



Aria Networks
Virtualize. Optimize. Monetize.

Using AI to Drive 5G Network Slicing

Dr Jay Perrett
CTO Aria Networks

Feb 8th 2017

'Virtual Networks in 5G - Opportunities or Hype?'

Opportunity – No Question !

- Drivers
- Significant 5G Technical Challenges
- Virtualisation is only part of the solution
- Demo : Closed Loop 5G Network Slicing



1 : Explosive growth in demand for wireless broadband services which require faster and higher capacity networks to deliver video and other content-rich services.

2: Massive growth of Internet of Things (IoT) applications – some of which will require ultra-low latency and need highly reliable IP connectivity.

4G was not designed to cope with the Smartphone Revolution.

Significant 5G Technical Challenges

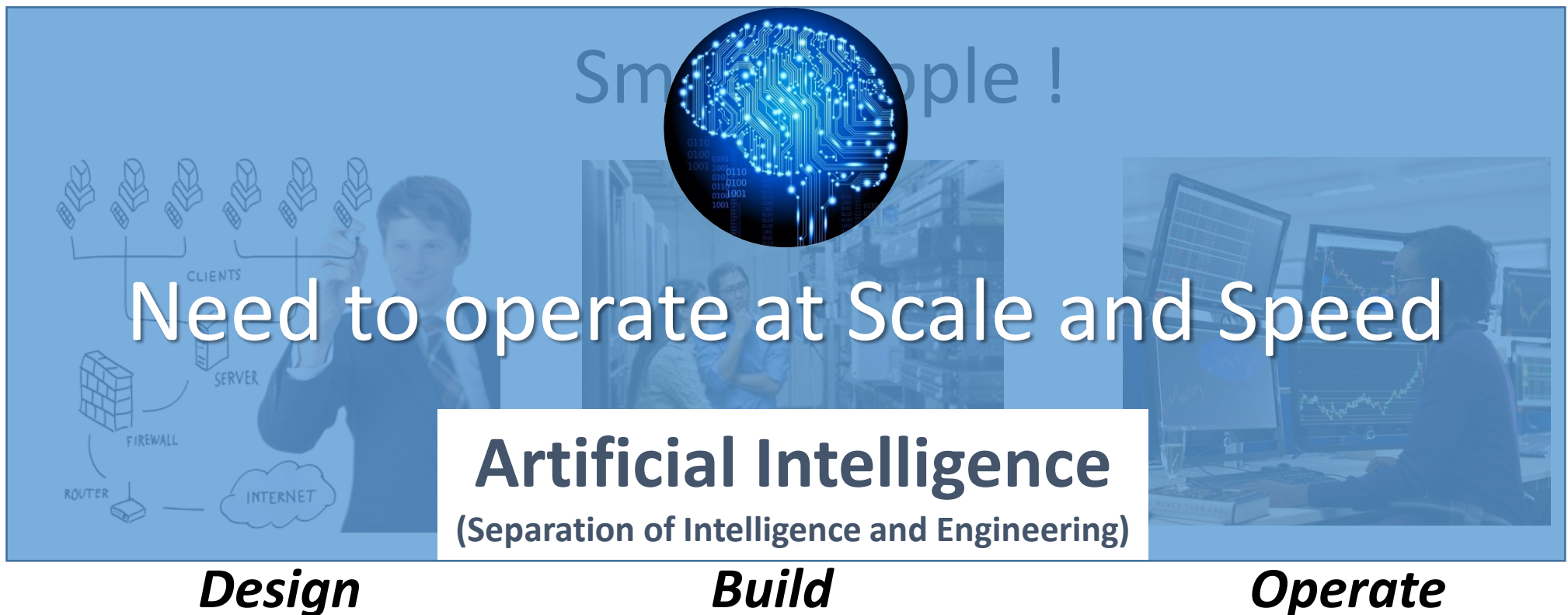
As the cellular industry prepares for the move from 4G to 5G in a few years' time, here are a few key challenges that need to be tackled. Here are a few examples ...

