

# Machine Intelligence for Telecom and Beyond

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- Adjunct Professor, Cyber-Physical Systems, KTH



- **Ericsson**

- Mobile Infrastructure, Digital Services, Managed Services
- 180 countries
- 100K employees
- 45000 patents
- 1 bn subscribers on networks managed by us

- **Ericsson Research**

- 2G, 3G, 4G and 5G were invented at Ericsson Research
- 50% are PhDs
- 40% of all Ericsson patents come from Ericsson Research

- **Elena Fersman**

- Head of Research Area Machine Intelligence and Automation, Ericsson Research
- Adjunct Professor in Cyber-Physical Systems specialized in Automation, KTH
- fersman.blogspot.com, instagram: elenafersman

# Do you know what's common between these?

Cortana

Lucida

Mika

Amelia

Alexa

Siri

Watson



# Data Lake

Cortana

Lucida

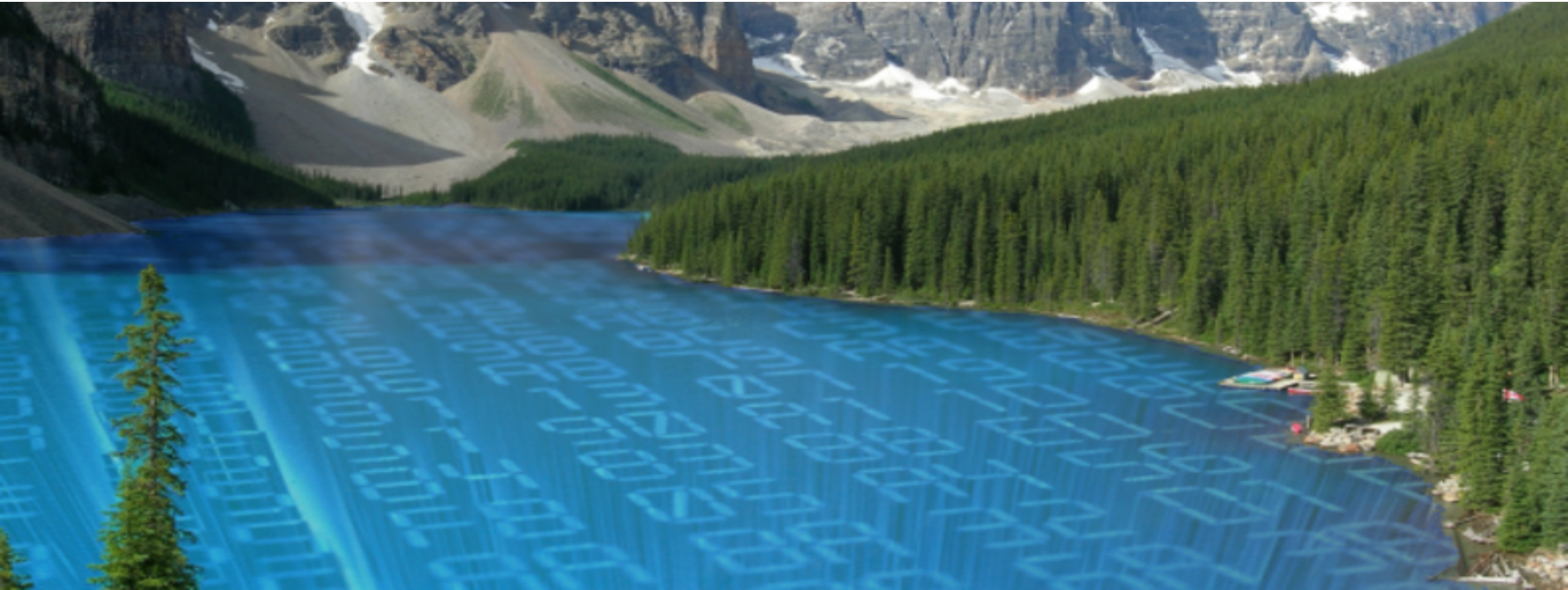
Mika

Amelia

Alexa

Siri

Watson





Hi, what is Machine Intelligence?

Hi Elena, according to Ericsson definition,  
Machine Intelligence is a combination  
of Machine Learning and Artificial Intelligence.

What's MSDP?

MSDP = Multicast Source Discovery Protocol  
MSDP = Multiservice Delivery Platform  
MSDP = Managed Services Delivery Platform



What are your sources?

Ericsson Product Catalogue, CPI Store, Wikipedia,  
and your calendar

Tell me when site X is likely to require a preventative maintenance visit?

Judging from the site profile learned over time, and the current site behavior, the maintenance will be needed in Q3 2018.



TALK IS  
CHEAP,  
BUT  
ACTIONS ARE  
PRICELESS

A black silhouette of a person's head and shoulders in profile, facing left. A large red 'X' is drawn over the mouth area, symbolizing silence or the suppression of speech.

What actions did you do for Operator A's network last month?

I changed parameter configuration in the 5G network nodes. I also sent offers to subscribers with high risk of churn.



Why?

Because we need to stay competitive towards our enterprise customers while keeping our subscribers happy.

