The Future of Wireless Network –AI Inside

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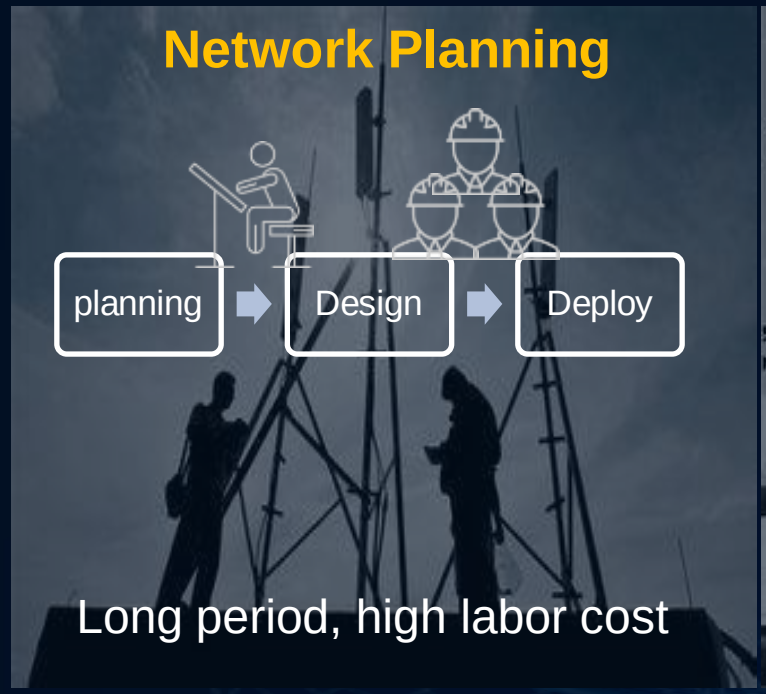
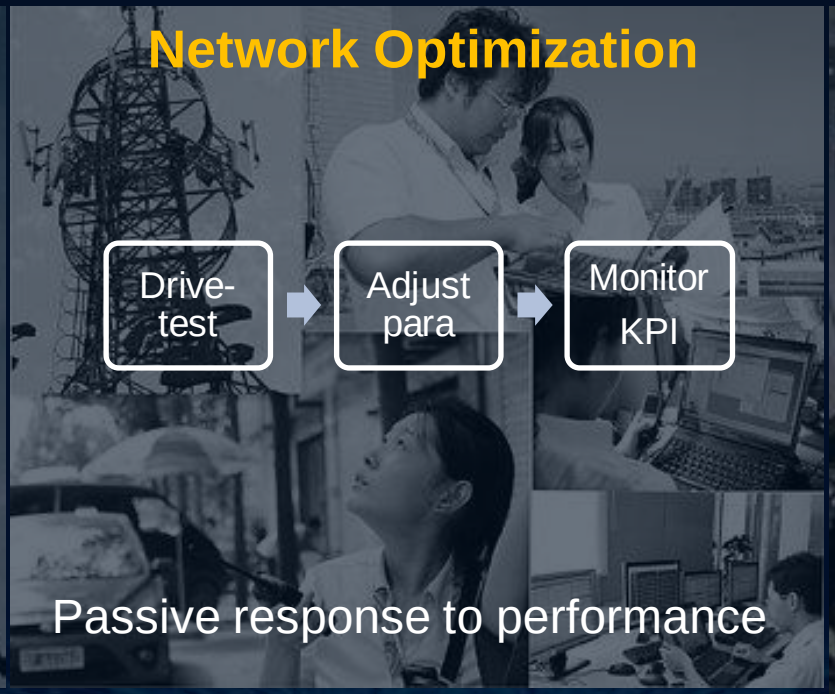
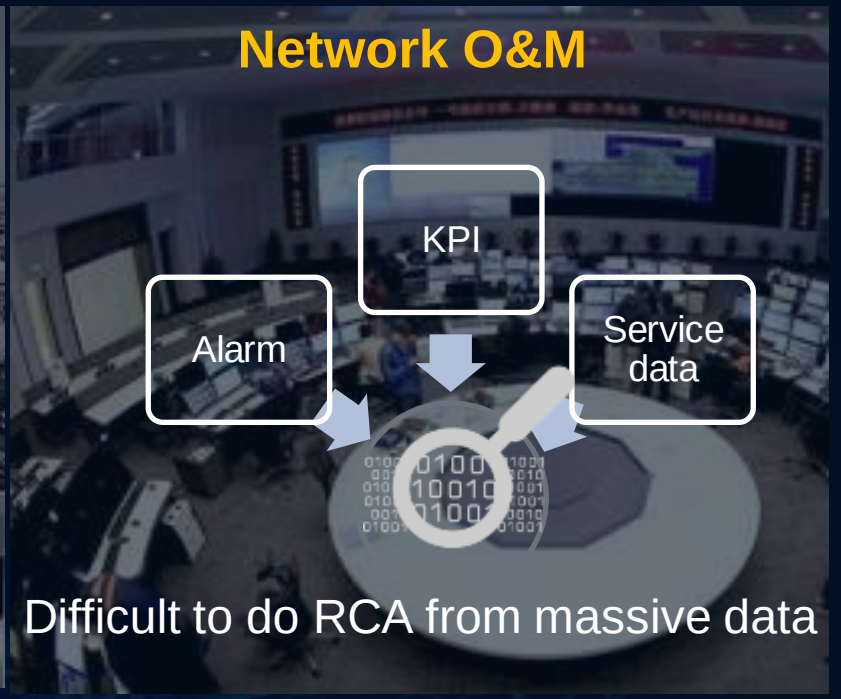
Challenge: Low Efficiency and High Cost on Network O&M







Intensive Manual Work

Complicated Wireless Environment

More and More sites

Increasing OPEX

OPEX : CAPEX ~ 4 : 1

Source: Gartner report

Cost structure needs change !

