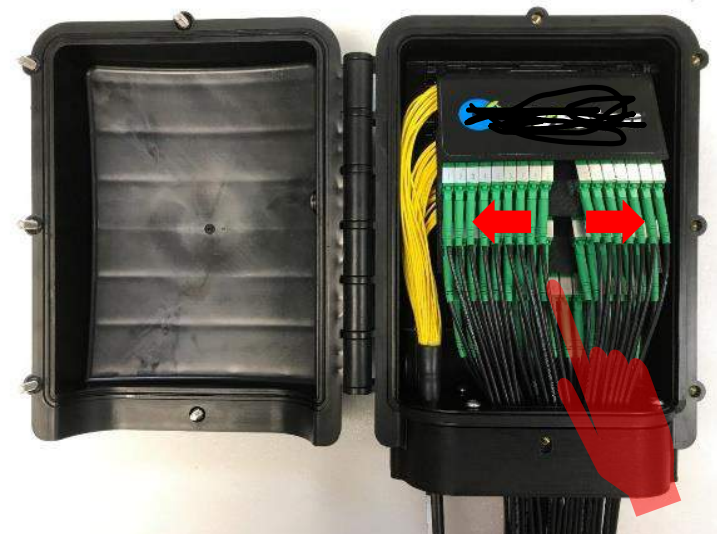
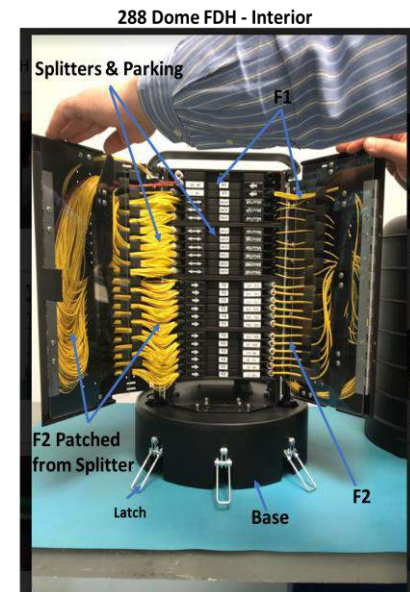
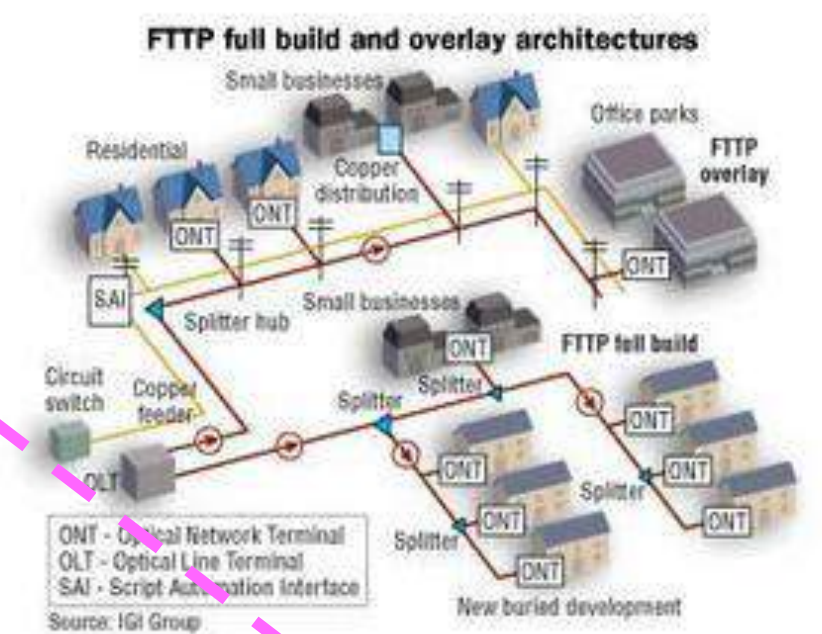
