Integrating Open RAN

Challenges and Approaches Needed

Mats Eriksson,
Lead Business Developer, Radio
Tietoevry Create

Product Development Services in brief

We design and develop software for the world's most advanced technology companies, as an extension of their R&D. We are part of the Tietoevry group with 24 000 employees

Every day, billions of people use software developed by Tietoevry.

We accelerate our customer's time to market and innovation in core product development, through deep domain expertise and best in class software engineering practices

We're building next generation products and solutions such as **5G Networks**, **Autonomous Cars**, **Smart Devices** and **Cloud and IoT Platforms**

World-class SW engineering services provider for OEMs

2 500 professionals in 9 countries,

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Serving customers in over **29** countries worldwide

Customer satisfaction >90%, "we deliver what we promise"

Specialized in **Telecom**, **Automotive** and **Electronics** Industries

A long-lasting partnership

Integrating Open RAN Agenda

1. What took us here? On innovation
2. Why is SW the key to unlock performance? Need for Speed and why is that important?
3. What is integration really?
4. Overview of Open RAN integration – Now and in the future
5. What is it that makes fronthaul integration difficult?
6. Integration of operational systems and why that is important for MNO’s
7. On the value chain(s) for Open RAN integration – finding the right partner

Nature of Innovation

Denial

> “Every fact of science was once damned. Every invention was considered impossible. Every discovery was a nervous shock to some orthodoxy. Every artistic innovation was denounced as fraud and folly. We would own no more, know no more, and be no more than the first apelike hominids if it were not for the rebellious, the recalcitrant, and the intransigent.”
>
> — *Robert Anton Wilson*

Perception of Technology Change

Amara’s Law

“ We tend to overestimate the effect of a technology in the short run and underestimate the effect in the long run ”

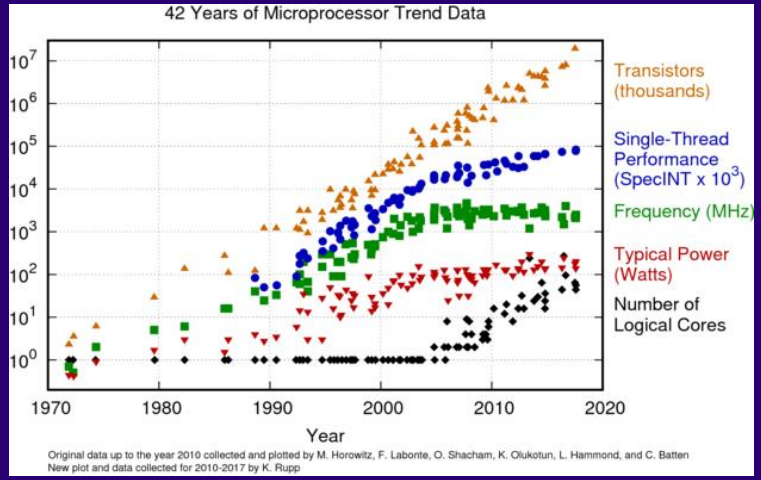
- *Roy Amara*

“ An analysis of the history of technology shows that technological change is exponential, contrary to the common-sense “intuitive linear” view. So we won’t experience 100 years of progress in the 21st century—it will be more like 20,000 years of progress (at today’s rate). The “returns,” such as chip speed and cost-effectiveness, also increase exponentially. There’s even exponential growth in the rate of exponential growth ”

- *Ray Kurzweil*

Need for Speed

Moore’s Law



Single thread performance has flattened!

https://www.karlrupp.net/2018/02/42-years-of-microprocessor-trend-data/

Need for Speed & Efficiency

SW Parallellism & Performance

- Moore’s Law enables new applications (RAN)
- Making value from Moore’s Law depends now completely on SW
- 5G RAN Baseband SW is extremely high-performance / compute intense
    - Emerging SW stacks from silicon vendors are a good starting point
    - But needs Tuning, Architecture, Integration & Optimization
    - This is a very difficult SW design challenge
    - Tietoevry has some 700+ R&D engineers in the baseband area

Need for Speed & Efficiency

Accelerators are needed

- Accelerators (GPU / FPGA / ASIC) are needed for high performing use cases
  - Creates a HW – SW coupling issue
  - Complicated to program
- The energy efficiency issue
  - The execution of baseband SW
  - Enabling more efficient radio algorithms
  - Translates to OPEX

Open RAN Integration is an R&D challenge at the final stage of solution development

Modifying it until it works!