Challenge: Growing Operation Complexity

- **Band : 2X**
- **Ultra Dense Deployment**

Multi-Band/Multi-RAT

Site : 5X

UCNC Network

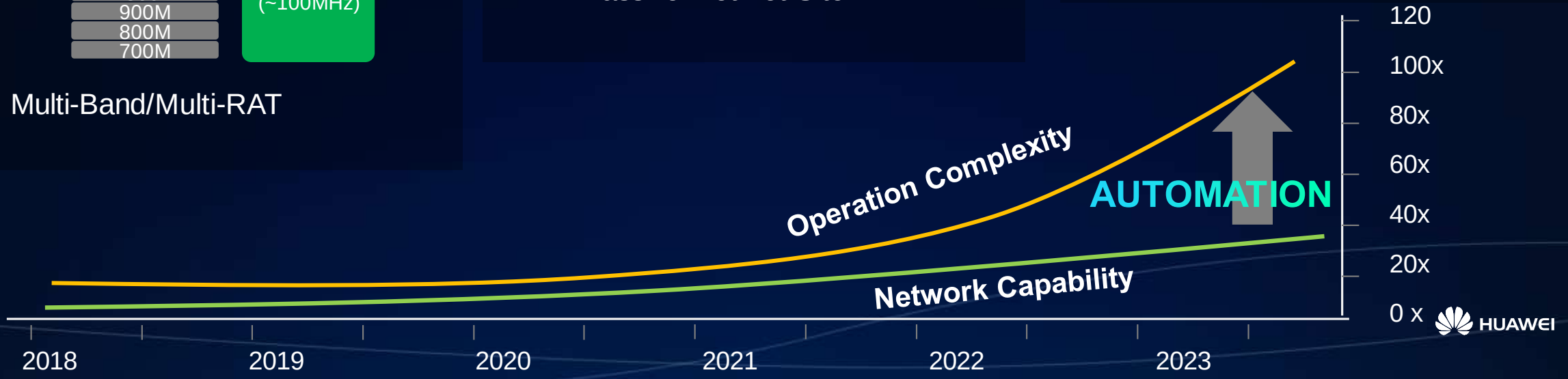
Massive Het-net Site

Scenario : 10X

Contextual Perception

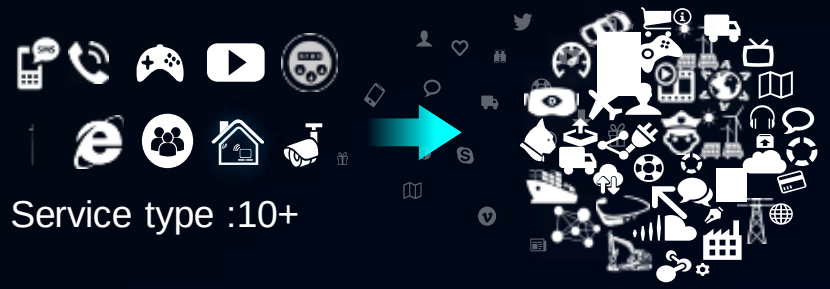
Highway Mall Big Event

Dynamic Scenario/Traffic Model



Challenge: SLA Guaranteed is Entering “Hard Mode”

Services Booming in 5G Era



Service type :10+

Service type: 1000+ , Diverse SLA

No Guaranteed SLA, Not Slicing!

Slice Template → Slice Topology Design → Slice Function Define → SLA Decomposition

- Guaranteed SLA requires the adaptability of a slice
  - Like in the Cloud/DC: scale in / scale out
  - Dynamic resource assignment
  - Dynamic scheduling depending on real-time resource usage

Network Must Evolve to “Industry 4.0”