# The value is in data

Cortana

Lucida

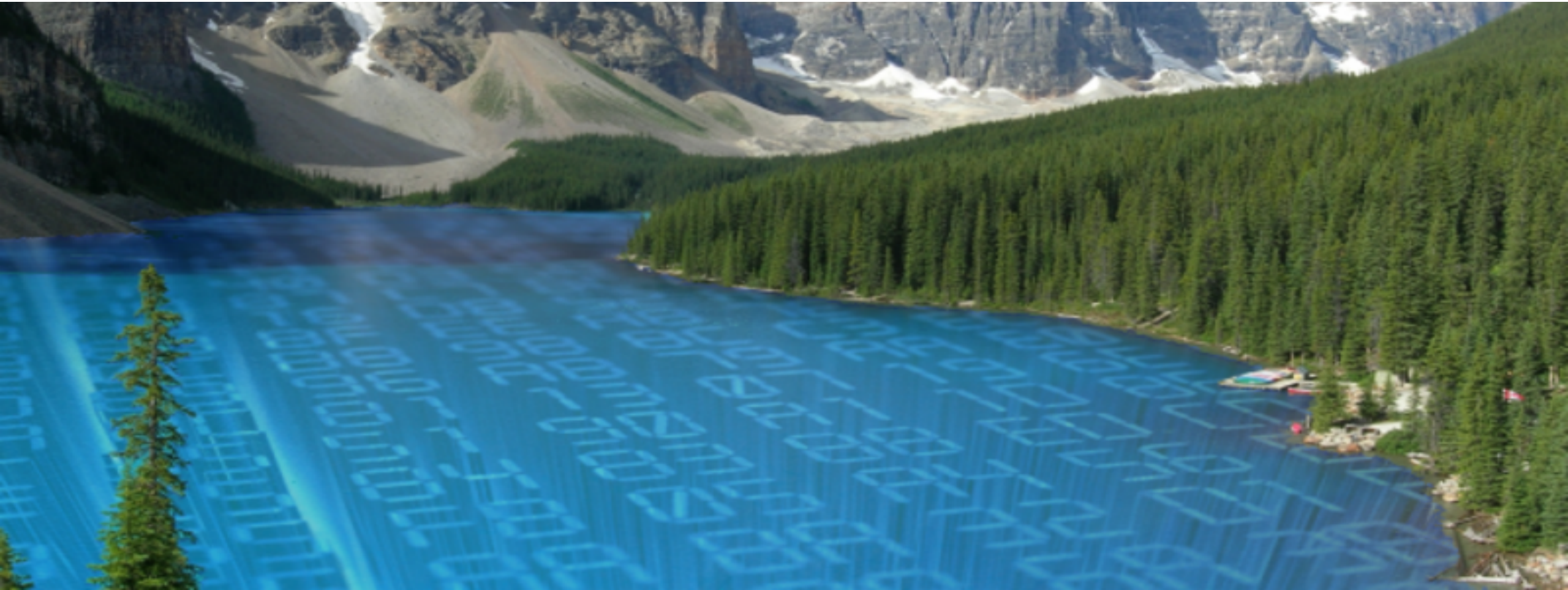
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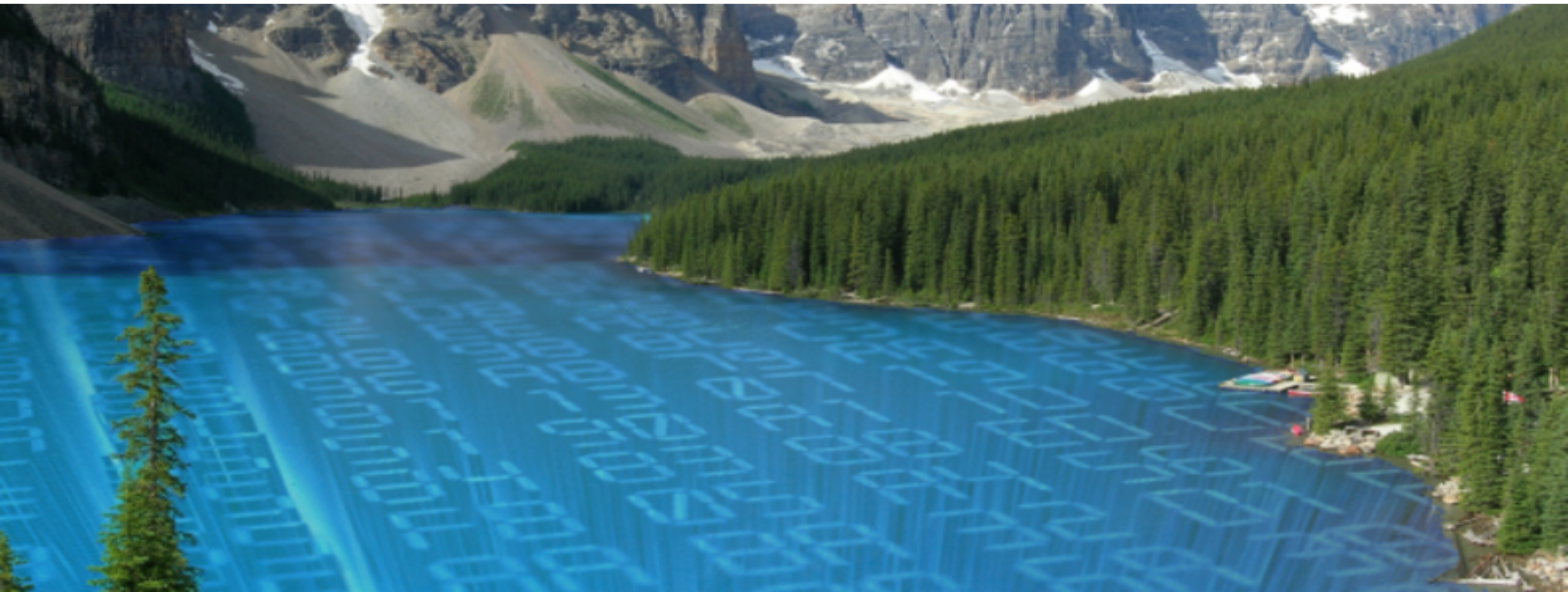
# From raw data to action



