Leveraging PNM to Optimize Plant Performance

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Contents

PNM Features

- Software Testing
- Common Data Collection
- Machine Learning
- Cloud

D3.1 PNM

- Powerful Measurement
- Intelligent Algorithm
- Use Case

Network Optimization

- Configuration Optimization
- Profile Management

Huawei Simplified O&M Solution

Features

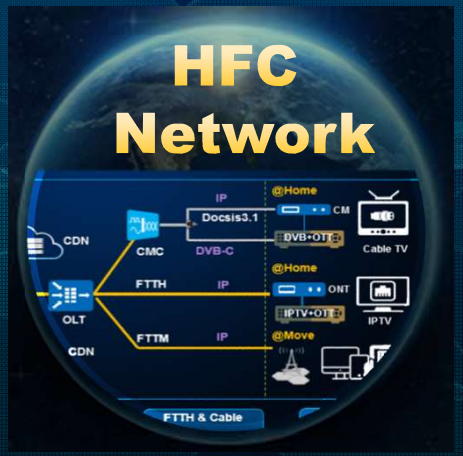
DOCSIS PNM Features

Software Testing

CCAP and CM provide the same capabilities as found in test and measurement equipment.

CCAP CM

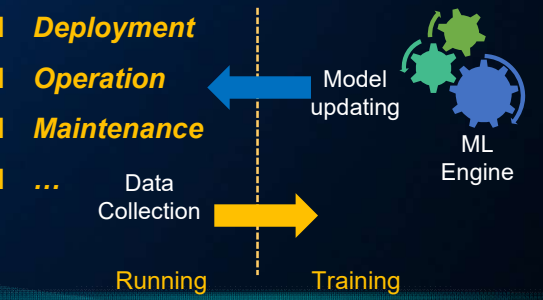
- *Network Analyzer Functions*
- *Spectrum Analyzer Functions*
- *Vector Signal Functions*
- *Other Test Points*



Machine Learning

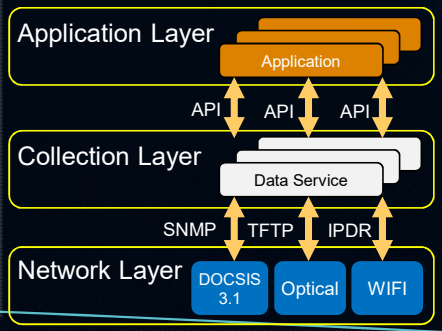
Learning the ability of RF expert; detecting, identifying, and locating the fault automatically.

- *Deployment*
- *Operation*
- *Maintenance*
- *…*



Common Data Collection

XCCF provides a structured approach to the collection of data from standards-based network deployments.



- *Protocol simplicity*
- *Common infrastructure*
- *Directly programmable*
- *Extensible & agile*
- *Open standards based*
- *Low level data processing*
- *Collect once and use many*

Cloud

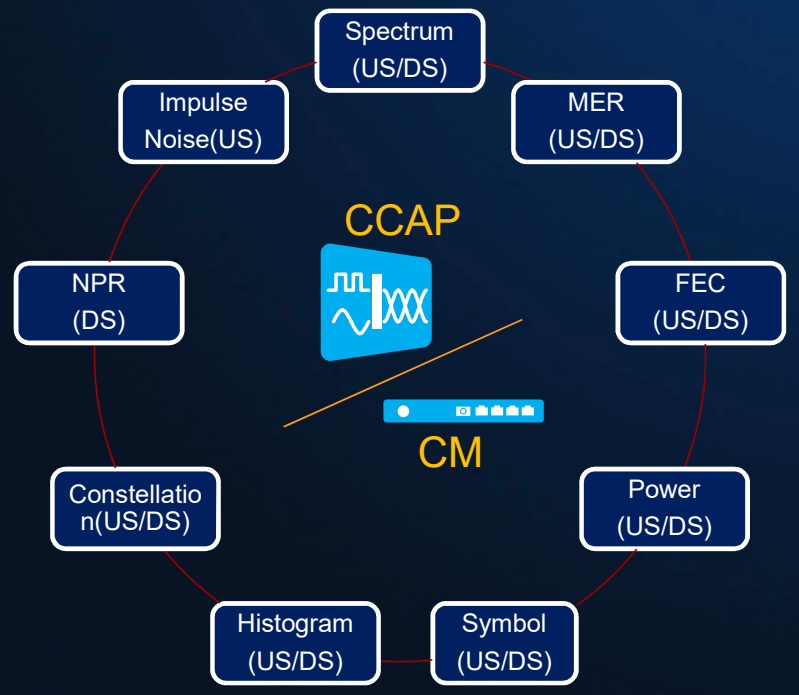
Cloud provides enough storage and powerful computing ability for the data save and AI algorithm.