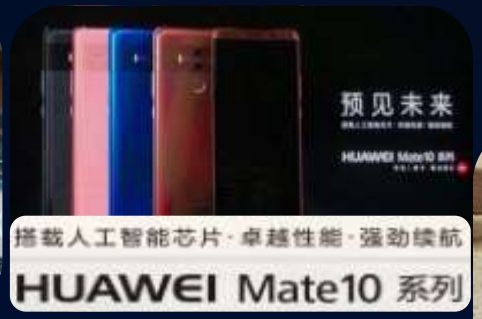
FMS, Flexible Manufacturing System

1080 types of personalized BMW7

AI Democratization Starts its Journey

Assist Smart Driving

On-device AI



IBM Watson

Sweeping Robot

Google Alpha go

- Machine Leaning
- Deep Learning
- Reinforcement Learning

Softbank Pepper

Massive Data

Mobike:1TB/day Taobao:7TB/day Web: 500PB/day

Hardware Computing Power

GPU: Float Operations, 10Tflops; CPU: 1.34Tflops

Mobile Network is Feasible move to AI

AI = Big Data + Algorithm + Computing

Wireless Network Inherent 4 Characteristics Make it Fertile Ground for AI

Massive Data

Real time data from network

Complicated Algorithm

Coordination Resource allocation

Computing capability

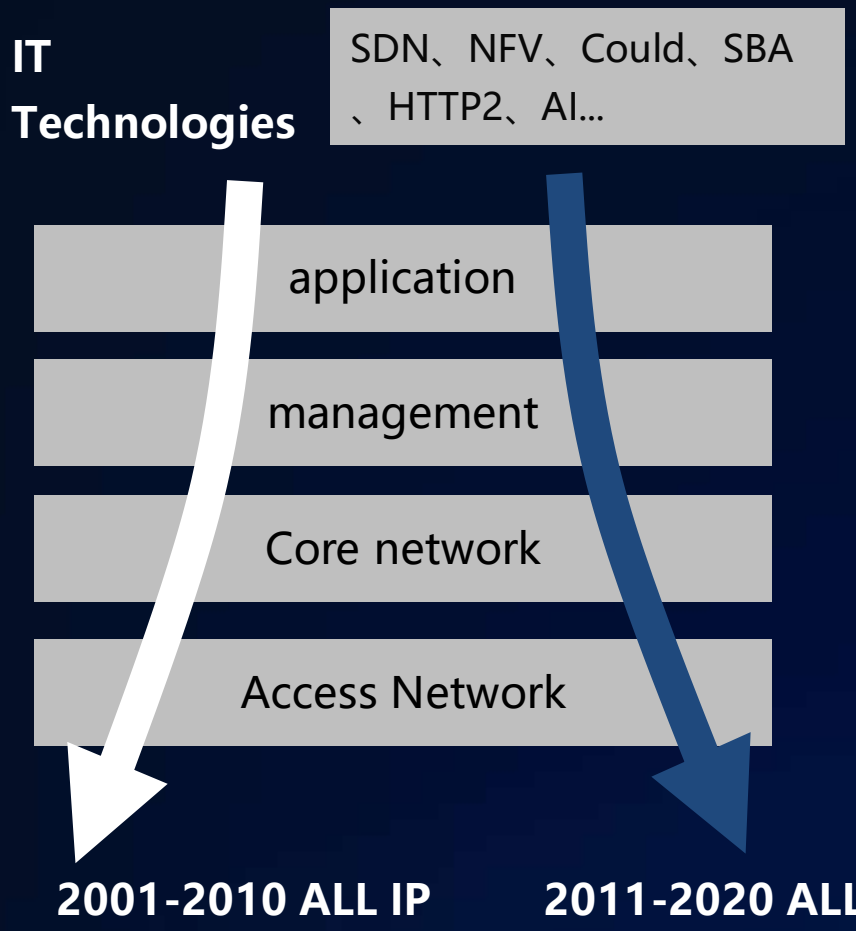
eNB, Cloud with high ability chip

Diverse Service

Blooming service, diverse SLA

When wireless network meets AI, new potential will be inspired

The Industry is on the way to ABCC

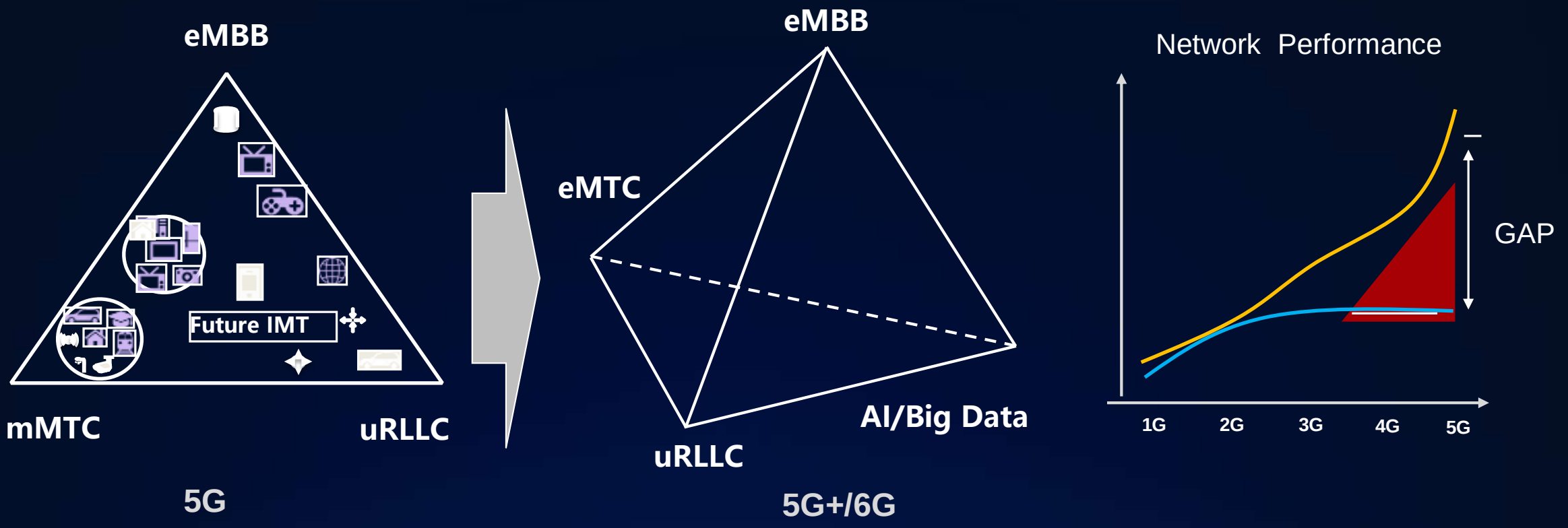


ABC²= AI+BigData+Cloud+Connection

TOP7	MV	A	B	C	C
APPLE	8890	Siri,chipset	App Store, Apple Pay	iCloud	3GPP
Google	7235	Deepmind	Gmail/Google+/Chrome/ Andriod	GAE	..
Microsoft	6459	,Zo..	350 m	Azure	
Amazon	5491	Echo/Alexa	200 m	AWS	
Facebook	5285	AML	2 b	OCP	TIP
Tencent	5236	AI Lab	900 m	腾讯云	
Alibaba	4889	NASA	DT	阿里云	3GPP