Data and its processing



# What's in the data lake?





# ONE DAY IN THE LIFE OF A MEDIUM SIZED NETWORK (~10M CUSTOMERS)



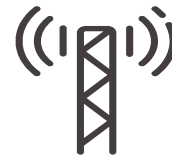
Web pages  
700,000,000



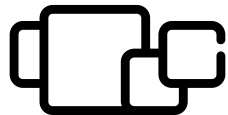
Internet sessions (PDP)  
66,000,000



Videos  
40,000,000



Radio sessions (RAB)  
120,000,000



+200 more types  
of events



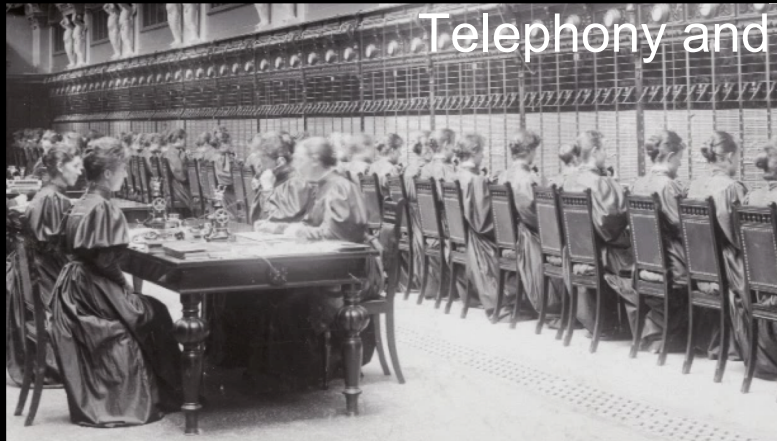
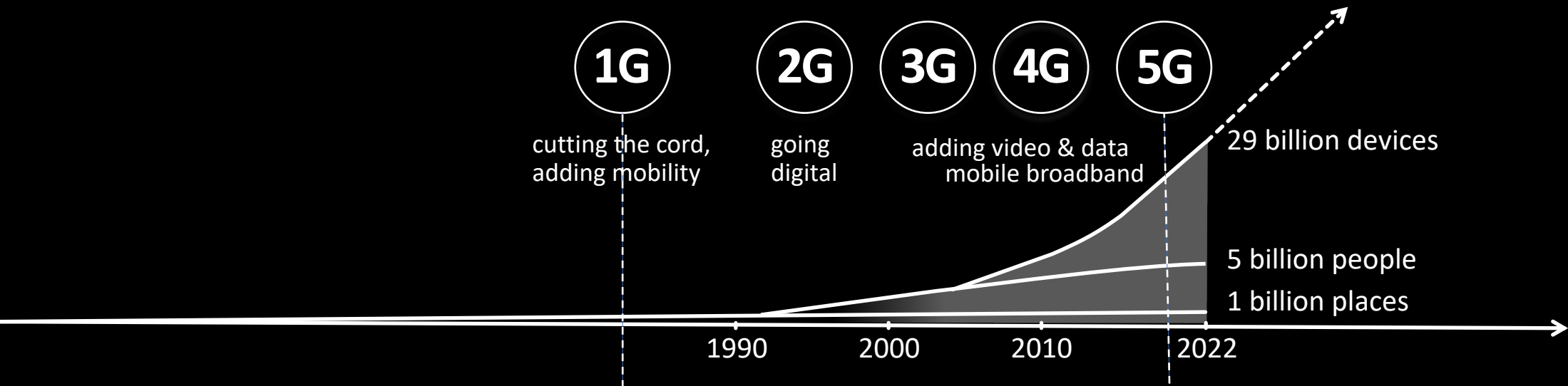
Handovers (HSDSCH-CC)  
300,000,000