- *More cost effective*
- *Flexible capacity*
- *Improved collaboration*
- *Always-on accessibility*
- *Security*

D3.1PNM

Proactive Detection to Identify Potential Faults

D3.1 PNM with Powerful Measurements



Built-in diagnosis, saving hub ***space*** and ***cost***

Cable Fault Identification Automatically

US Ingress	DS Ingress
CPD Fault	Impulse Noise
Linear Fault	Non-linear Fault

FBC Impairments

Mirco-Reflection	Notch
Roll-Off	Tilt
Filter	High Adjacency
Low Adjacency	Resonant Peaking

Manual → Intelligent

1 Month → 1 Day

Spectrum Analysis Capability:

250K per Day

Case 1: Us Spectrum Analyzer to Identify Us Noise

Real-time Spectrum Scanning

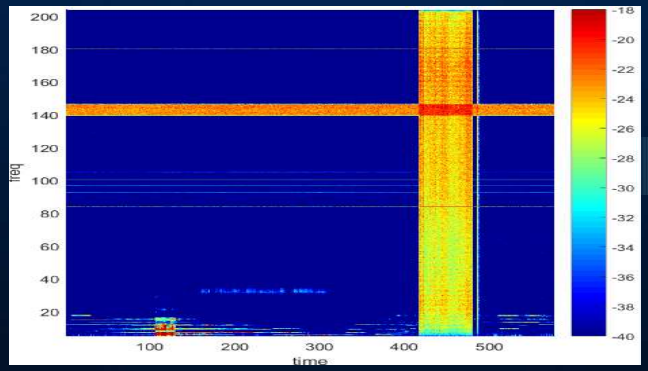
Period(ms):

100ms

Range(MHz):

0-204

24-hour Spectrum Monitoring



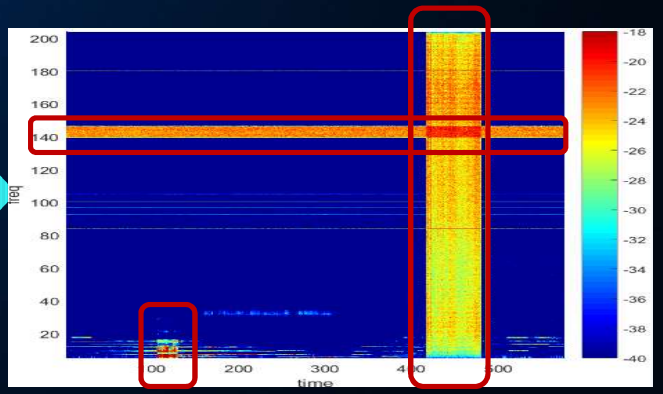
Period(s):

5s

Roll Polling:

All CMC

Noise Automatic Identification



- ***Noise Type Identification***
  - Ingress Noise
  - Impulse Noise
  - AWGN
  - CPD (Common path distortion)
- ***Noise Level & Freq Band***
- ***Occurrence Time/Prediction***

D3.1PNM

Case 2: Full Spectrum Analyzer to Locate Us/Ds Faults

Us Noise Identification & location

- ✓ Ingress Noise
- ✓ Impulse Noise

Ds Impairment Identification & location

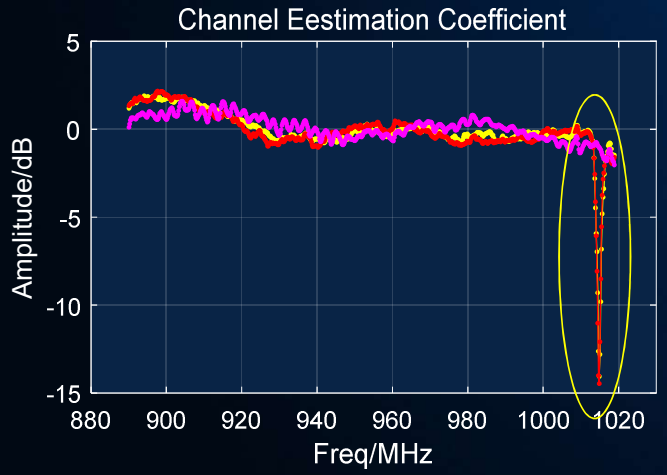
- ✓ High adjacency
- ✓ Low adjacency
- ✓ Notch
- ✓ Resonant
- ✓ Tilt
- ✓ Filter
- ✓ Roll-off
- ✓ Micro-reflection
- ✓ FM ingress
- ✓ LTE ingress
- ✓ More…