- **The downward trend of IT technology is a basic trend. The major reason is that the carrier network must adapt to application changes.。**

5G+ and 6G will be AI inside

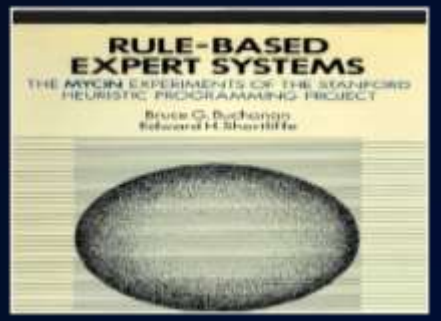


- 5G is not only provide connection, and also win the new business in the digital era.
- AI can help to improve the network performance, and simplify the network management.

Wireless AI Leapfrog to a New Phase

Result based on rules

Expert System



Knowledge based on data

Machine Learning

We are here

Creation based on logic

Deep Learning

IT Industry are Here

Cognitive

Modeling	Modeling	Modeling	
↑	↑		
Characteristic	Characteristic	Characteristic	Self Evolution

Wireless AI Vision and Case list

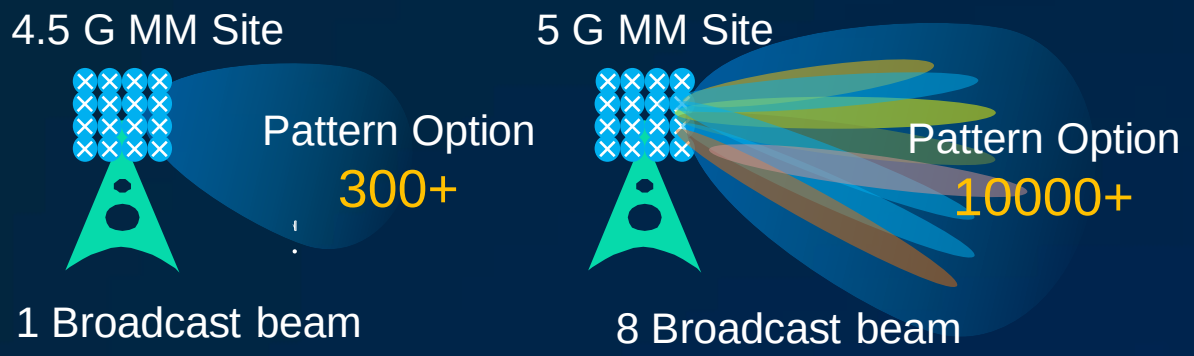
--Learning Radio Environment ,Make impossible to possible

	Network O&M	Network Performance	New Business
Customer Values	 **Simplify O&M**	 **Beyond Performance Limits**	 **Enable New Business**
Typical Cases	• Massive MIMO Self-Adaption • Intelligent Alarm Association • LampSite Topology Smart Optimization • Adaptive KPI Anomaly Detection • Fault Alarm prediction • Scenario Self-Recognition • PCI-conflict optimization, CCO ……	• Free Measurement multi-carrier selection • VoLTE Quality Improvement • Bottom user experience improvement ……	• TCP Optimization • Network Fingerprint Enabled High Accuracy Location • Using Artificial Intelligence to Predict Ride Requests ……