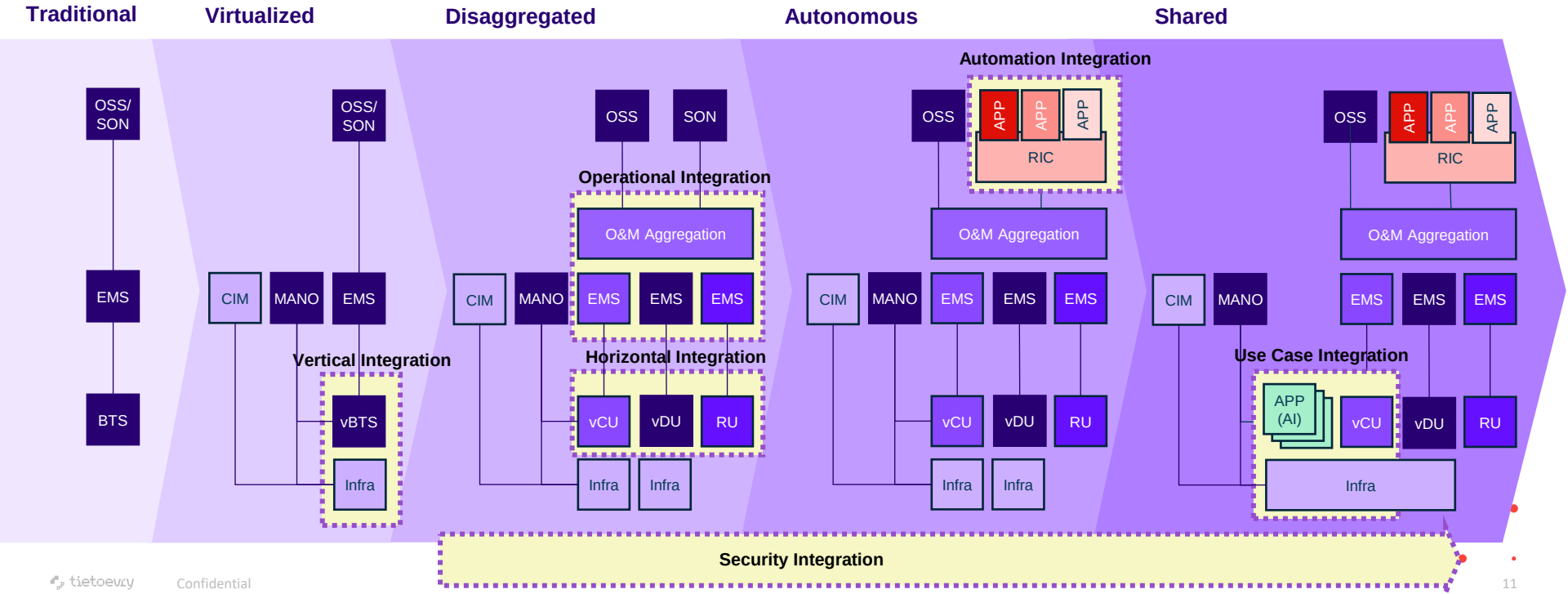
Connecting things that likely work!

- RAN is not the same thing as gNB (BTS)! Hybrid networks
- Easy to integrate is not the same thing as interoperability!
- Integration for tailoring? Use cases and variant volume issues

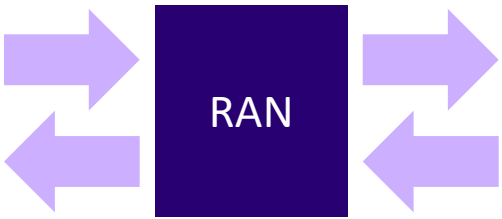
“ there is only construction and re-construction ”
Jack Järkvik