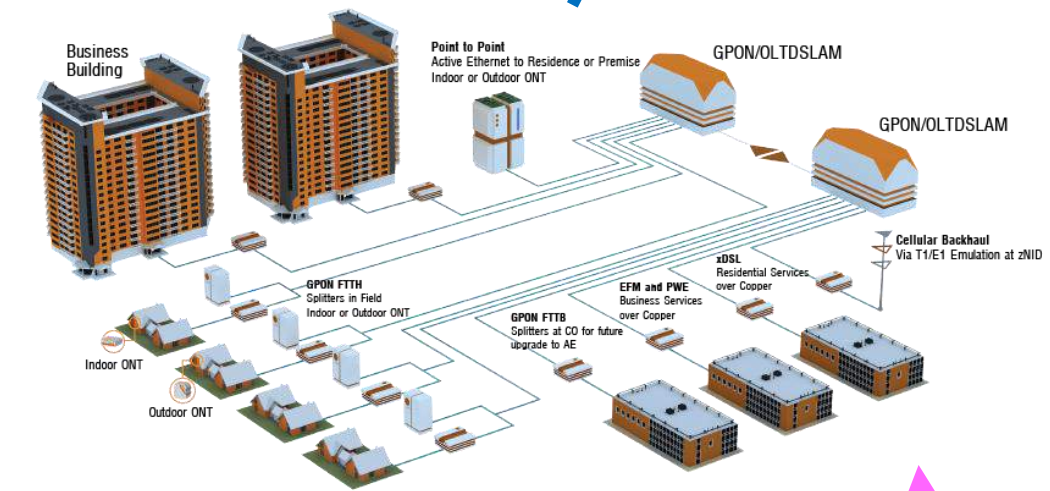
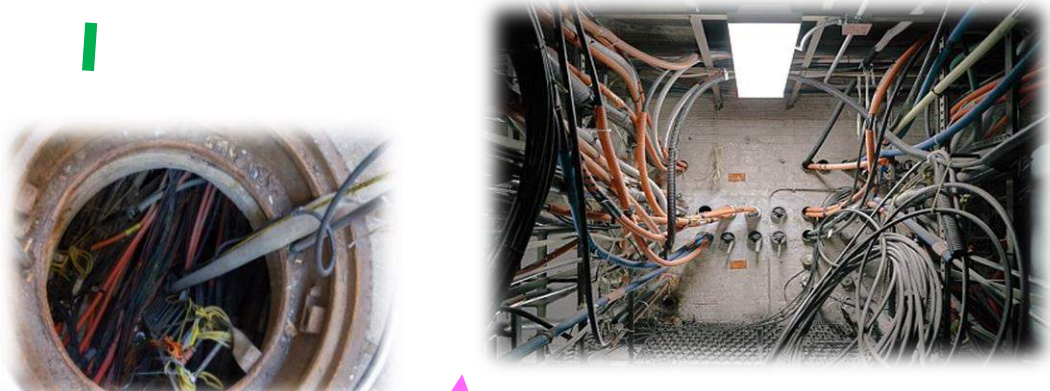
