Avanseus
Mar 2021

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Avanseus is the No.1 predictive maintenance software provider for Telecommunications Networks and is rapidly expanding its solutions to Data Centers and Industrial IoT

Artificial Intelligence
for Telecom, Enterprise & IoT Applications

Gartner Cool Vendor 2018

Cool Vendor in Communications Service Provider Business Operations

Topics

1. Corporate overview
2. CAN – Inputs and Outputs
3. Use cases – overview
4. Multi-vendor, multi-technology experience
5. Technology basics and algorithmic structure
6. Fault and degradation prediction experience
    a. RAN fault prediction incl. cell down
    b. Microwave LOS issue and misalignment prediction
    c. Transport fault prediction incl. fibre issues
    d. Core fault prediction
    e. Tower passive infra fault prediction
7. Closed loop automation
8. Software architecture
9. Customer cases
10. Business benefits

Backup

1. Topology correlated end-to-end RCA for predicted faults
2. Operationalization

Company Snapshot

High Growth AI start-up

- Founded in **June 2015**
- Headquartered in Singapore, Presence in India, United States and Europe
- >200% growth in annual revenue from 2017 to 2018 to 2019

Differentiated Predictive Maintenance Software

- Full stack software for predictive operation with industry dominance in telecommunications
- Proven on **50 telecom** networks globally with **75%** precision and **45%** coverage as global average
- **40%** reduction in incidents and outages in 6 months and increased network availability

Growing Patent Portfolio

- **8 Patents** (4 granted , 2 published, 2 filed)
- **Multi-vendor, Multi-domain and Multi-technology** compliant
- AI with advanced algorithms for prediction, correlation, clustering, root cause analysis and automation

Global Blue-chip Customers and Partners

- Strategic partnerships with channel partners and industry partners
- Widely deployed in different telecom networks globally

Industry Recognition

- **Awarded Gartner Cool Vendor** recognition in 2018 and featured in multiple Gartner reports
- Selected as Microsoft Scale-up Program Member
- Among Top 15 for Emerging Enterprise award in Singapore - 2020

Experienced Management Team and Board

- Qualified team of telecommunications and software development experts
- Deep operational expertise
- **65 FTEs** with 55 Engineers

airtel

vodafone

oi

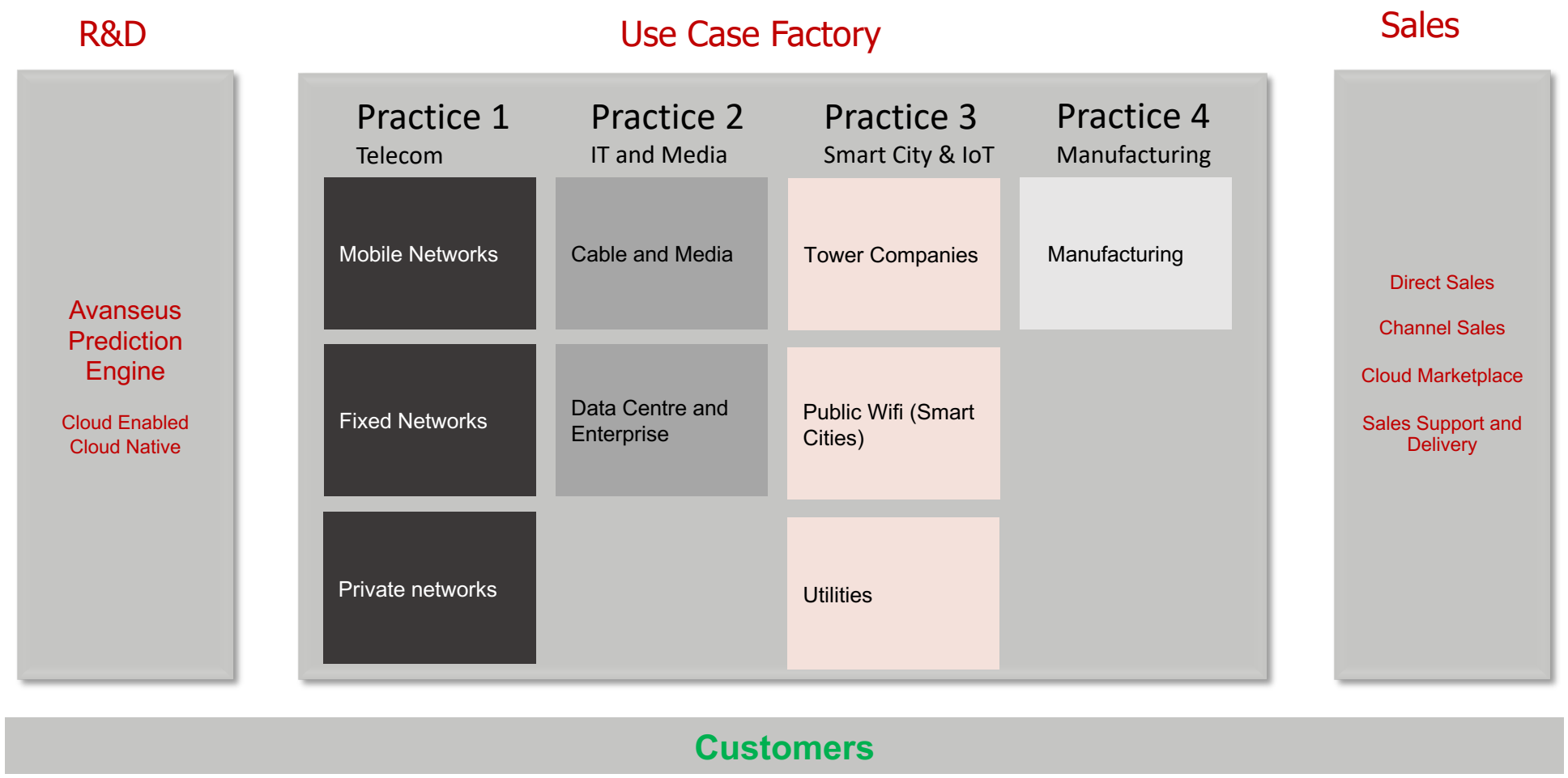
Solution Operationalization: Software has been **selected by two of the world's largest network operators** after extensive trials