1. **IoT ...** Volume and Number of connections (3GPP based networks has control plane limitations)
 - Including M2M, automotive, home automation, smart city, device to device etc
2. **Data Volumes / Throughput ...**
 - 5 Billion devices (2015 mostly smartphone) → 50 Billion connected devices (2020)
 - 2.5 exabytes/month (10^{12}) 2015 → 25 exabytes/month (2020)
3. **Flat rate tariff** user expectations.
4. **Cloud based resources**, e.g. CRAN
5. **Real-time information** for time critical services, e.g. emergency services, smart city applications.
6. **Energy efficiency...** Wireless/mobile broadband infrastructures account for more than 50% of the energy consumption of telecommunication operator networks, while the amount of global energy consumption of ICT approaches 4.5% with a rising trend. It is important that future 5G networks.
7. **Standards ... APIs ...** Open – standard - Interoperable

Conclusion : From a system level perspective 5G outlines one particular challenge that overarches all technology, operational and business focussed challenges and that is one of **flexibility**. **By definition this leads to programmability of network components aka NFV. Note this is not restricted to Mobile 5G networks!**

Virtualisation is only part of the answer

1. NFV : Separation of Function from Hardware.
 - Enables Flexibility
2. SDN : Separation of Data from control plane
 - Enables Network Programmability
3. There is a third component Who/What is responsible for network design, build and operate the network ?



Smart People !

Need to operate at Scale and Speed

Artificial Intelligence
(Separation of Intelligence and Engineering)