Integration & Automation

Open RAN adding new Integration Challenges

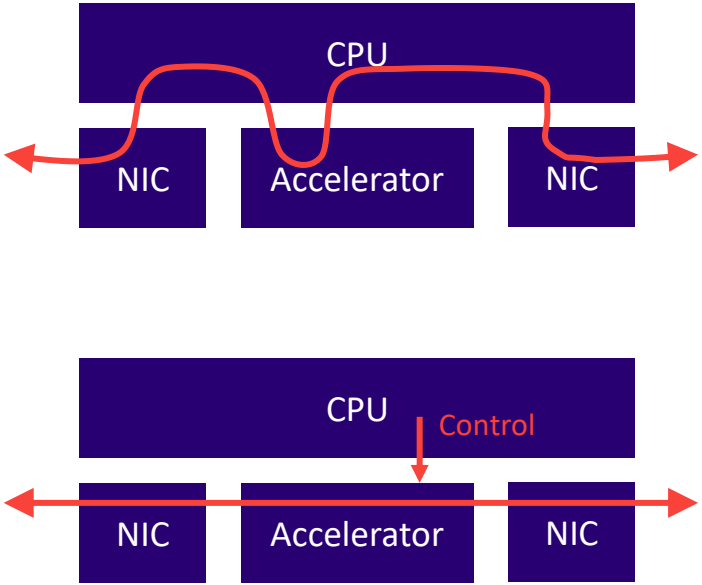


Virtual RAN is a ”pipe and filter” application



- Very high data rates
- Complex and resource demanding algorithms involved
- CPU performance vs RAN performance – e.g. energy efficiency
- Poll-mode for packet arrivals
- Scaling over multi-core
- Cache hit-rates
- Various Linux distributions & releases
- DPDK and other libraries
- L1 – L2 integration – FAPI

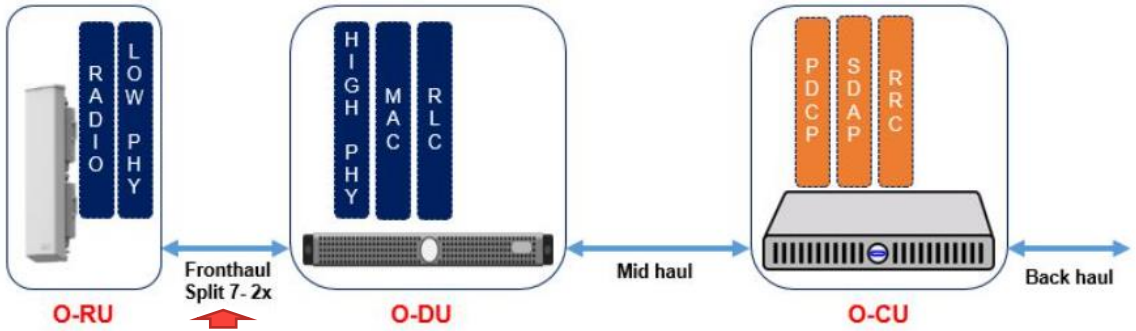
What is the balance between flexibility and performance? Towards an in-line architecture? Or specializing the CPU?



- There is a benefit of having acceleration optional (”look-aside”)
- But comes at a performance penalty
- PCIe bus congestion
- Accelerators are difficult to program
- In-line architecture one option
- Technology evolution towards making the CPU more specialized
- **All of this requires great domain knowledge to achieve the right optimization**

The O-RAN Fronthaul interface

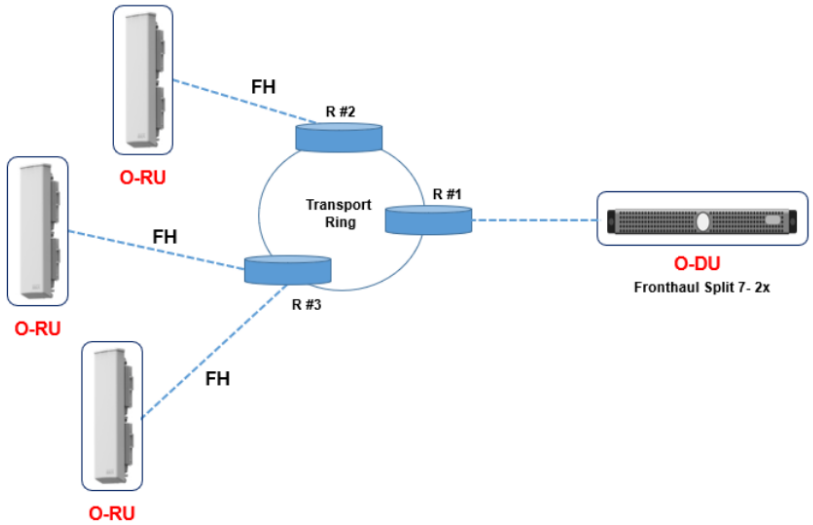
- O-RAN standard created by operators (O-RAN Alliance) target to enable a larger eco-system and diversity of vendors
- It is required that vendors will collaborate to create customized solution
- Any vendor DU to any vendor RU should be compatible - Open Fronthaul
- Example: O-RU , Antennas, O-DU can be purchased separately