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Sum data  
10→100 TB/day

Real-time data rate  
100,000→1,000,000  
events/second

# 5G – a foundation for digitalization



Telephony and mobile broadband



A digital infrastructure for industrial and societal transformation



SENSORS  
EVERYWHERE



BROADBAND AND MEDIA  
EVERYWHERE



SMART VEHICLES,  
TRANSPORT



INFRASTRUCTURE, MONITOR  
AND CONTROL



CRITICAL CONTROL  
OF REMOTE DEVICES



INTERACTION  
HUMAN-IOT

# 5g

USE CASES





# Evolution to 5G will see increase in network complexity

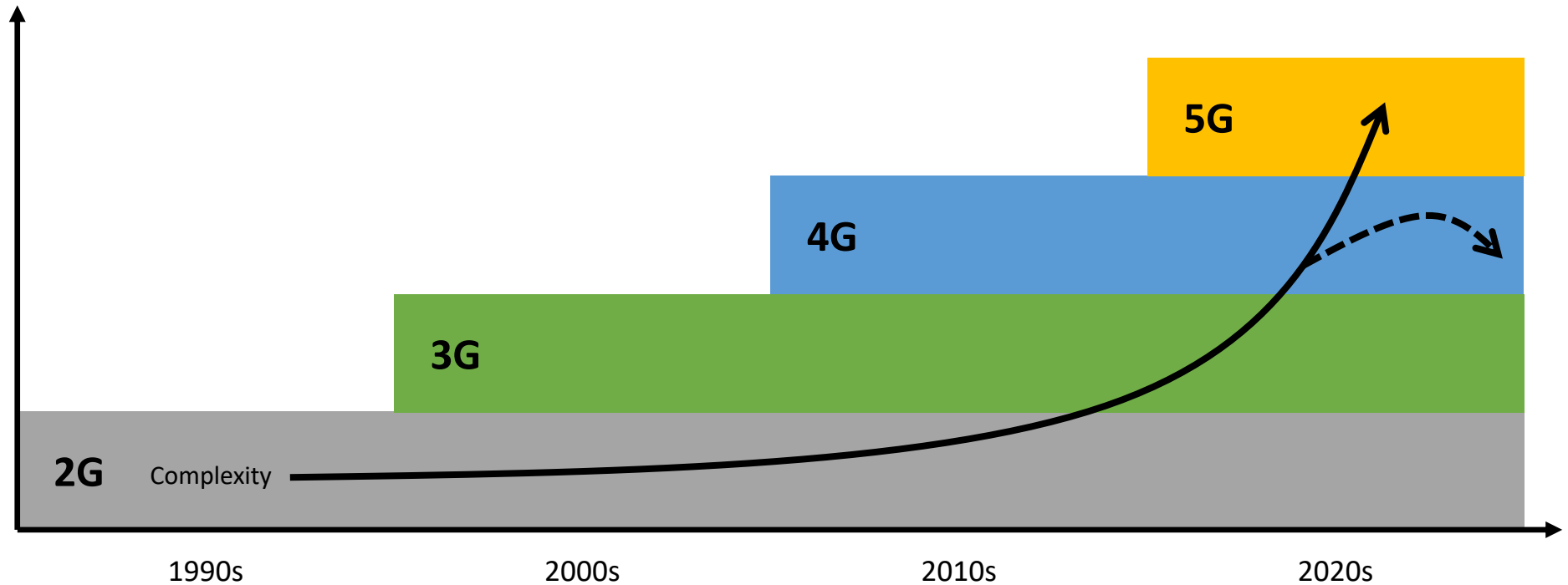
Multiple coexisting technologies

Network function virtualization

Vast differences in terminal capability

Significant variation in traffic demand

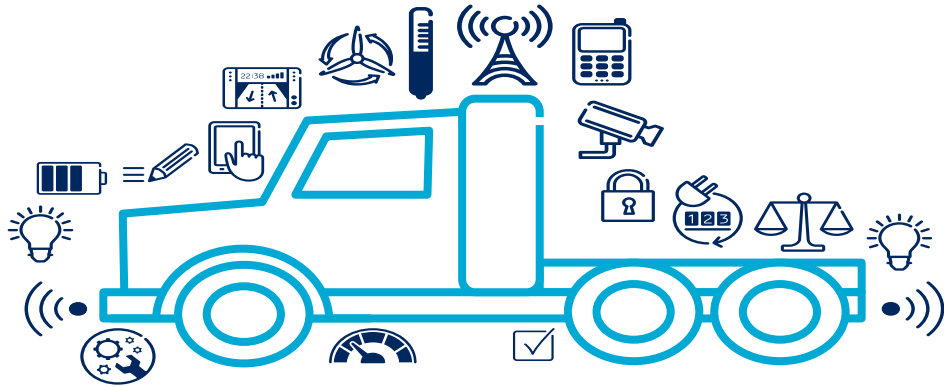
Completely new & varied use cases



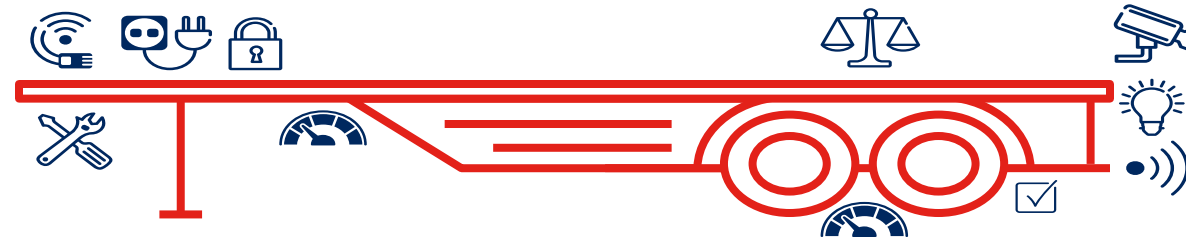
Dealing with opex and network performance in this environment will go beyond the reach of humans