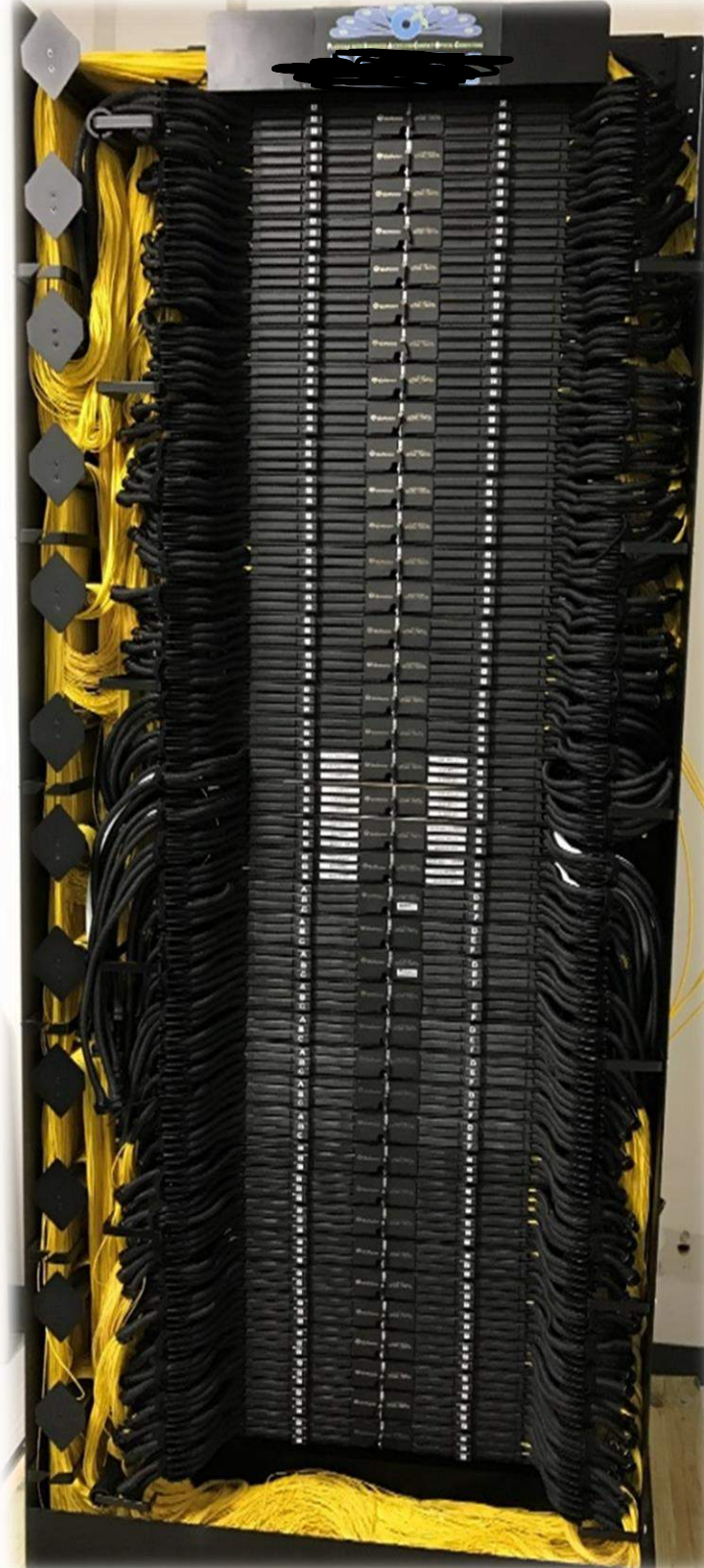
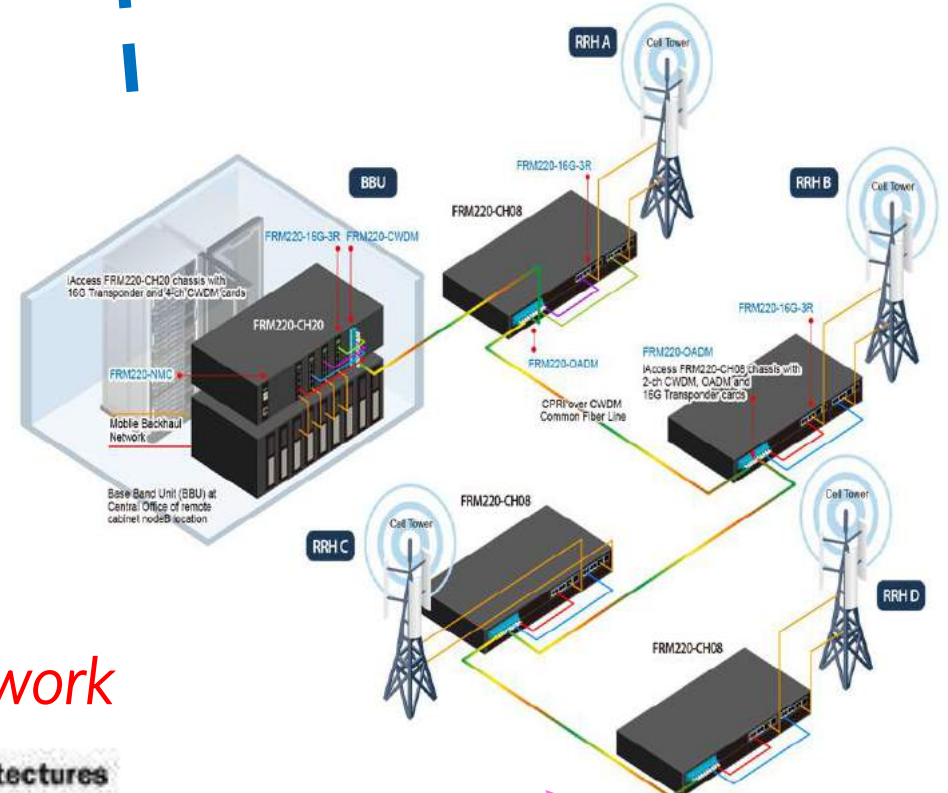
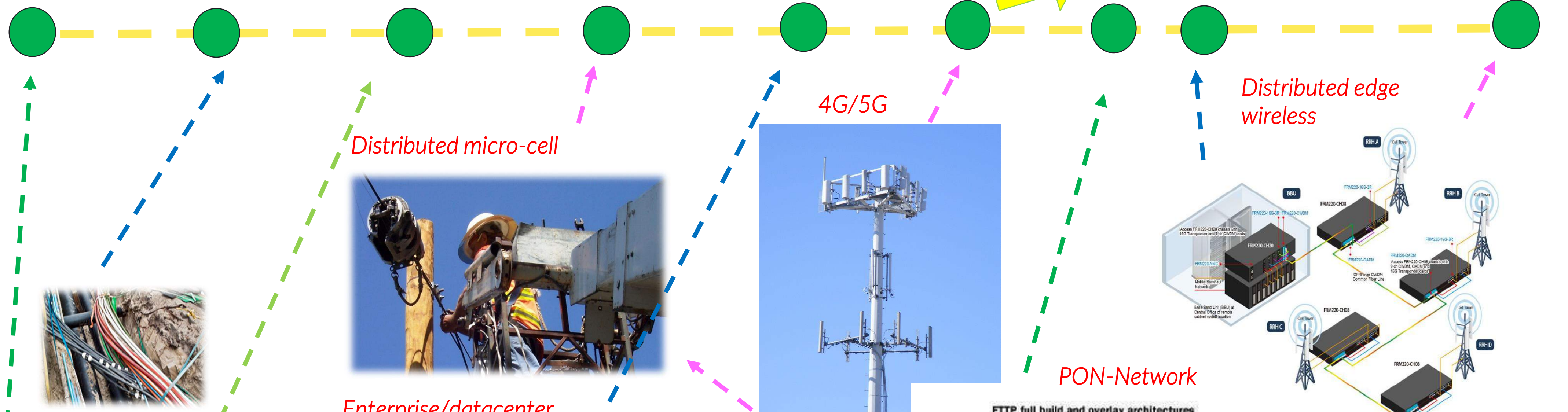