O-RU<->O-DU integration

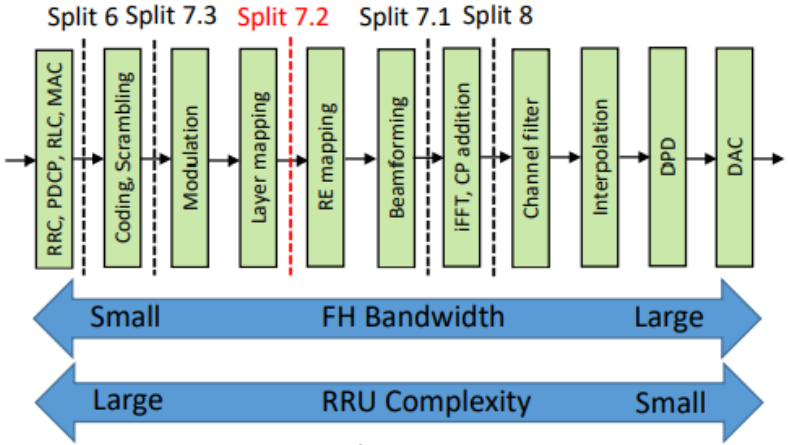
O-RAN Radio Unit ↔Distributed Unit interface overview

- O-RU and O-DU connected by a high speed, low latency and highly reliable transport link known as Open Fronthaul. 10/25/40Gb Ethernet II (asynchronous)
- Transport network is scalable and different topology can be created
- Uses eCPRI protocol for succesful synchronized transfer of digital DU data (freq. domain IQ samples) between O-DU and O-RU
- eCPRI itself do not deliver a full interface standardization that would allow a true interoperability among different vendors.
- O-RAN is defining DU↔RU interoperability

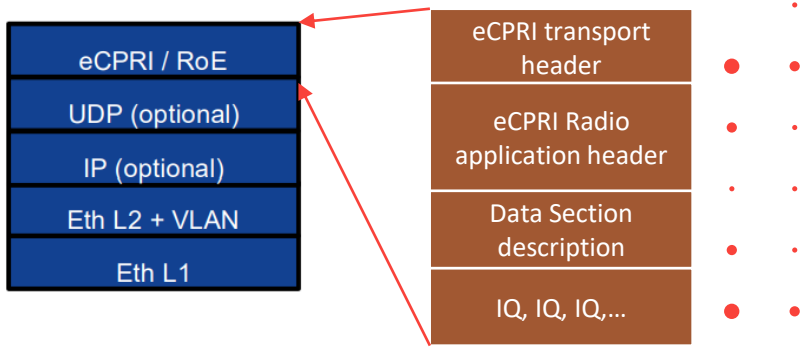


O-RAN Radio Unit ↔Distributed Unit interface overview

- O-RAN utilizes so called 7.2 split already used in eCPRI (extended CPRI)
- Digital data transmitted in frequency domain (not time domain)
- Allows compressed or uncompressed formats of digital IQ samples
- Transmission/reception timing windows defined to avoid eCPRI packets loss over Ethernet transport interface- stringent FH latency requirements