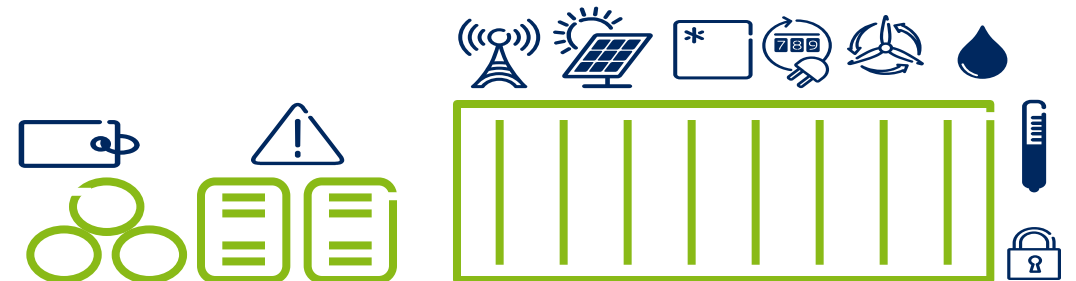
# Complexity in the connected world



e.g. transportation systems are increasingly complex and full of sensors, smart devices and steered by multiple services running on both devices and cloud



the integration of components like trucks, trailers and containers shall be simple



Patient A.  
Blood pressure:  
160/100  
Measured at home

Doctor booked

Street light armature  
#42:13, lamp 2

Work order sent  
to Streets & Parks dept.  
Juni 4, 2012  
2:34 PM

Blinking bulb at  
157 Highstreet  
Message sent to  
caretakers

Booking  
confirmed

High levels of  
particles in oil  
Book service?

A1 northbound  
Congestion: 18 km/h  
Suggest alternative route?