Reality is to have the monitoring capability on the ground over OSP domain

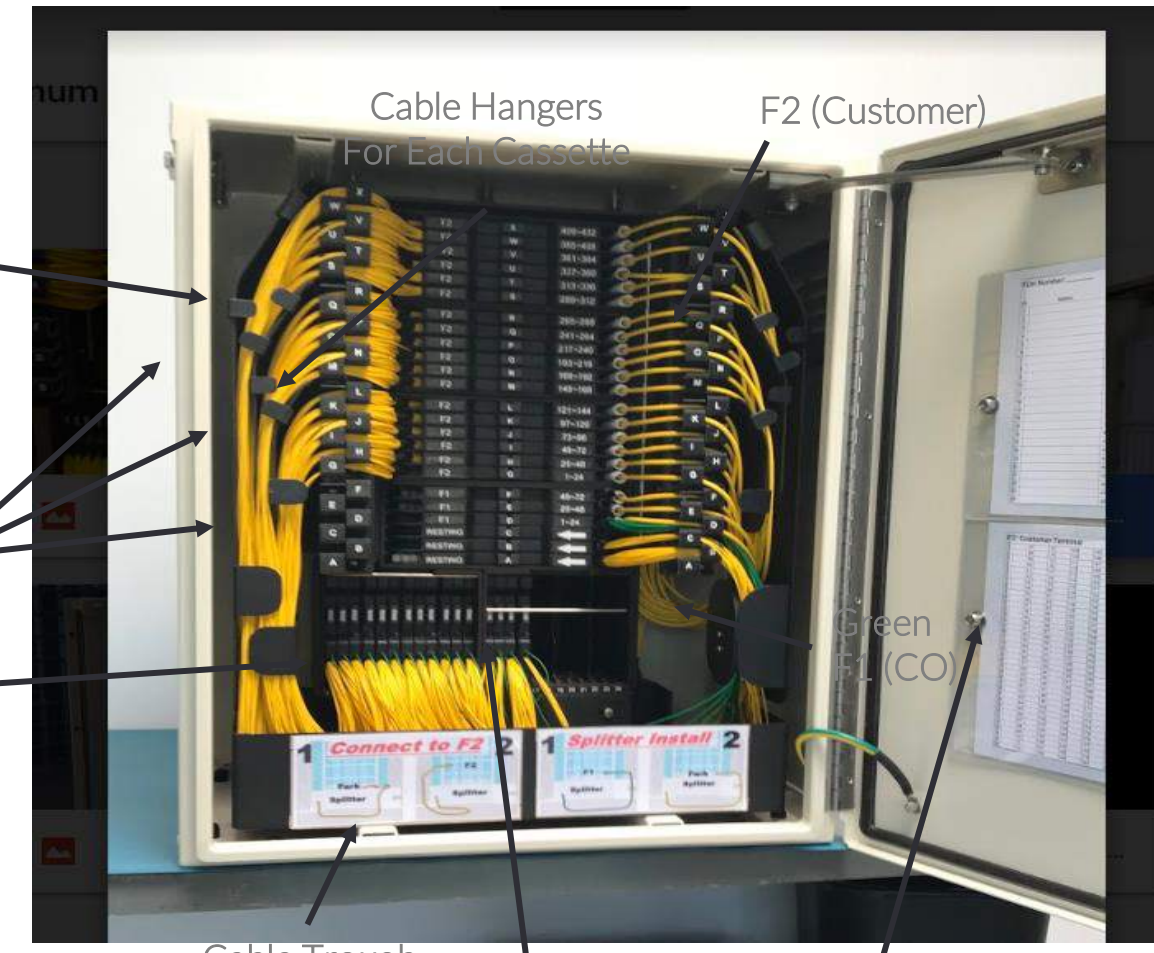
OSP "Cloud on the Ground" Plane

Heading to CO/DataCenter

Layer -0/1 Physical Construction Above and Below Ground