Case1:Massive MIMO Pattern Self-adaption

MM Solution Bring Challenge to O&M Team

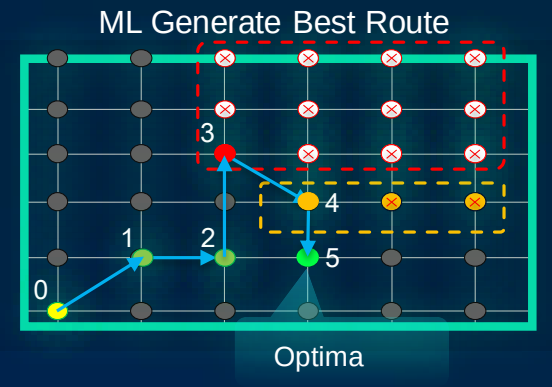
Configure Pattern Complexity Explosion



Diverse Scenarios, Fluctuated Traffic

ML based Solution lock Best Pattern quickly

ML Boost Fast Optimization



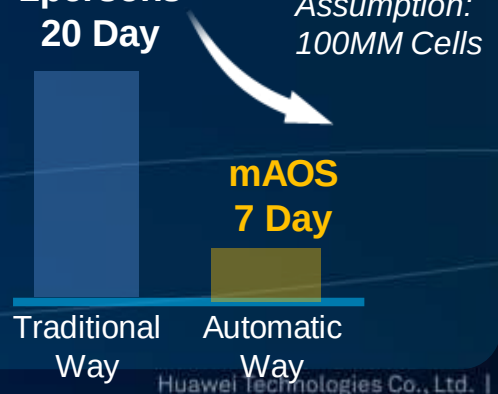
Step0: Initial selection base on massive experience modeling

Step1-5: Automatic Iteration optimization by ML.
Avoid ● (Bad) and ● (Normal) , fast approach ● (Good) Area

Powerful Strategy Library Accelerate Optimization

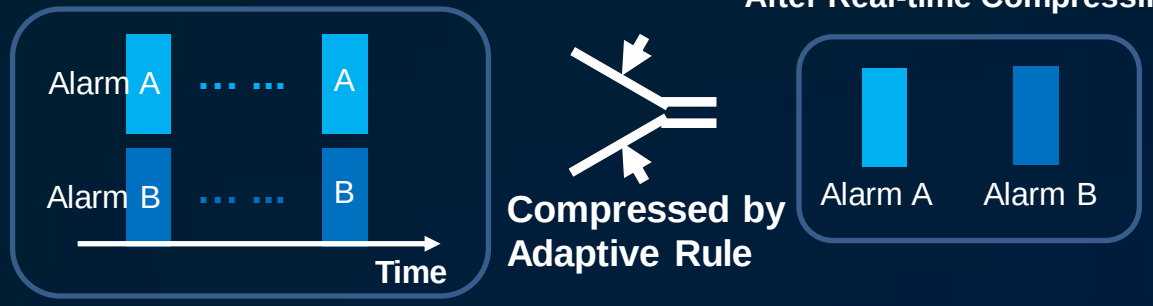
Joint Trial Test Result in Japan

Optimization Time

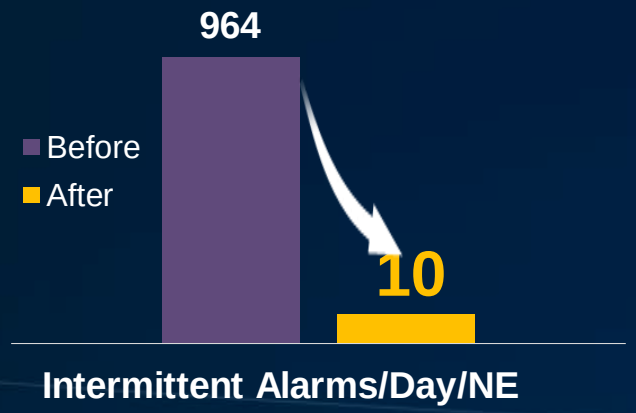


Case2: Alarm Processing

Compress Alarms, Reduce Dispatch Orders

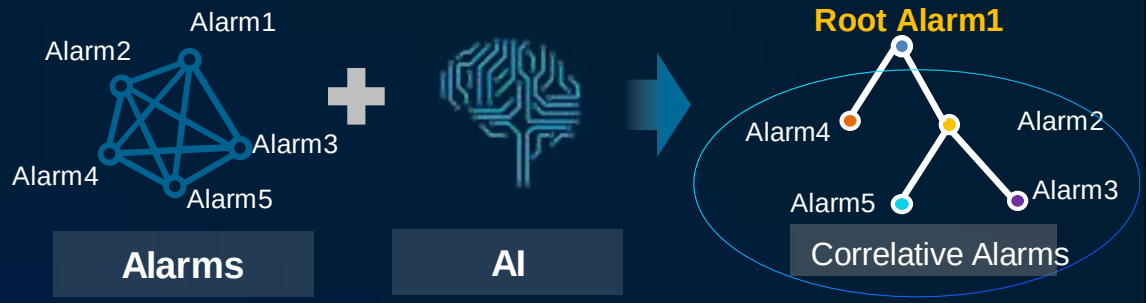


- Adaptive Rule Will Be Setup Correctly by **100%**
- Intermittent Alarm Will Be Reduced by **99%**