Loaded  
units:  
1500

Remaining units:  
4500  
Estimated departure:  
2:55 PM

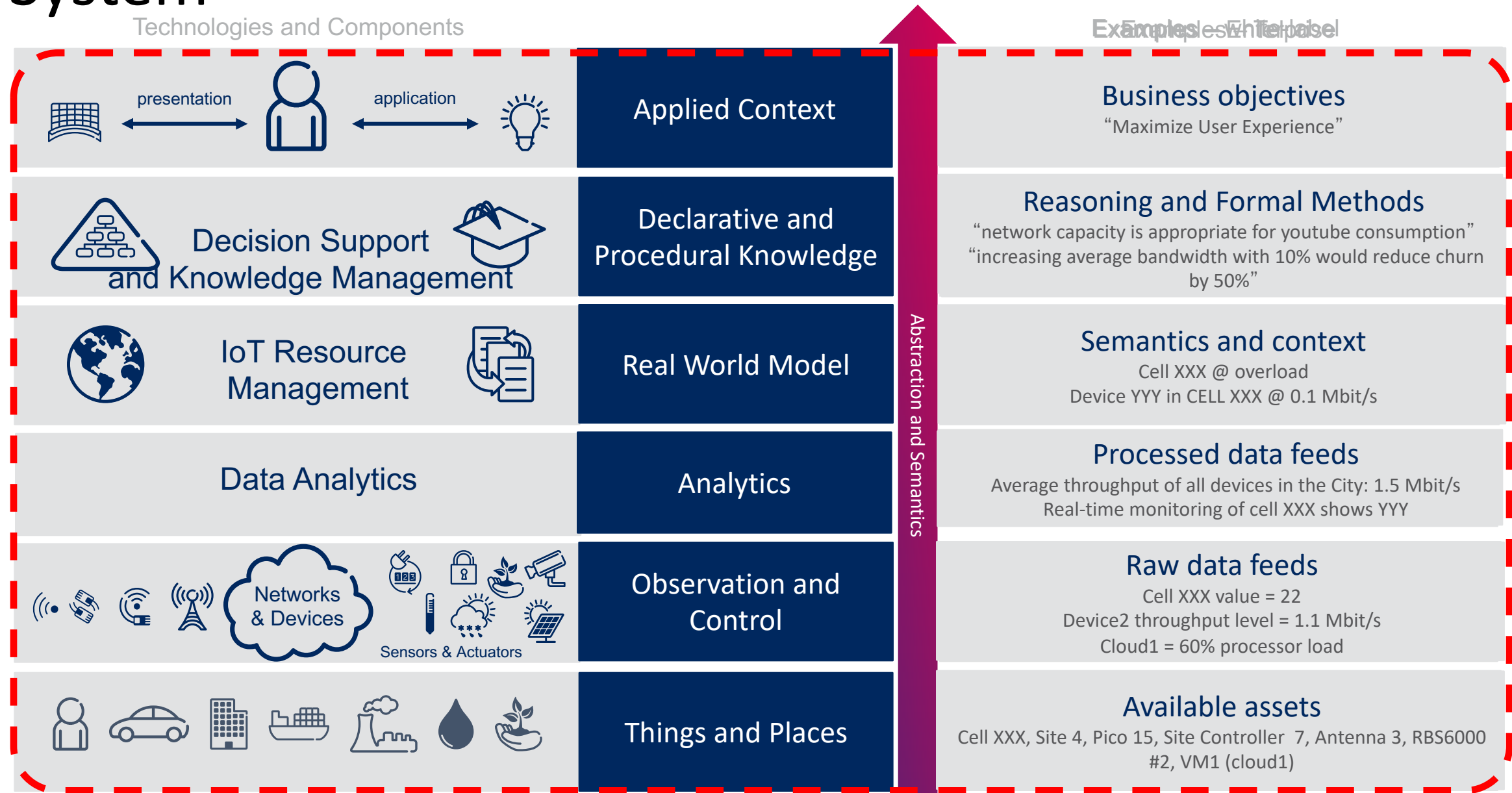
Plant1 too dry!  
Message sent  
to dad

Cyclist  
approaching  
Change to  
green signal

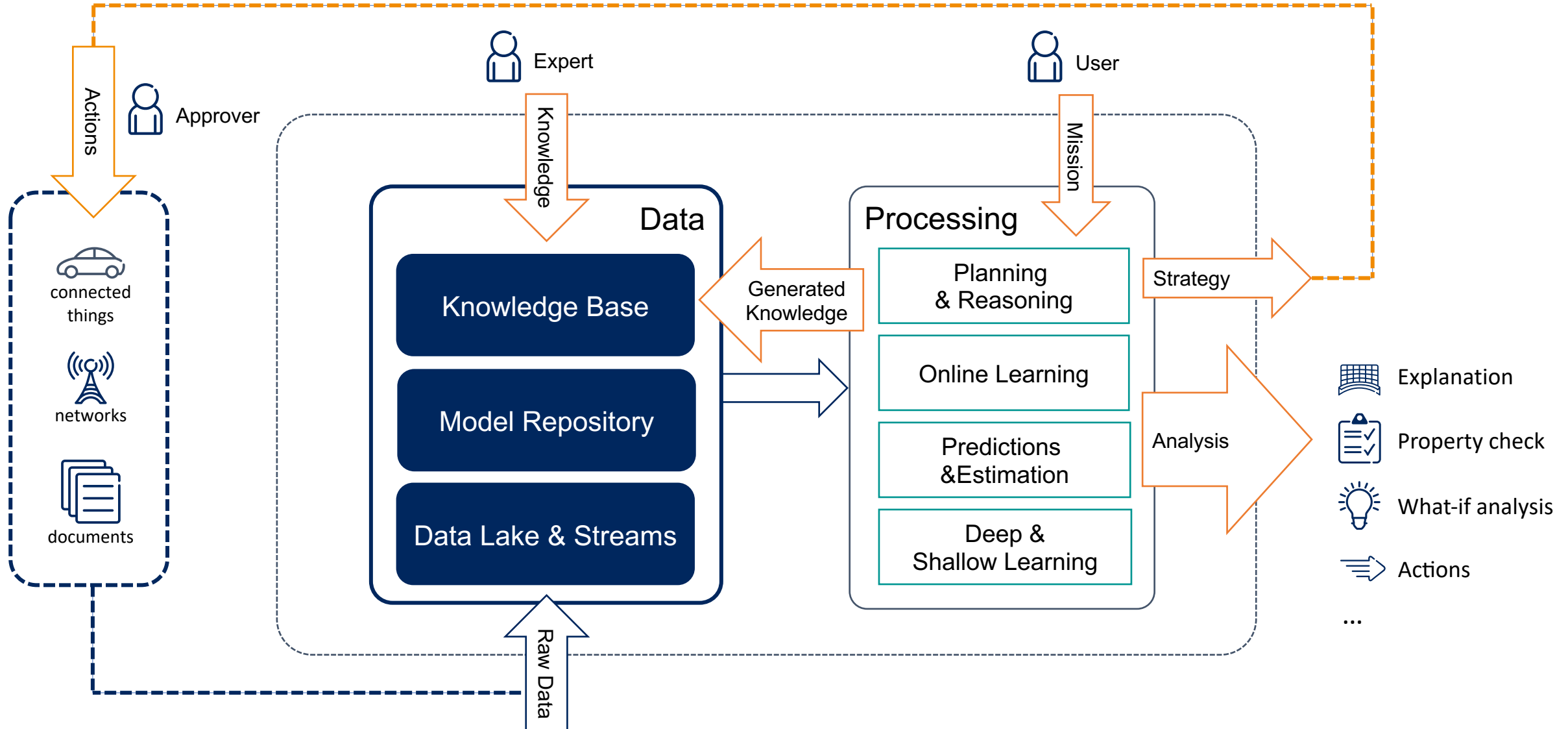
Great!

CO<sub>2</sub>-emission:  
Below target value

# Management and Operations of a Cyber-Physical System



# Technologies behind the scenes





# Intelligent Site



Power failures  
detection

Prediction accuracy

- **85%**  
in combined prediction of  
site down
- **85%**  
in battery degradation
- **90%**  
in grid outage



Sleeping cells  
prediction\*

**7 out of 10**

Sleeping cells correctly  
predicted up to 24h in  
advance



Field dispatch  
prevention

**9 out of 10**

unnecessary site visits  
predicted correctly



Digital Twin  
- site profiling

**At least 1**

anomaly detected in  
**44% of sites**  
over a month



SLA/ KPI  
degradation\*

KPI accuracy

Throughput : **80%**

Latency : **85%**

# Use Case – Sleeping Cell Prediction

## Description

Identify the patterns or triggers that predict the likelihood of a site going to sleeping/silent mode, and automate actions to resolve the issue.