Split 7.2

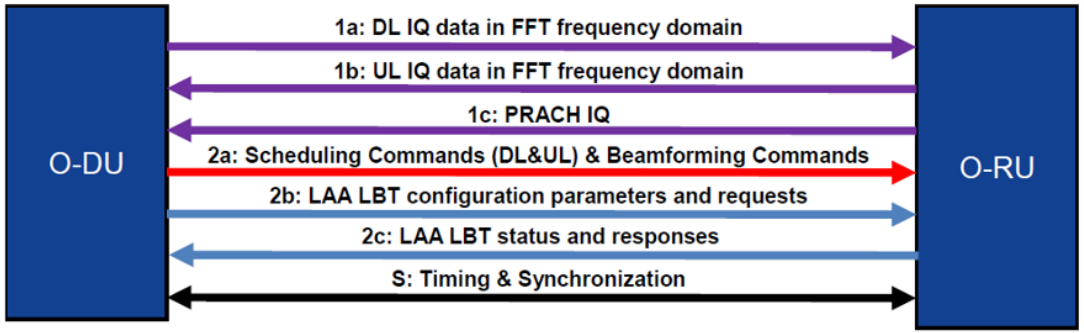


Protocol stack

eCPRI packet

O-RAN Fronthaul: Control-, User-, Sync- & Management-plane

- Fronthaul interface is carrying IEEE1588 traffic, ORAN packets
- eCPRI packets are carrying ORAN C-plane (From DU only, no ACK) or U-plane messages,
- C-plane are scheduling/beamforming commands for U-plane
- Shouldn’t loose any CU-plane packet (strict delay constraints),
- S-plane is IEEE1588 , syncE
- M-plane is a separate plane of ORAN for O-RU but can use the same ethernet link. Used to provision/control/manage the RU (freq. Band, adresses, KPI reads etc.)



Horizontal Integration

Why is it difficult to integrate Radio Unit with Distributed Unit?

- ORAN still gives some space for different interpretation – RU/DU can be ORAN compliant but may still not work.

ORAN interpretation

- Companies possesing the L1 or L2 have no knowledge about the RU
- Companies producing RU's are not aware of L1 Upper PHY/L2/L3 details
- Operators forced to build its own team of experts for integration.
- RAN vendors want to use components (e.g. FlexRAN) w/o modifications. Integrating those components require domain expertise

Domain expertise

- Some L1 products is not (fully) ORAN compliant and offer limited functionalities , not covering all use case scenarios
- ORAN DU parameters are not matching ORAN RU parameters
- ORAN is still under development. ORAN 6.0 is newest.
  ORAN 6.0 must be backward compatible, but some problems still arise.

DU/RU are not ORAN Compliant, not matching the settings

- Lack of proper equipment if someone want to integrate (ORAN lab access)

Expensive Lab equipment

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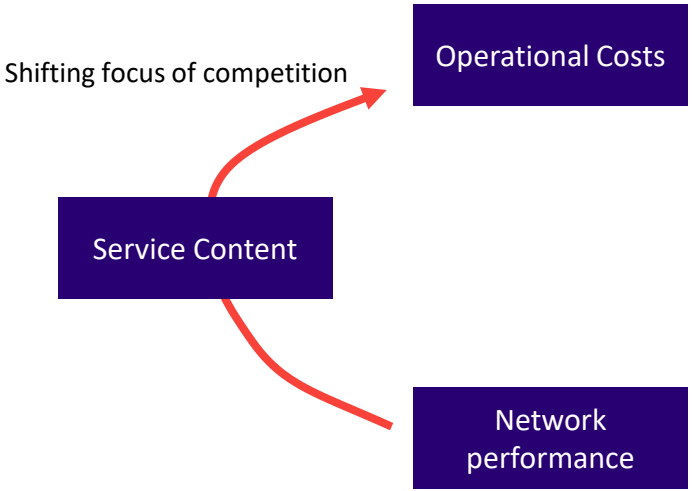
A historical look-back at Automation – Semantics are crucial

- Entirely manual – every hop needed manual operation
- The data plane was integrated – i.e. a microphone could send information to a loudspeaker
- To automate phone call dialling required us to integrate:
  - The protocol by which we send digits (rotary dial)
  - The semantics of those digits (country & area codes, subscriber numbers)
  - (intent was excluded – telephone directory – planning approach)
- After being automated, we refer to it as the Control Plane

→The intent and semantics layers are crucial if we are going to achieve interoperability and zero-touch operations

Mobile Network Operators need investing in more efficient work processes – irrespective of Open RAN