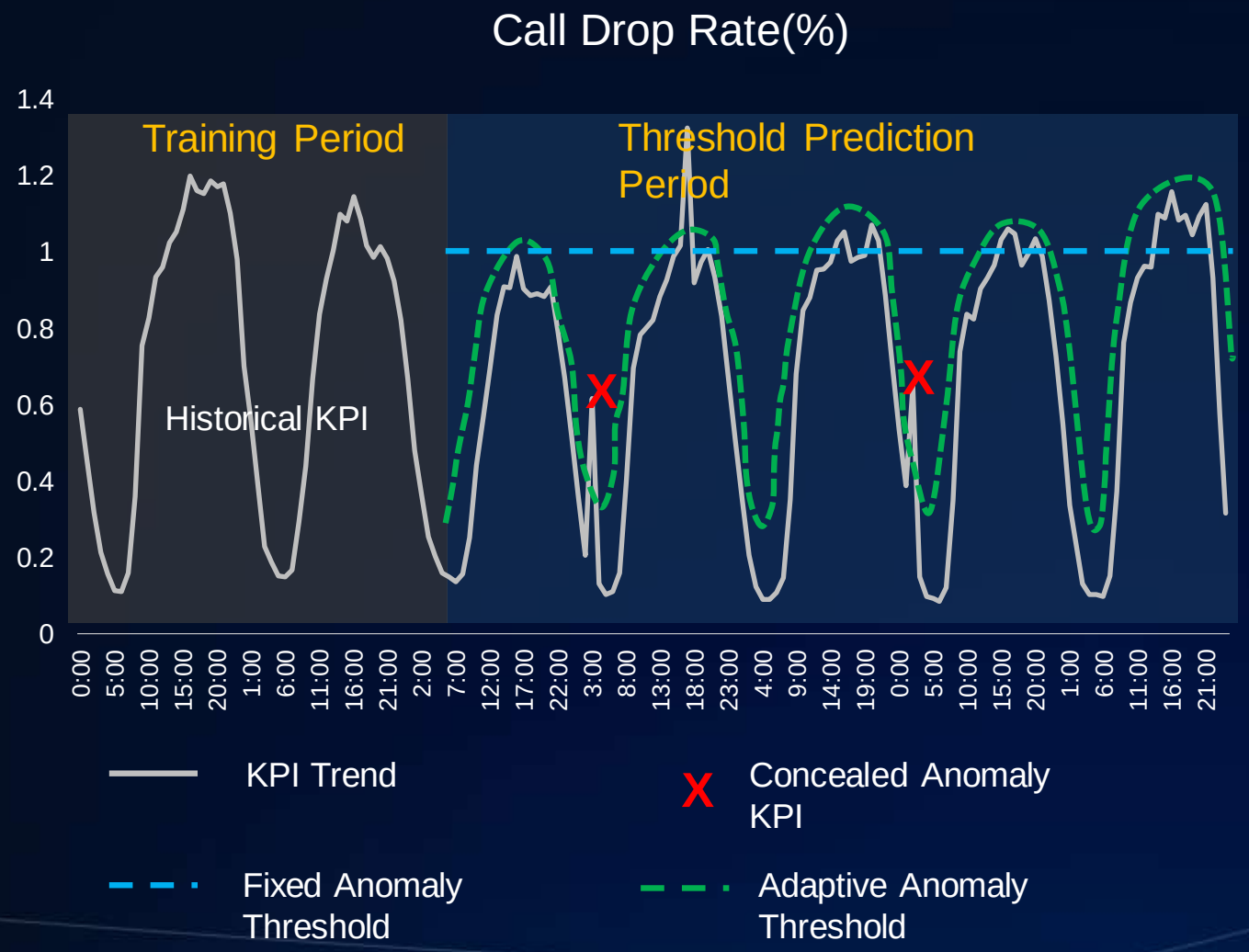
Based on LTE Network of Changsha in 1 Day

Analysis Root Alarm, Improve Efficiency of Troubleshooting



Based on LTE Network of Shanghai in 1 week

Case3:Adaptive KPI Anomaly Detection



Adaptive Threshold

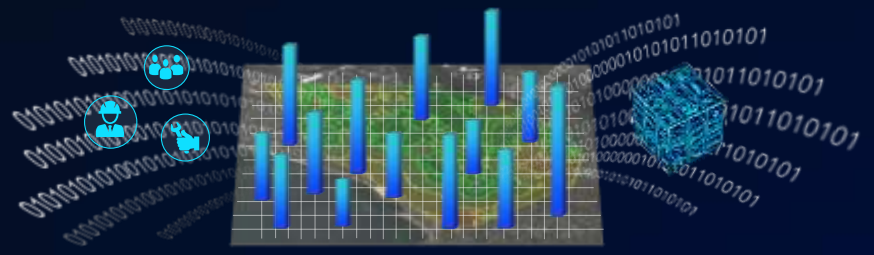
Based on prediction by ML

- Find Concealed Anomaly KPI
- Avoid tremendous fault alarm
- 95% Accuracy
- Setting at Cell/Cluster Level