Design *Build* *Operate*

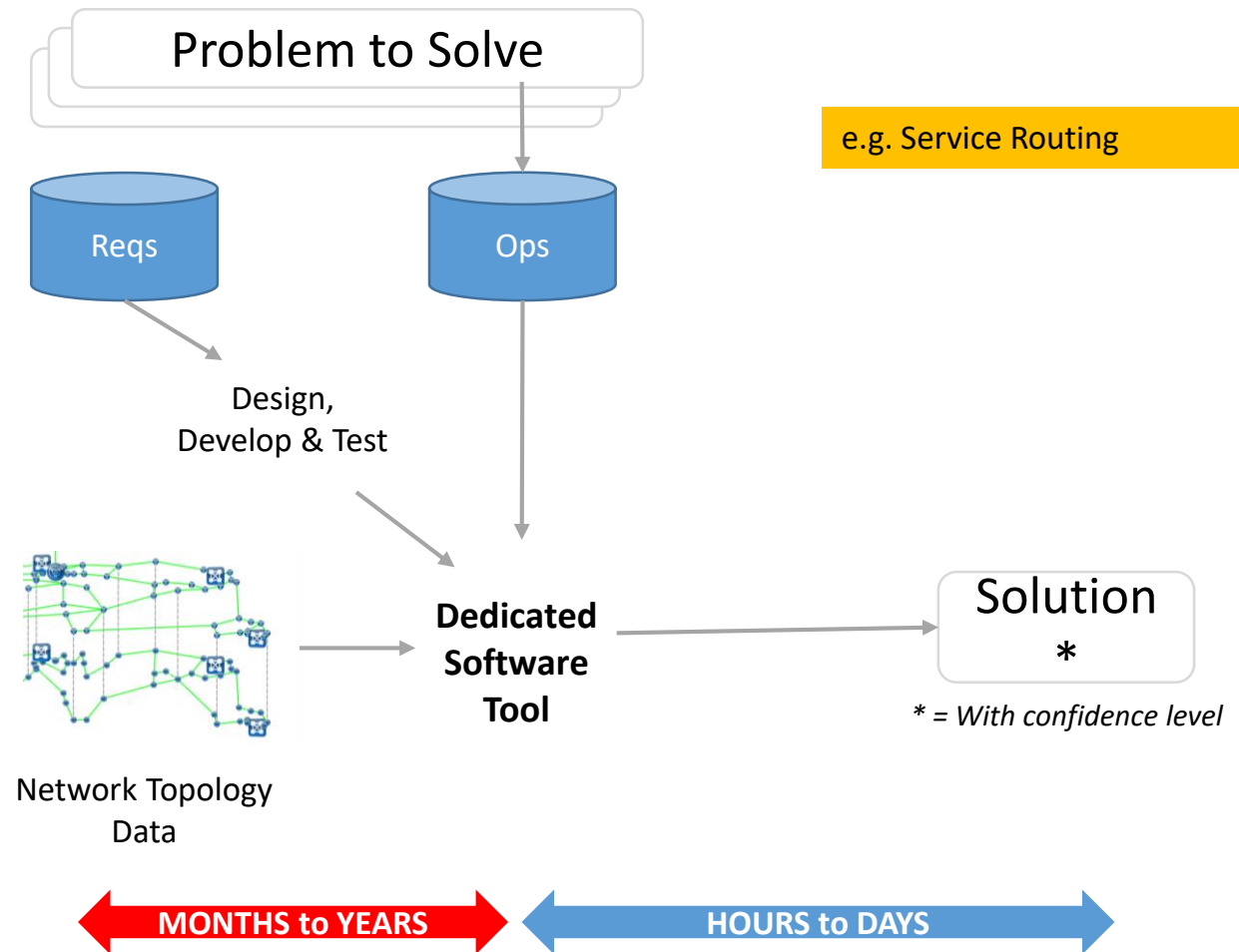
Network Problem-Solving ... legacy

Pros

- Complete control over every aspect of design
- Familiar s/w design cycle

Cons

- Hugely expensive to build
- Project management overhead