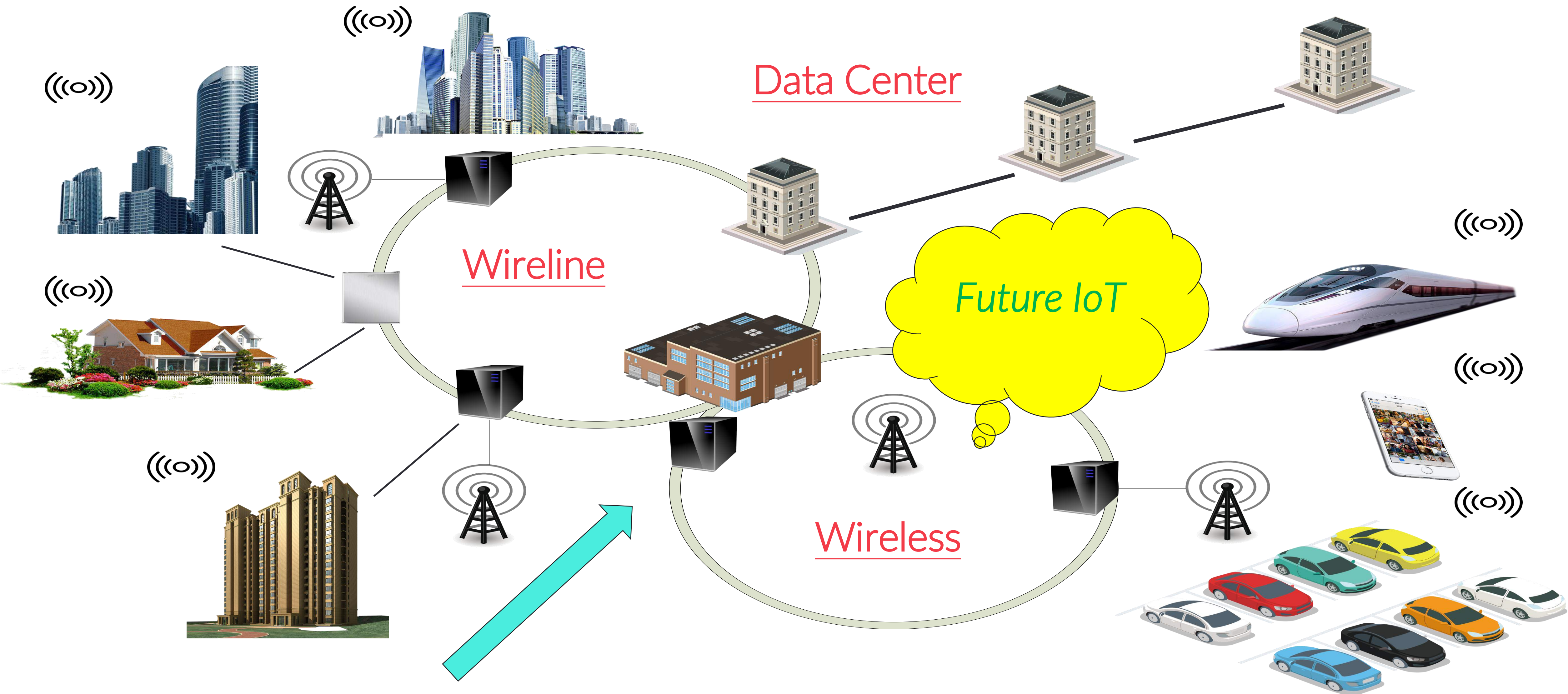
3 - Routing Guides (one per 144)



Splitters

Splitter Cassette Latch

Emerging Comprehensive ODN armed with monitoring at each section enables meaningful data collection.