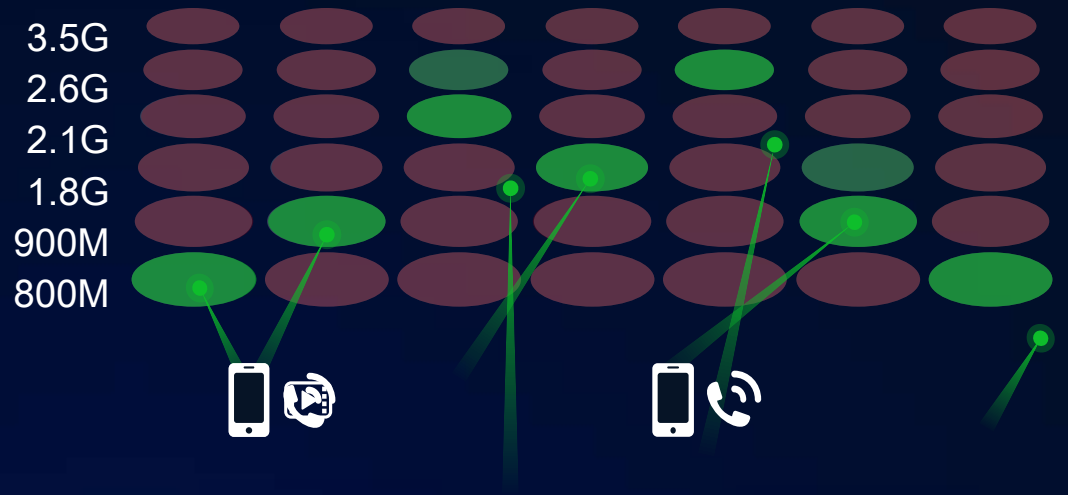
Adaptive KPI Anomaly Detection

Case4:Smart CA with Virtual Grid

基于虚拟栅格的数据模型化



Always on the Best Carriers: 60+% Improvement



More Possibilities with Network Fingerprint

Recognition

Prediction

AI Standard in 3GPP

TR 23.799| 2016.11

S2-164035

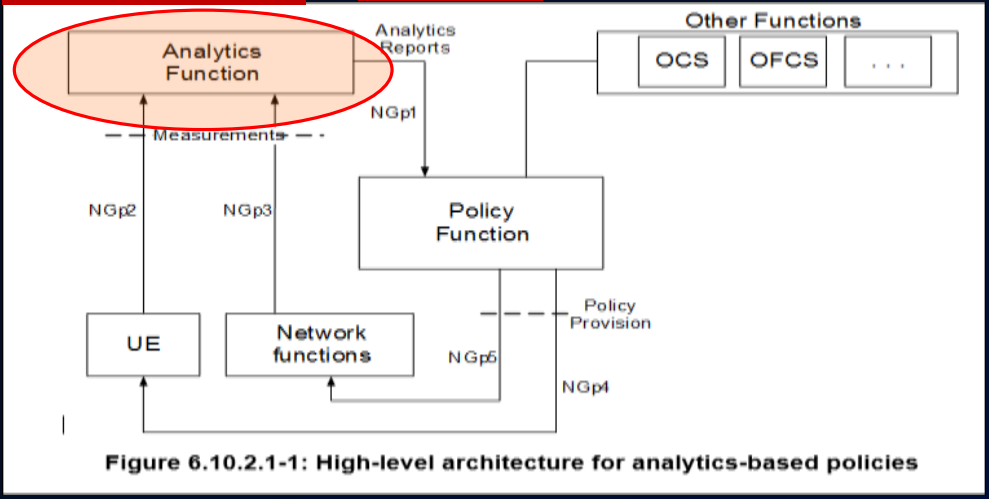
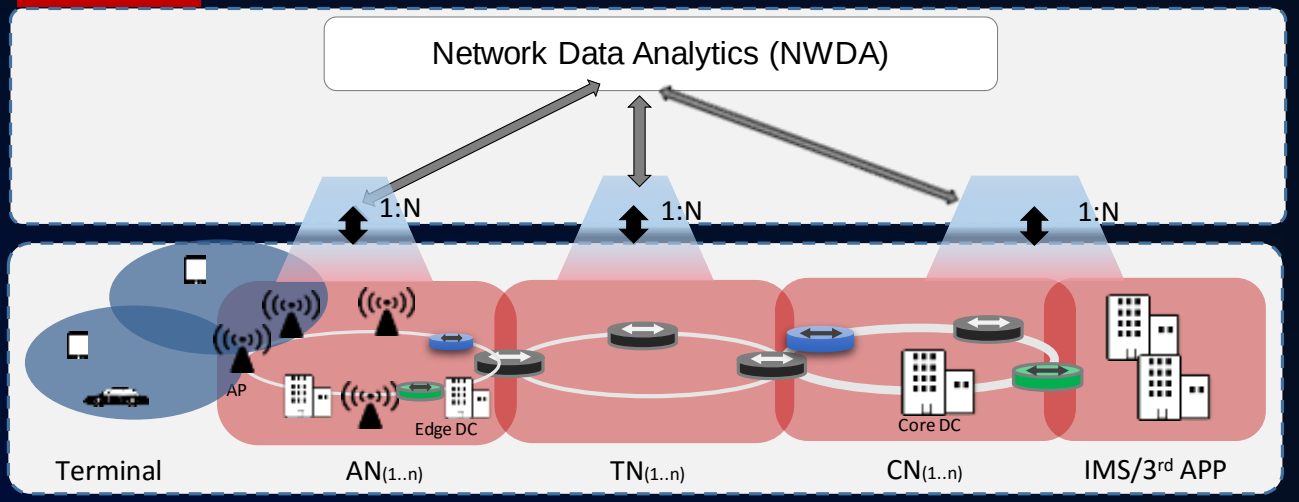