- Little scope for re-use
- Not scalable for large/complex data
- High TCO
- Rare expertise required



Current AI – Machine Learning techniques

Pros

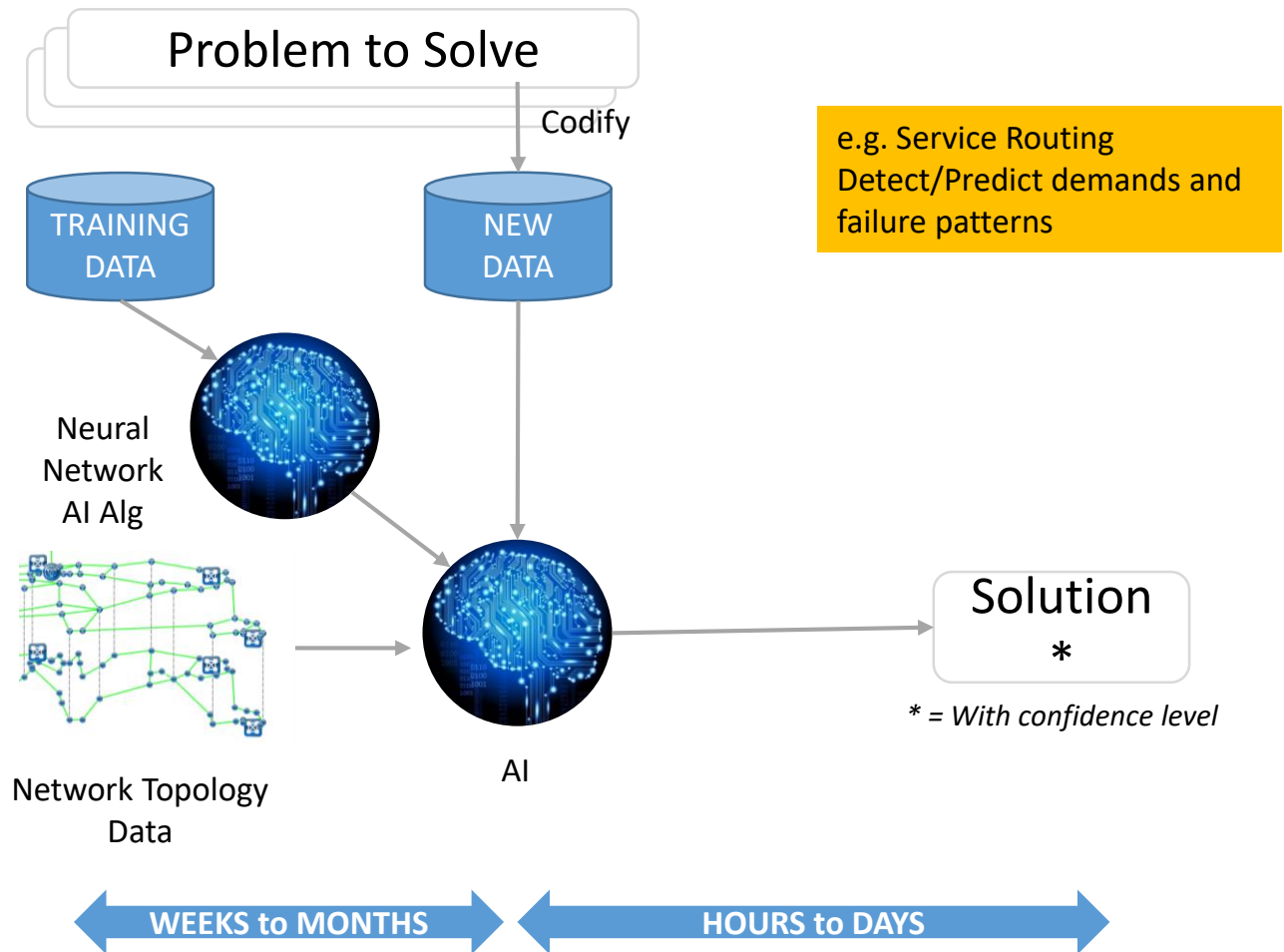
- Can find a solution more quickly than rules-based algorithms