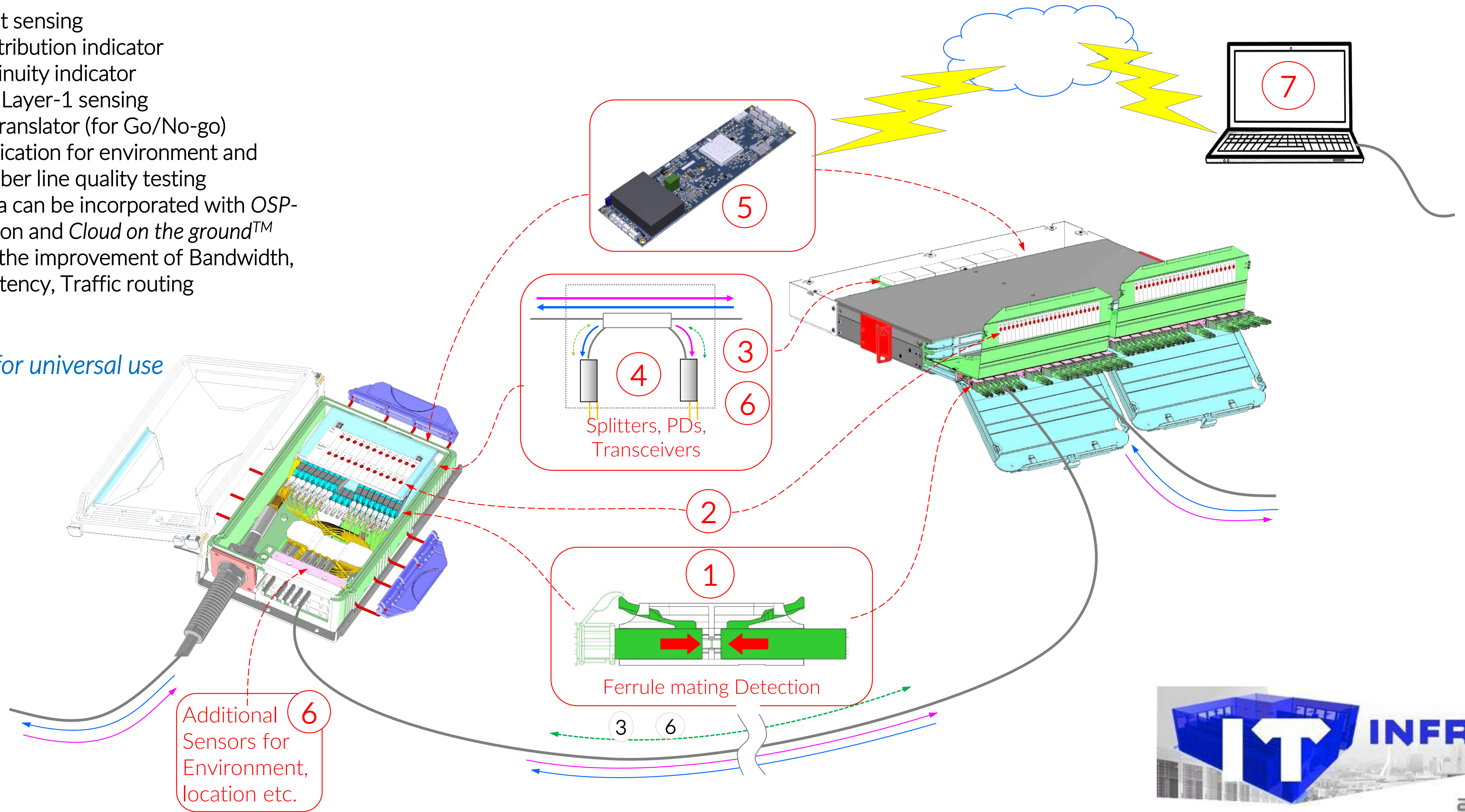


Optical Bi-Directional tapping with mechanical sensors at all the major junctions