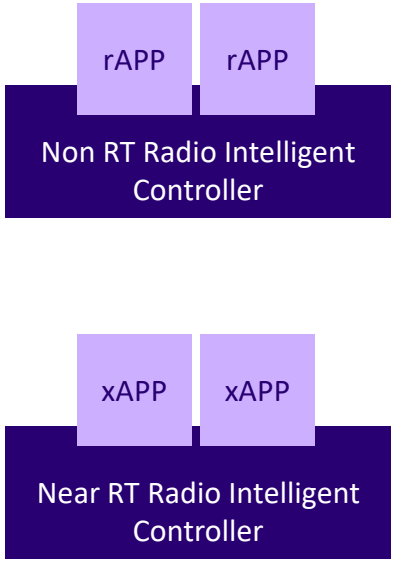


- Finally, Operation & Maintanance finds its way to the spotlight
- Cost control, or the way to compete?
- Operational processes, tool-chains and data flows become purpose-built for operators to compete
- **Operational systems are no longer off-line batch systems, they are part of the control-loop and require substantial integration efforts**

What drives OPEX?

- Radio Access Networks are costly to operate – the lions share of running mobile networks
- But what are the costs?
  - Energy consumption
  - Site Rental
  - Backhaul costs
  - Cost for maintenance – mostly swap and repair of broken equipment – field personnell
- **(Hidden) Costs related to non-optimal networks – i.e. improve performance of networks**
  - **Network complexity**
  - **Calls for automation & intelligence**

Moving intelligence into an APP-world



- Towards the idea of programmable networks – implementing control-loops
- Providing an ability for tailoring
- Opens up for more innovation
- The issue of the diversity of the RIC platforms

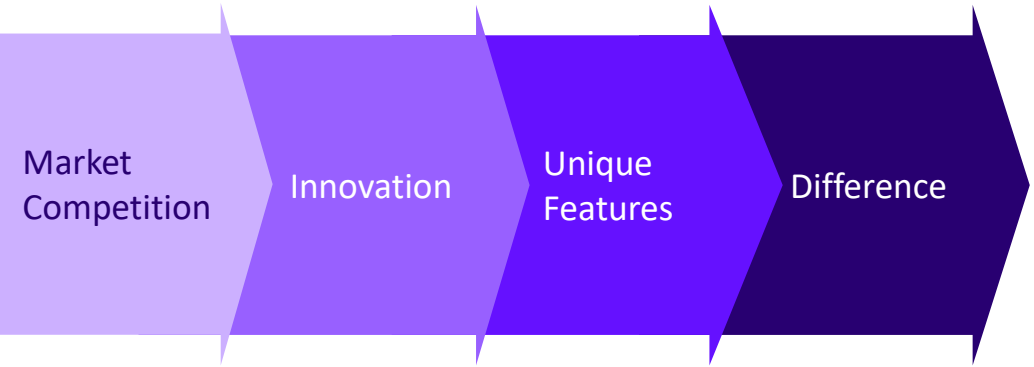
Conflicting Control loops require careful integration in the context of an Mobile Network Operator

Policy conflict

Control conflict

- APPs are implementations of Control loops
- Conflicting goals will cause all kinds of problems:
  - Oscillation
  - Non-optimal system states and behaviur
  - Less throughput, higher energy consumption
- These APPs are there to control the RAN (which is very different from iPhone APPs)
- Integrating in Lab is different from optimizing in operation
- **This implies that a certain collection of APPs needs to be integrated – in the context of the mobile network operator**