## Data Requirements

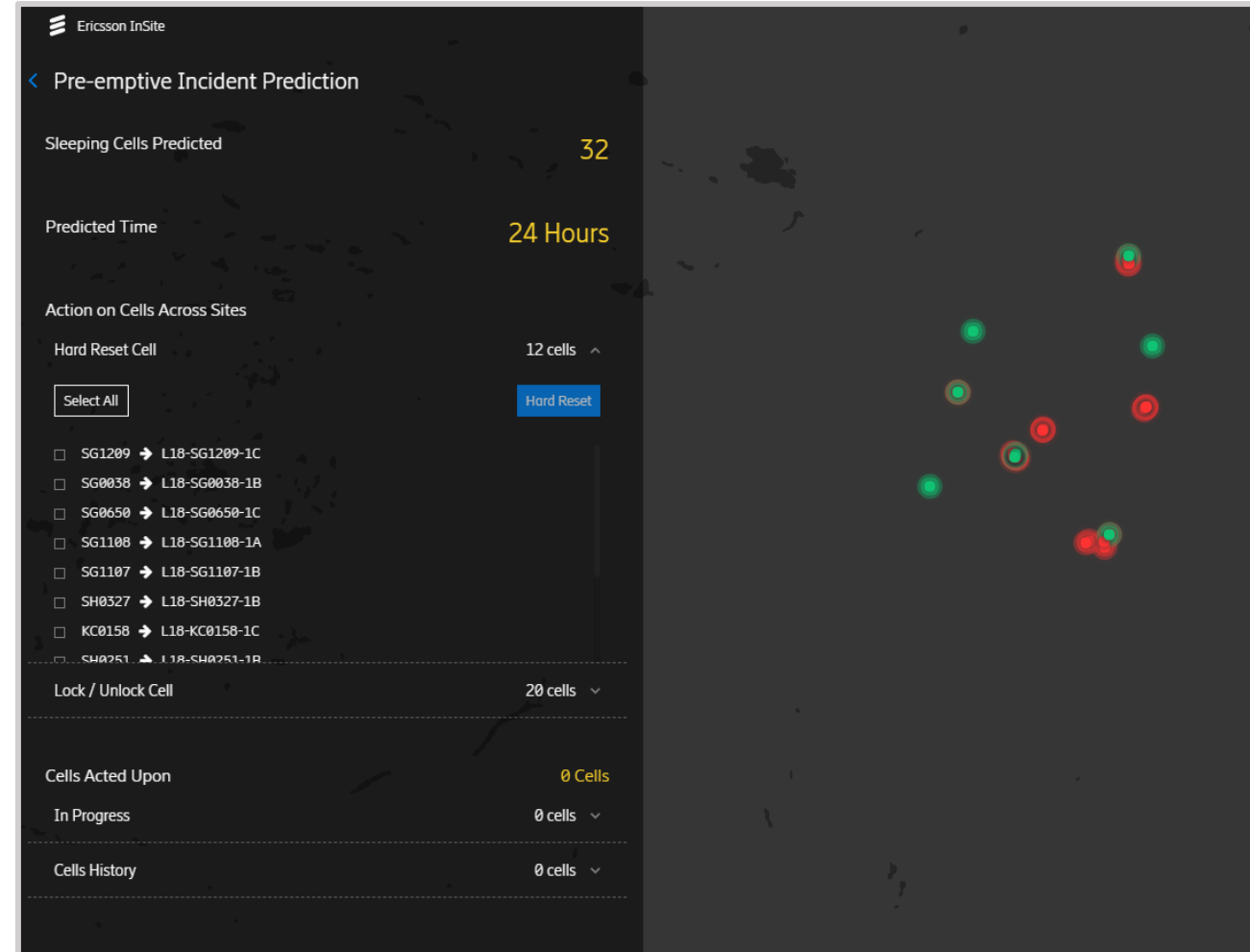
PM Counters, Site Parameters (incl. physical locations), Configuration Management, CTUM, Cell Trace and Automation logs