Cons

- Still very complex
- Can only solve 1 class of problem – need a new “Model” for every new problem
- Training period can be lengthy
- AI solutions still need to be designed
- New development process for a new class of problem
- Typically vendor-specific

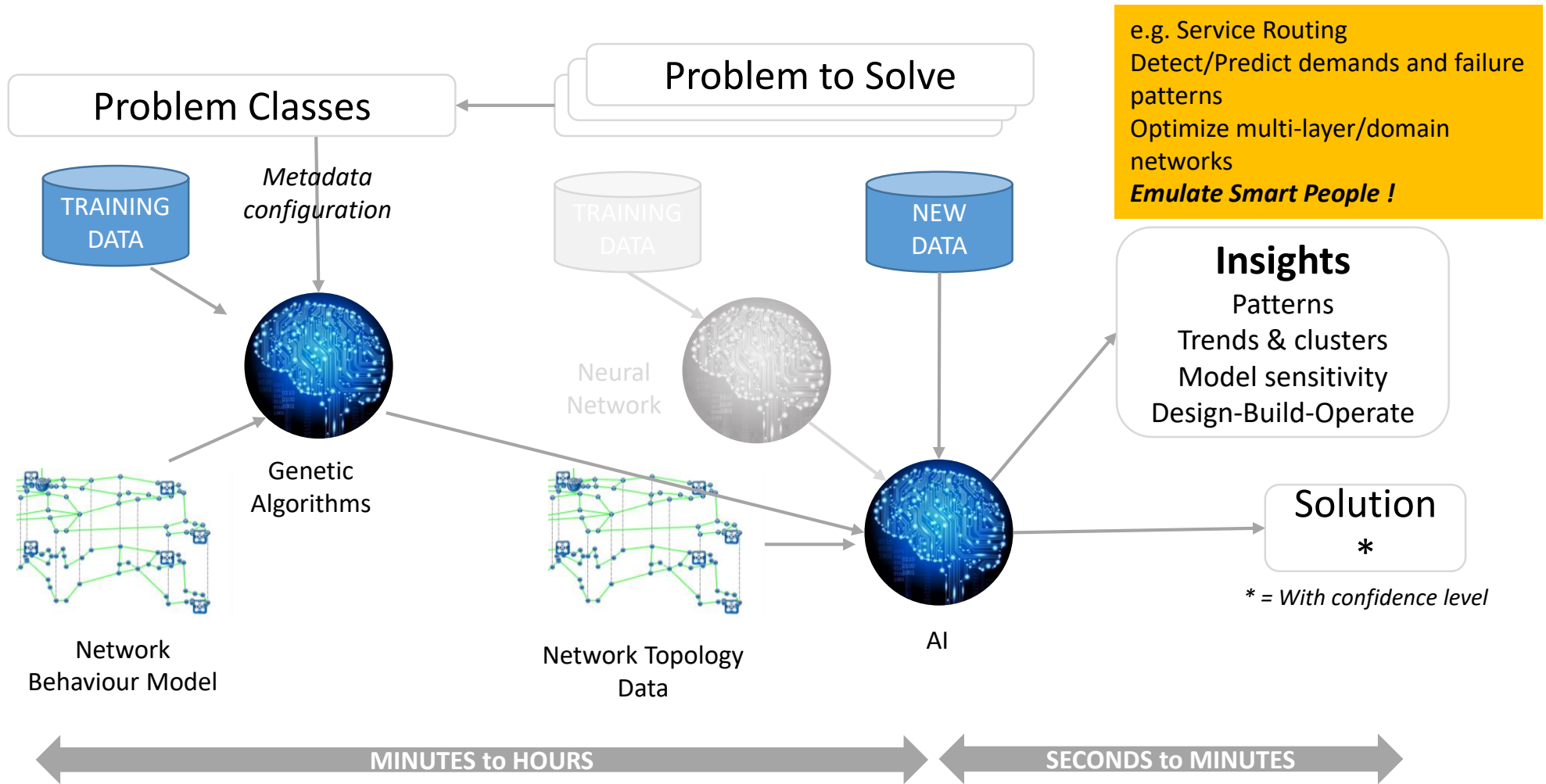


Need to Address Cons



Even Deep Learning !