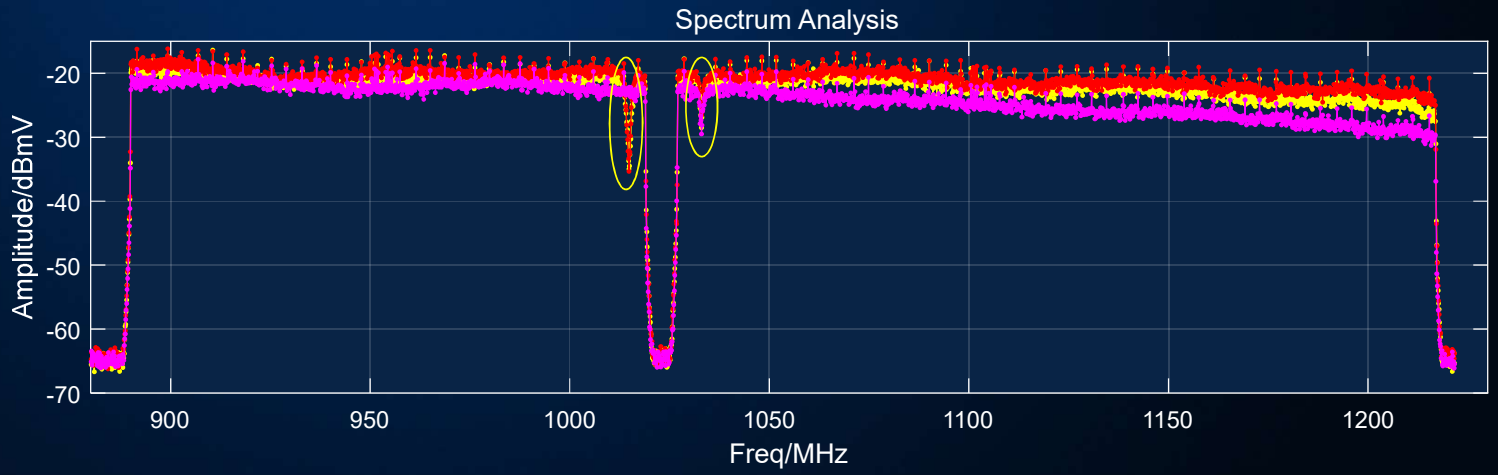
Machine Learning (Classification)

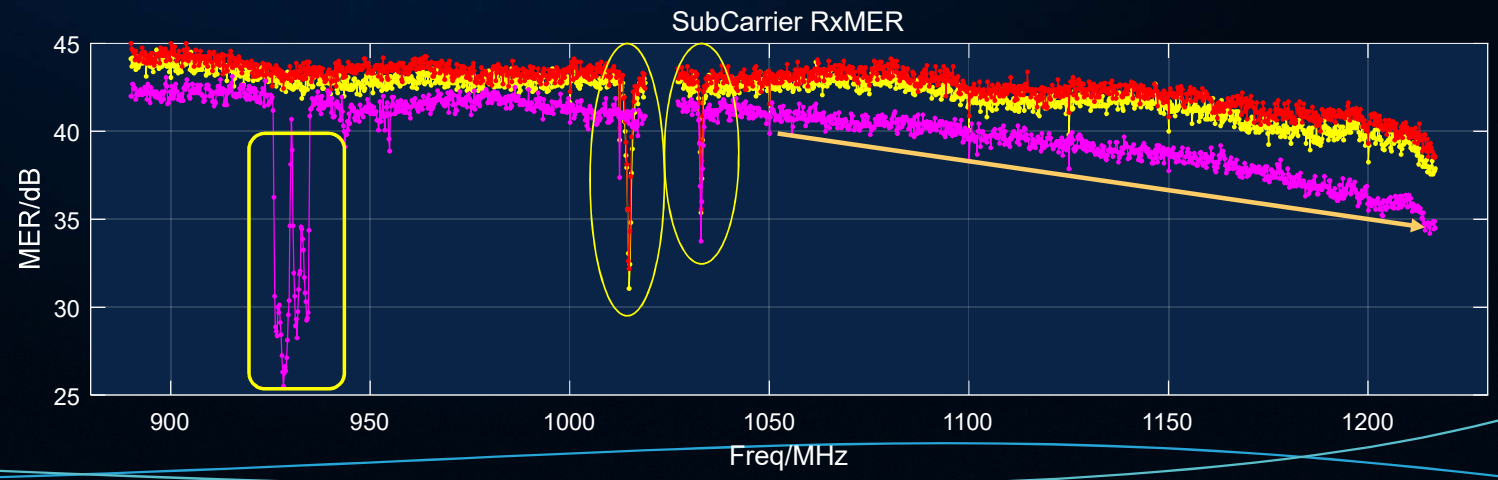
Detection → Feature Exaction → Identification → Correlation analysis Topology analysis → Location