Functions and Features

1. Port engagement sensing
2. Port number distribution indicator
3. End to end continuity indicator
4. Tapping Bidi for Layer-1 sensing
5. Optical Power Translator (for Go/No-go)
6. Expandable application for environment and none-intrusive fiber line quality testing
7. All collected data can be incorporated with *OSP-Plane™* application and *Cloud on the ground™* architecture for the improvement of Bandwidth, Performance, Latency, Traffic routing optimization

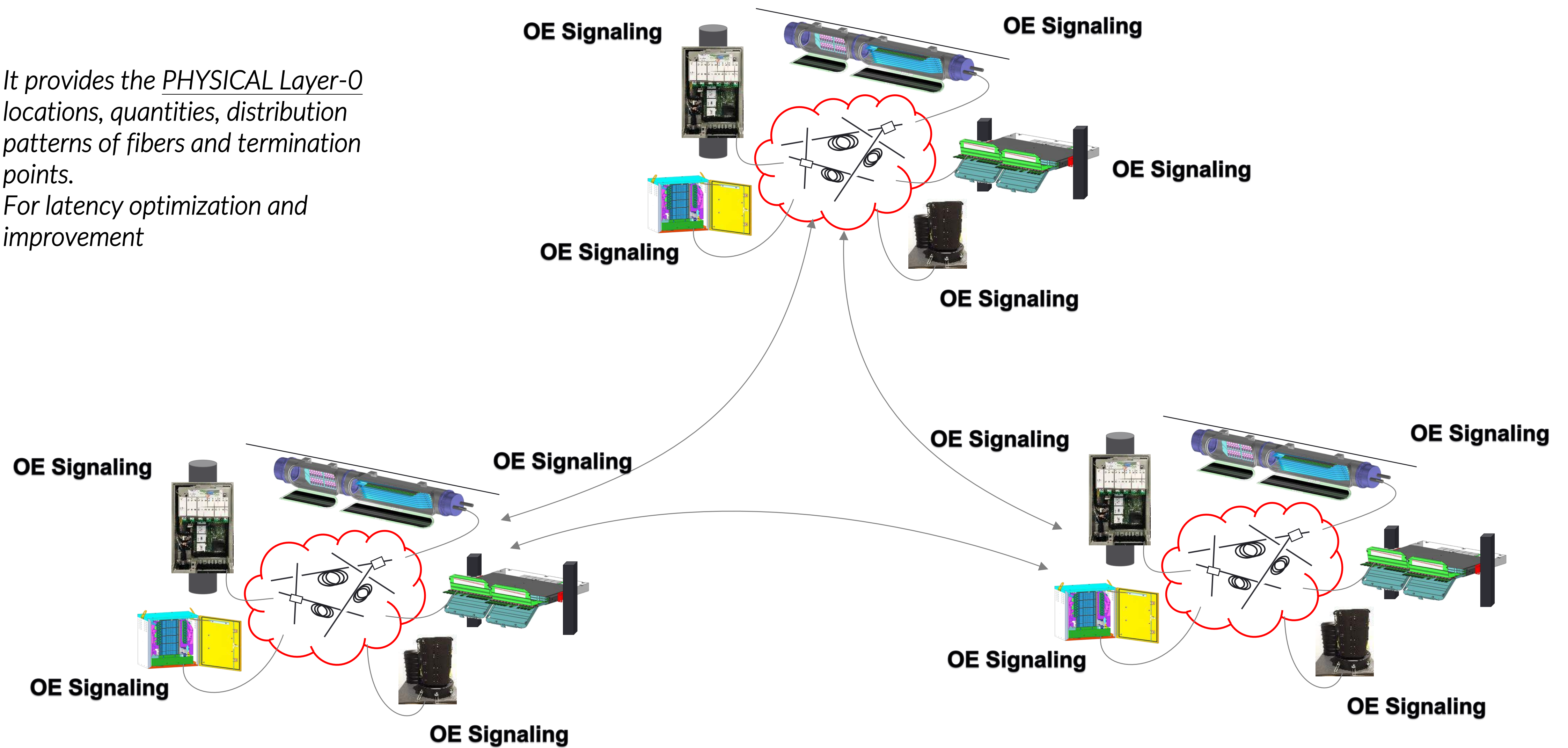
A true black-box for universal use



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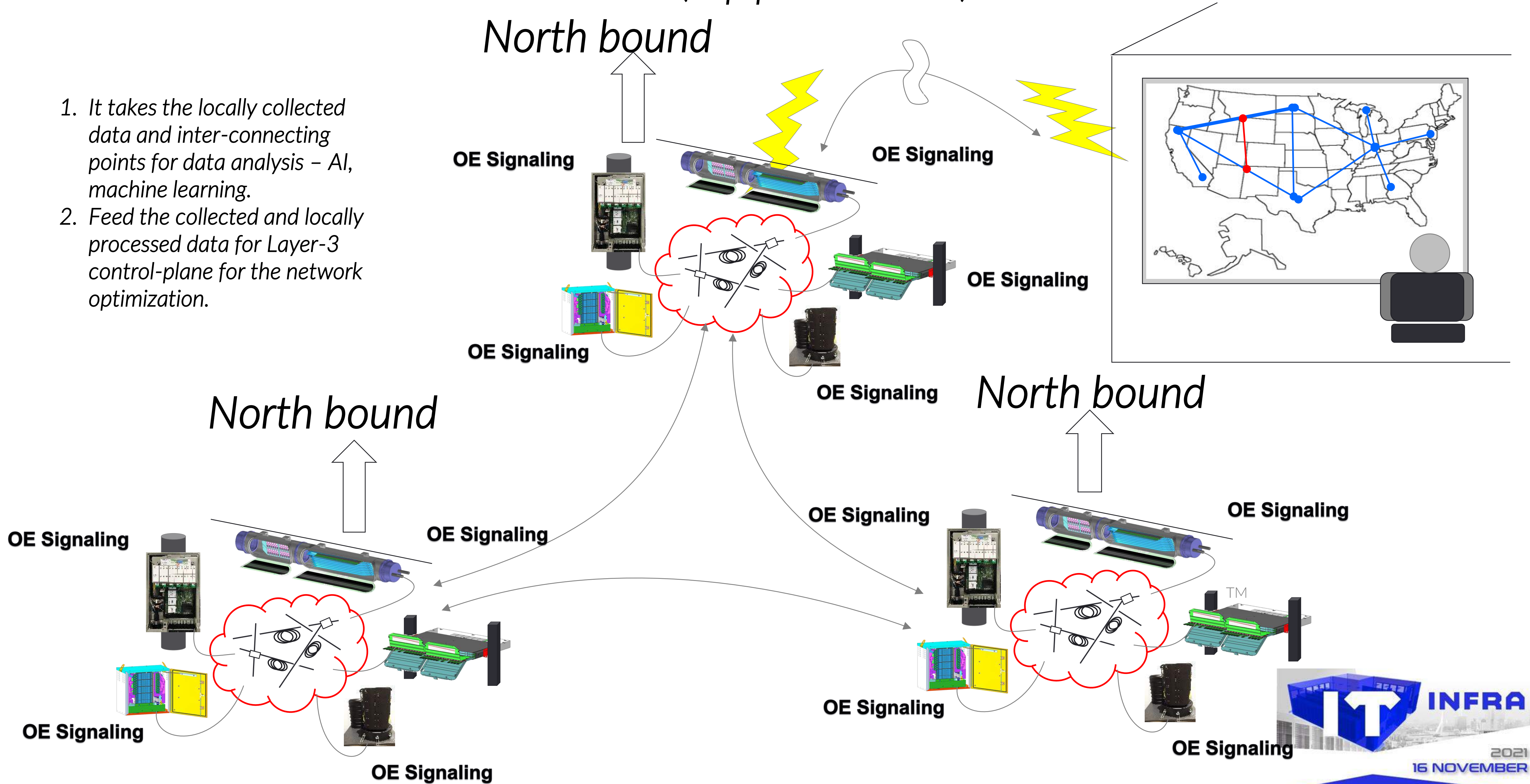
Cloud on the Ground (Architecture)

1. It provides the PHYSICAL Layer-0 locations, quantities, distribution patterns of fibers and termination points.
2. For latency optimization and improvement



OSP-Plane (Application)

1. It takes the locally collected data and inter-connecting points for data analysis – AI, machine learning.
2. Feed the collected and locally processed data for Layer-3 control-plane for the network optimization.



Nature provides us with limitless examples of the economy of the geodesic. Observation of nature through the twin lenses of physics and mathematics enables us to conceive new technologies that are both practical and elegant.

T H A N K Y O U !

Thank you for your attention!



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