Using AI... to create AI



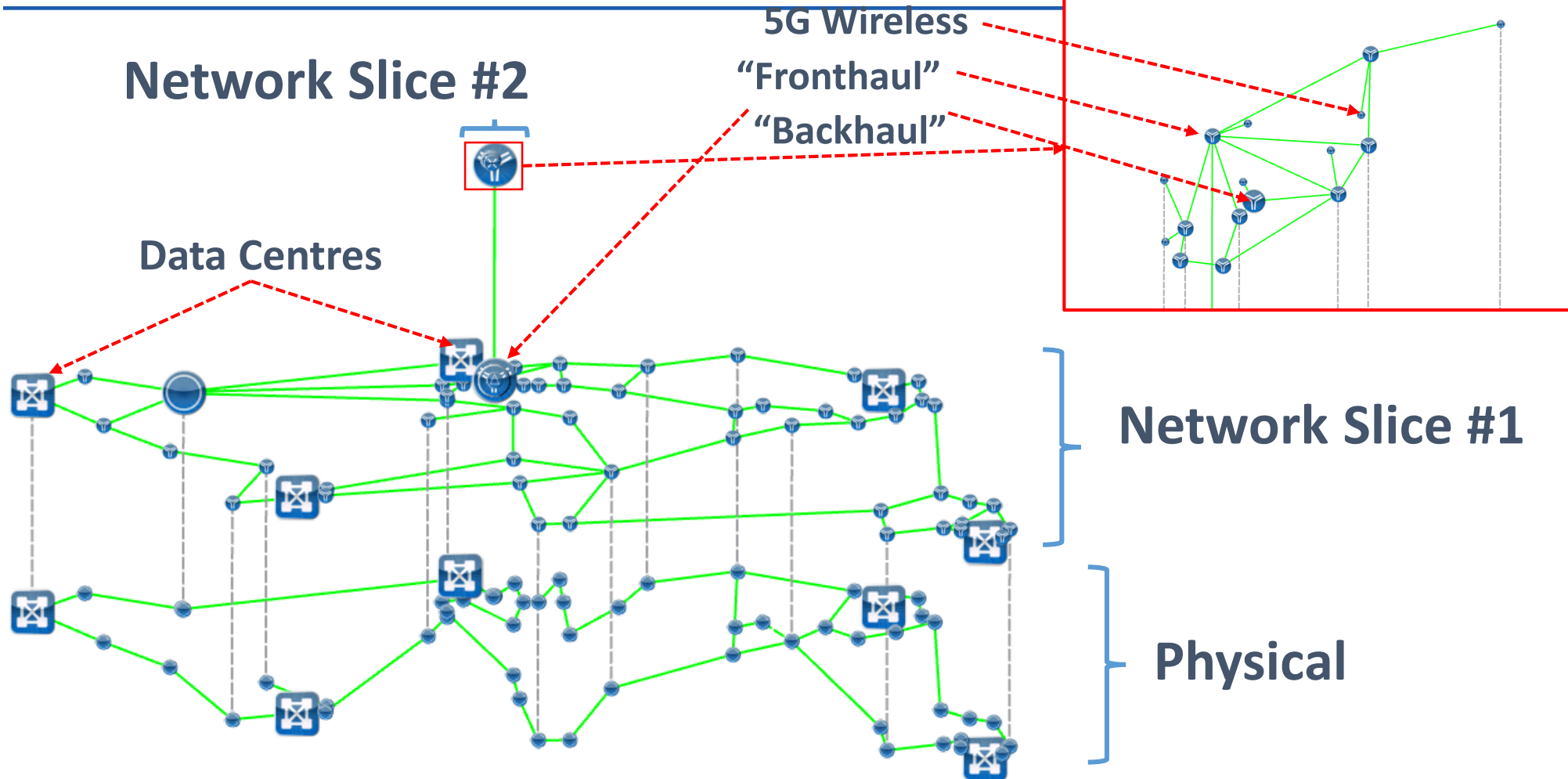
Objective driven and learns in real-time,
i.e. flexible, fast, autonomous

Closed Loop 5G Network Slicing

- This is an example of all I have been talking about ...
 - Closed loop NFV automation (no human involved)
 - Service dependant requirements at the technical, business and regulatory level
 - Engineering a complex 5G application – Network Slicing
 - Managing cloud resources
 - Eco-system developed solution
 - Real Time

- **Use Case 1: Catalogue-driven Slice & Policy Creation**
 - RaceCar Ltd. (Grand Award race organizer) orders a new service for supporting the racing event
 - New slice created by the service provider for RaceCar (includes allocations for 5G Field Wireless, cloud video streaming to spectator devices, advertising, etc.)
 - Smart City policy mandates a 20% capacity margin maintained for existing 5G communication services for public safety and emergency preparedness.
- **Use Case 2: Reactive Closed Loop-driven Network Slice Creation**
 - As the event unfolds there is an overload on the live video streaming service (causing financial metric threshold violations) and a feedback loop creates a network slice dedicated to the cloud video service. This policy was part of the service order.
- **Use Case 3: Predictive Analytics Policy Network Slice Modification**
 - SmartCity policy mandates a 20% capacity margin maintained for public safety and emergency preparedness. Once network utilization goes over 80% a feedback loop gets triggered to resize the Municipal GP network slice according to policy. This policy was part of the service order too.