## Data Models & Algorithms

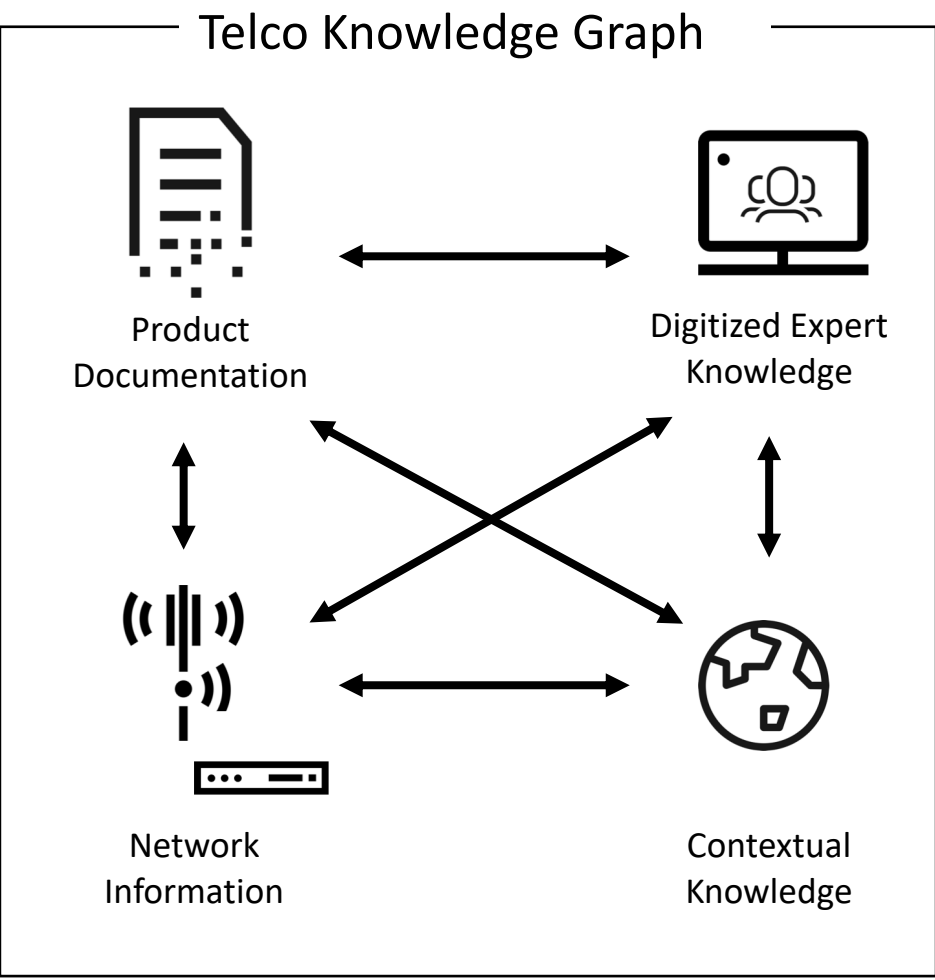
Conditional Inference Tree

## Automations

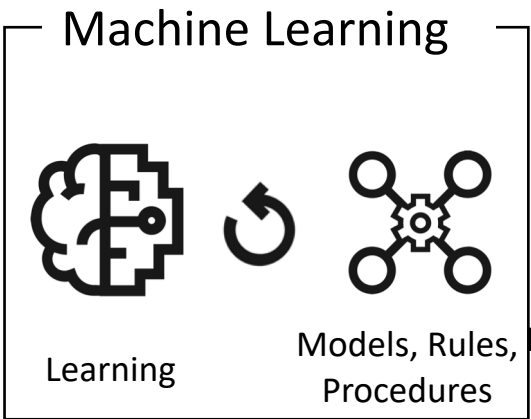
Trigger pre-defined runbooks in an Automation tool to perform remedial tasks (e.g. unlock)



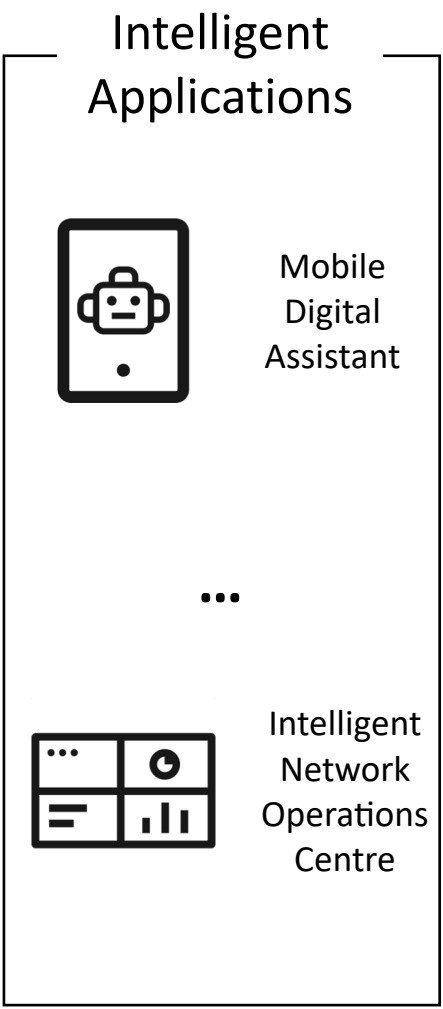
# Telco Knowledge Graph



Insights  
Structured,  
Linked Data



Data  
Informed  
Decision-Making



# Key insights

## **Data-driven and data-centric research**

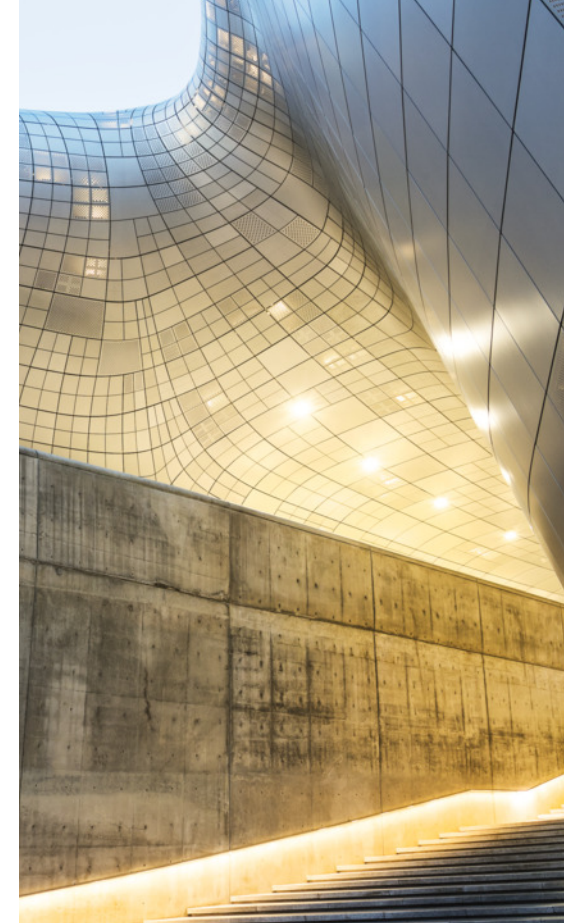
- Dealing with heterogeneity through semantics
- Right data at right time and place
- Keeping the global state together

## **Mix of AI approaches and techniques**

- ML meets Reasoning
- Declarative meets Procedural
- Collaborative Intelligence

## **Frameworks will be needed for success of AI applications**

- Safety
- Trust
- Transparency
- Explainability
- Privacy





# Questions & Answers





[www.ericsson.com/research](http://www.ericsson.com/research)