D3.1PNM

Case 3: Multiple Measurements to Identity Faults







Impairments

- LTE ingress at 925~935MHz
- Notch at 1014~1017MHz
- Notch at 1032~1035MHz
- Roll-off at 1100~1218MHz
- Negative tilt

Network Optimization with Digital Twin

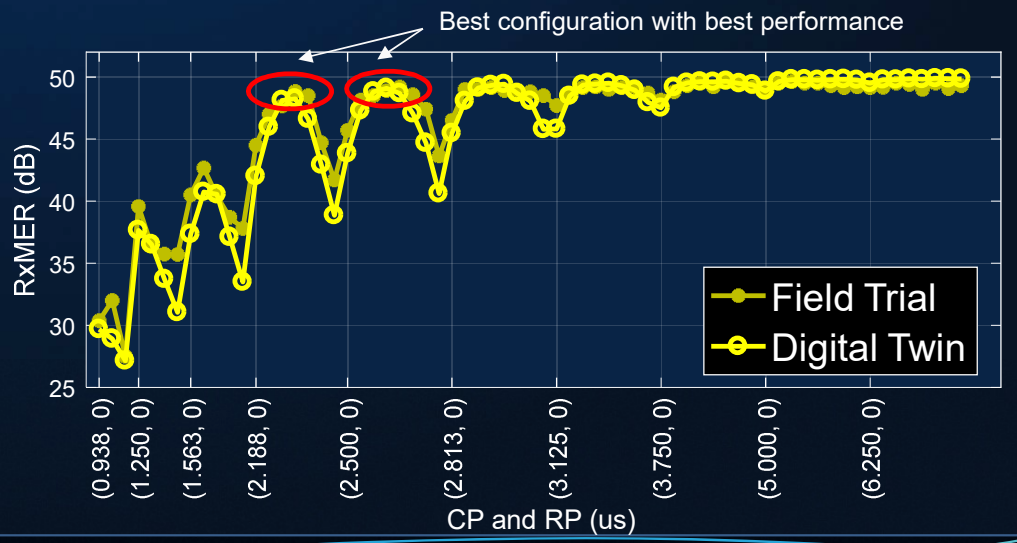
D3.1 configuration optimization

- ✓ OFDM channel placement
- ✓ Power spectral density
- ✓ Windowing
- ✓ Cyclic prefix
- ✓ Roll-off
- ✓ FFT size
- ✓ Interleaving depth
- ✓ Pilot mode
- ✓ Guard band
- ✓ Adjacent channel interference
- ✓ Profile assignment

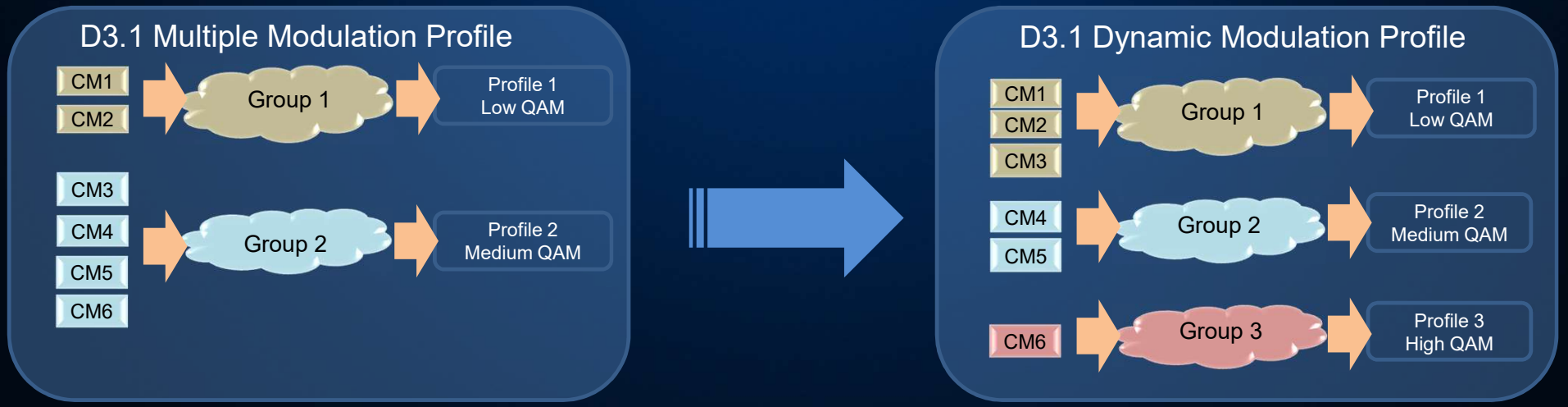
Example: Performance with different CP and RP

A network with group-delay (-10dB@1us) and micro-reflection (-15dB@1.5us), the performance of field trail and digital twin.