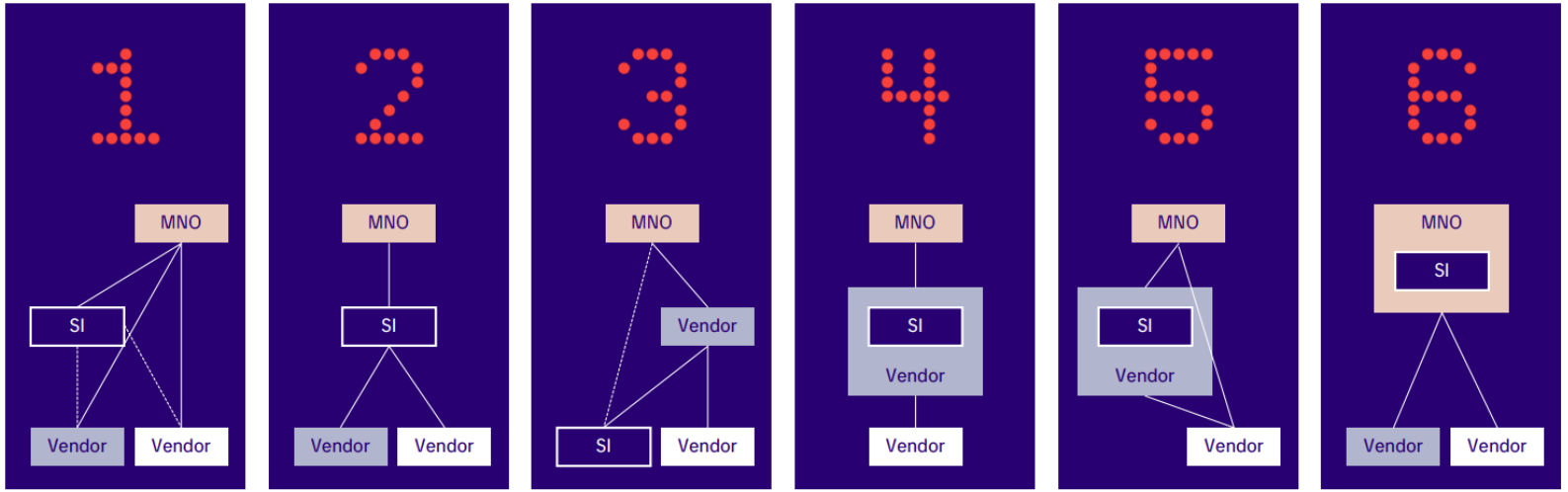
Interoperability and full automation is somewhat contra-dictionary to innovation



- Standardization vs Innovation
- Acknowledge differences as we want innovation
- Integration becomes the key to enable innovation
- I.e. stiching a selected set of products, and their differences into one solution

Open RAN Integration

Finding the right value chain is crucial to avoid just another Lock-in



Integrating an Open RAN solution is as difficult as integrating a RAN!
Integration is a continous process!

It's perfectly possible given you have the right partner

Complexity is still there!
But remember Amara's law!

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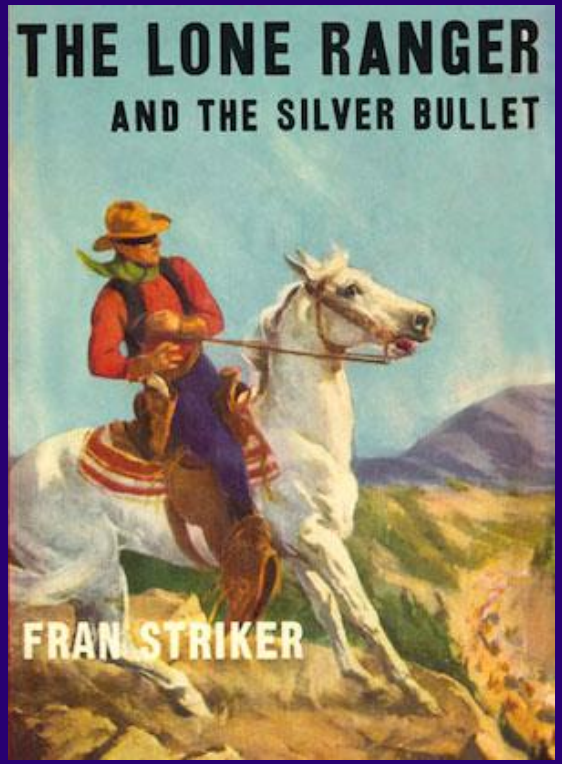

Tietoevry has 2000+ professionals with very relevant skills

Tietoevry white paper on Open RAN Integration (see attachments tab in the webinar)
https://www.tietoevry.com/en/blog/2022/03/key-open-ran-integration-challenges/

Thank You!
Q&A

Mats Eriksson,
mats.eriksson@tietoevry.com

Lead Business Developer, Radio
Tietoevry Create

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