Figure 6.10.2.1-1: High-level architecture for analytics-based policies

- SA2/RAN3
- SA5

1: S2-173192/173193 Discussion about Big Data Driven Network Architecture
2: S2-164035 Analytics-based Policy (Motorola Mobility, Lenovo)
3: S2-164691 New Key Issue on Context Awareness (Telenor, NEC, Orange, Deutche Telekom AG)
4: S5-173364 New SID Study on utilizing artificial intelligence in mobile network management

S2-173192

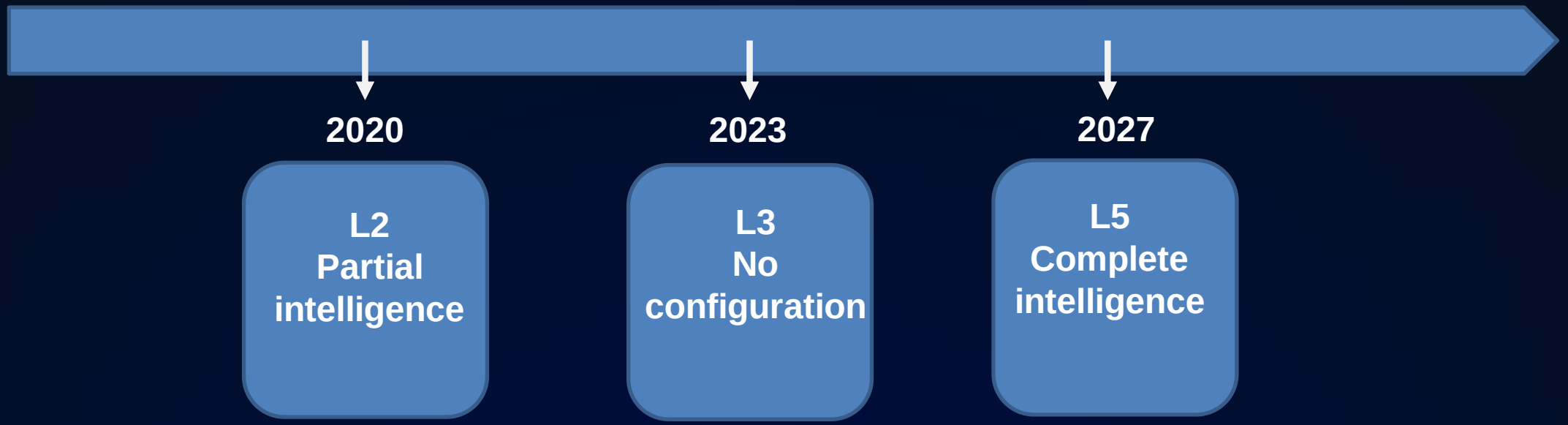


S2-164691

The focus of this key issue is to highlight the need of a mechanism which can discover, reason and predict a situation by efficiently turning raw measurements into well-defined knowledge (referred here as context). Solutions to this Key Issue will:

- Determine which information from the UE, external applications, Network Functions, and RAN can be combined and how, to create richer session/network context information that can optimize decision making.
- Investigate which kind of analysis can be applied;
- Investigate which reference points or communication models should be used to enable monitored information to flow among NFs (e.g., UP and/or CP functions) and 3rd party applications

5G+ AI forecast



My dream: we establish such a network, like a large machine, he seems to have life, in a variety of complex environment, breathing with the environment changes, the flow of resources, the antenna of the base station wagging. He knows all the state of the network, also predict all changes that will happen in the network, including possible failures, even changes in the environment, and timely adjustment, and continuous evolution, and the maximum efficiency of information transmission and service. And no more managers are needed.

Huawei Wireless AI DA-Lab

Wireless Intelligence DA-Lab

Data Analytics Laboratory (DA LAB)
Established in 2016.9, Core ability,
Data storage and process: 0.5PB,
0.5PB equivalent to 1,000,000 GUL cell ,
Plan to 2PB in 2019.

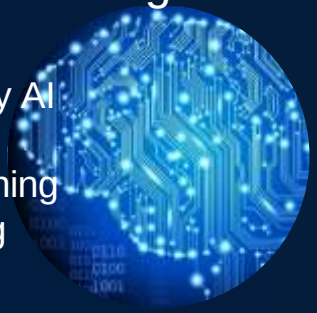
4 Key ability for DA-Lab

Data training

- Data storage
- Data analysis
- Data modeling

Pre-research for AI Algorithm

- Import industry AI algorithm
- Machine Learning
- Deep Learning



DA LAB

Verification for AI Algorithm

- 3-rd party
- Self-study
- Off-line verify

Incubate valuable model

- High accuracy position
- Scenario recognition

Wireless AI Alliance

Alliance goals and participating units

Alliance goals

Relying on the cooperation platform of industry-university-research, to realize the intelligent guidance and in-depth integration of wireless big data, and promote the development of green, efficient and intelligent communication.

Organizational Units

中国移动 China Mobile

HUAWEI

Participating Units

China University of Science and Technology

Beijing University of Aeronautics and Astronautics

Zhejiang University

Beijing University of Posts and Telecommunications

Alibaba.com

Cooperative Units

未来移动通信论坛 FUTURE MOBILE COMMUNICATION FORUM

WIRELESS WORLD RESEARCH FORUM

Thank You.