- Digital twin result is similar to the field trail result.
- Best performance when CP=2.1875 and RP= 0.9375us.



D3.1 Dynamic Modulation Profile Enhance Reliability and Efficiency



- **Intelligent Adjustment**

  Automatic profile adjustment according to real network quality

- **High Efficiency**

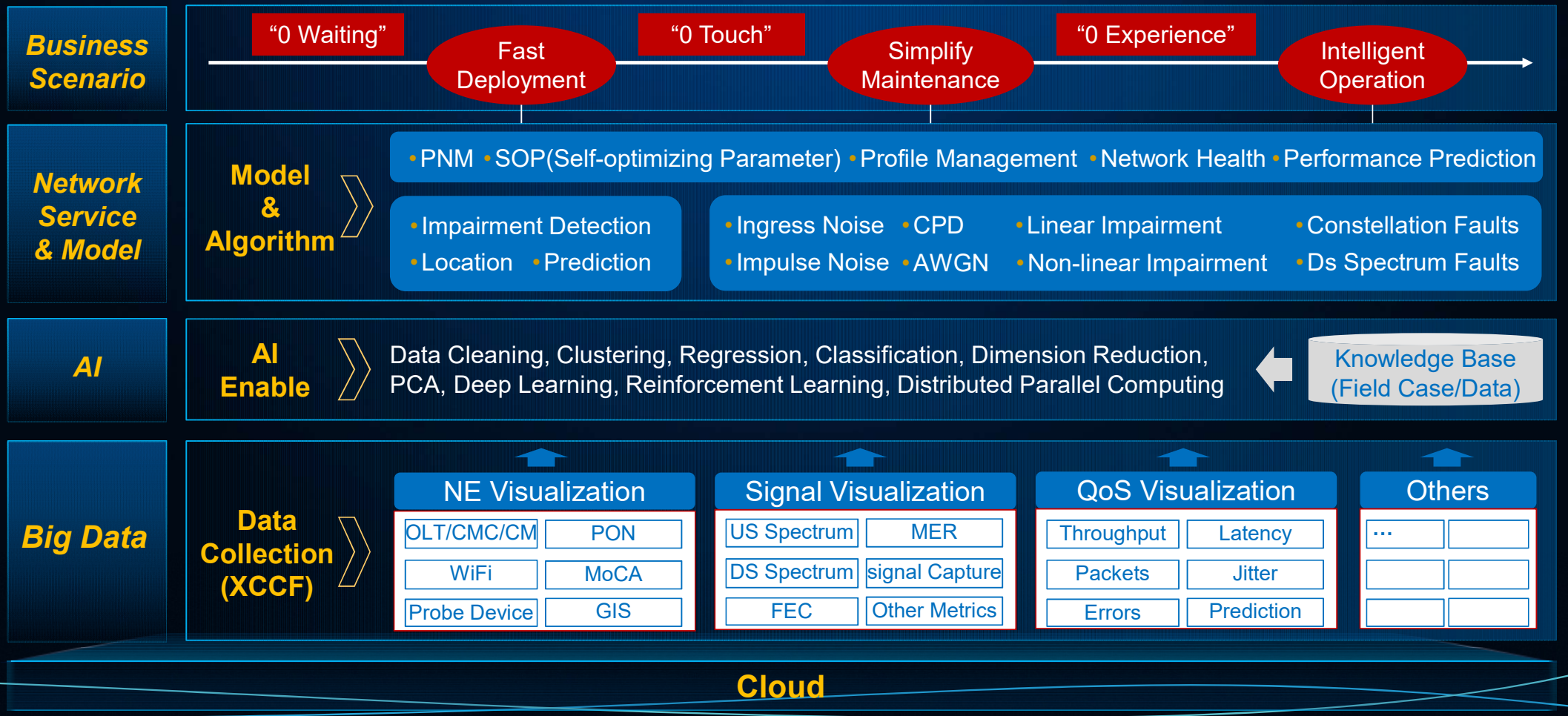
  Spectrum efficiency improved by **30%-80%**

- **Stronger Reliability**

  Less CMs offline when circuit interruption occurs

Huawei Solution

Simplified O&M Solution



THANK YOU

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