Network Slice Visualisation



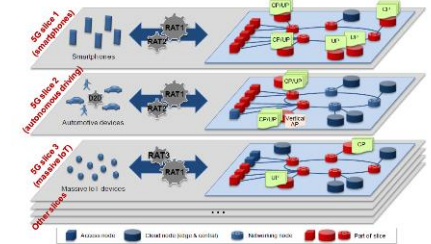
- No of ambulances Demand Multiplier
- No of staff
- Telemedicine
- Telesurgery Service Types
- Special equipment Node IDs
- Location(s)

Network Slices

UC1: Catalogue Driven Network Slice Creation

UC2: Closed Loop Driven Network Slice Creation

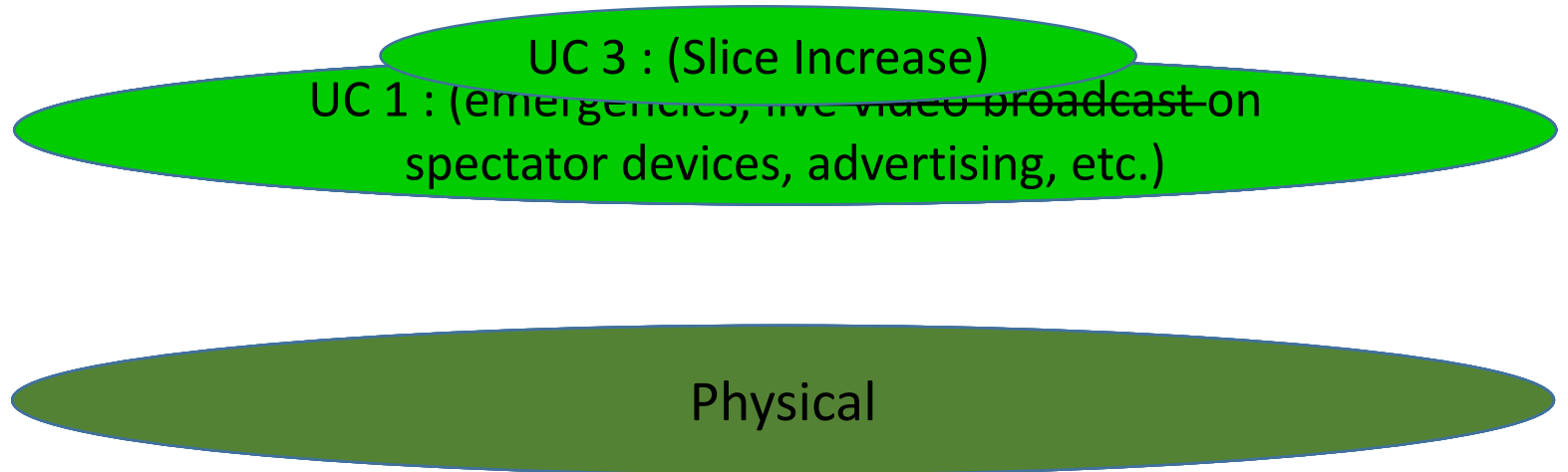
UC3: Catalogue + Policy Network Slice modification



**Monaco
Grand Prix
Video**

**Monaco
Smart City
+ Grand Prix**

Physical



Initial conditions : Physical Global Network (5G, IP and Optical)

Demo - Video



ivNT Capacity Planner

File View Network Services Scenarios Reports Options Help Standard Demo OMI NMI Catalyst

Smart City

7	PE-5-1 [7]	PE	Routable
8	PE-5-2 [8]	PE	Routable
9	PE-P1-1 [9]	PE	Routable
10	PE-P1-2 [10]	PE	Routable
11	PE-P2-1 [11]	PE	Routable
12	PE-P2-2 [12]	PE	Routable
13	Data Centre 1 [13]	Race Car - Big ...	Routable
14	Data Centre 2 [14]	Video Streaming	Routable
15	Data Centre 3 [15]	Web Hosting	Routable
16	Data Centre 4 [16]	Ad Services	Routable
17	Pop 1 [17]	POP	Routable
18	Pop 2 [18]	POP	Routable
19	City 1 [19]	Core	Routable
20	City 2 [20]	Core	Routable
21	City 3 [21]	Core	Routable
22	City 4 [22]	Core	Routable
23	City 5 [23]	Core	Routable

Thank you – Any Questions?