Avanseus Global Representation

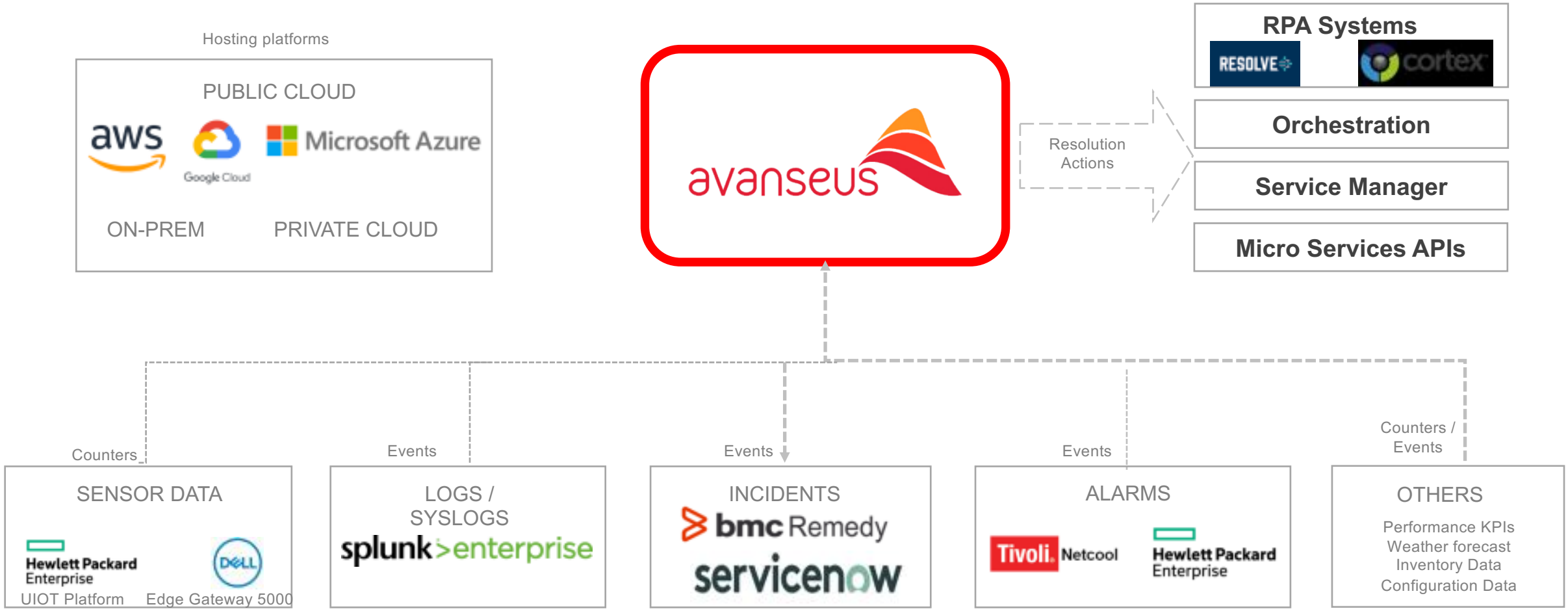
Avanseus

60 Staff across 9 countries
Headquartered in Singapore
Entities in United States, Italy, and India

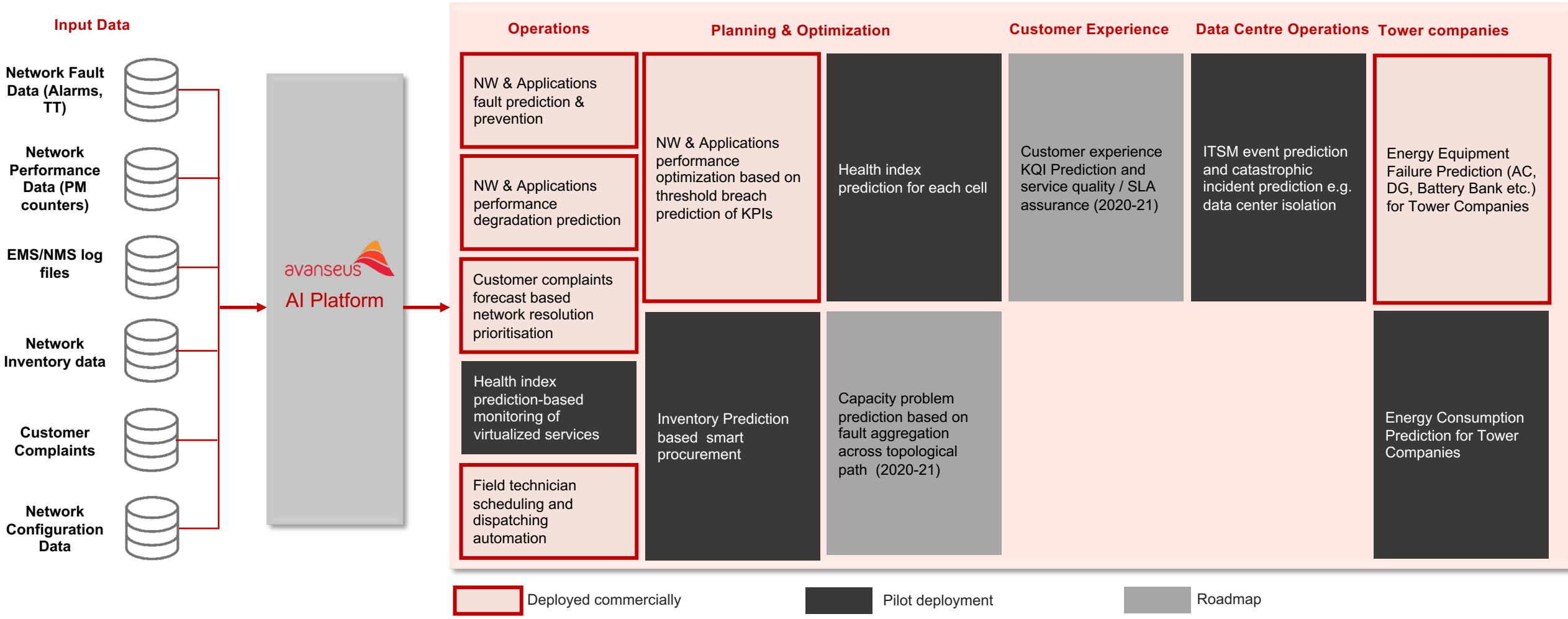
How Avanseus delivers value to its customers



Avanseus CAN – existing operators ecosystem (a highly pre-integrated platform)



Use Case Summary: Progress & Roadmap



Multi-Vendor Multi-Technology Capability

Wireless Access – Open RAN

MAVENIR ALTIOSTAR

Wireless Access - 2G/3G/4G/LTE Nodes and Modules , Repeaters and In building Solutions, Antennas

NOKIA HUAWEI ERICSSON Alcatel·Lucent ZTE中兴 KATHREIN Antennen - Electronic ALTAI Super WiFi NETWORK ORANGE

Core Elements – SGW, MGW, IMS, MMEs, MSCs, SGSN , GGSN , BSC , RNC , STPs , Switches (Wireline/Wireless)

NOKIA HUAWEI ERICSSON ZTE中兴 MOTOROLA NORTEL NETWORKS

Fixed Network Elements – DSLAM , Digital Loop Carrier (DLC) , Access Aggregators , MUX

ERICSSON Alcatel·Lucent ECI THE ELASTIC NETWORK TEJAS NETWORKS

Transmission Equipment – SDH , PDH , Microwave IDU ODU , LMDS , Fiber Nodes ,MSPP, MW Antennas

NEC Alcatel·Lucent cisco JUNIPER NETWORKS TEJAS NETWORKS Coriant ECI THE ELASTIC NETWORK UTSTARCOM

Data Equipment – ATM , Ethernet Switches , MSPP , Access Points , Routers

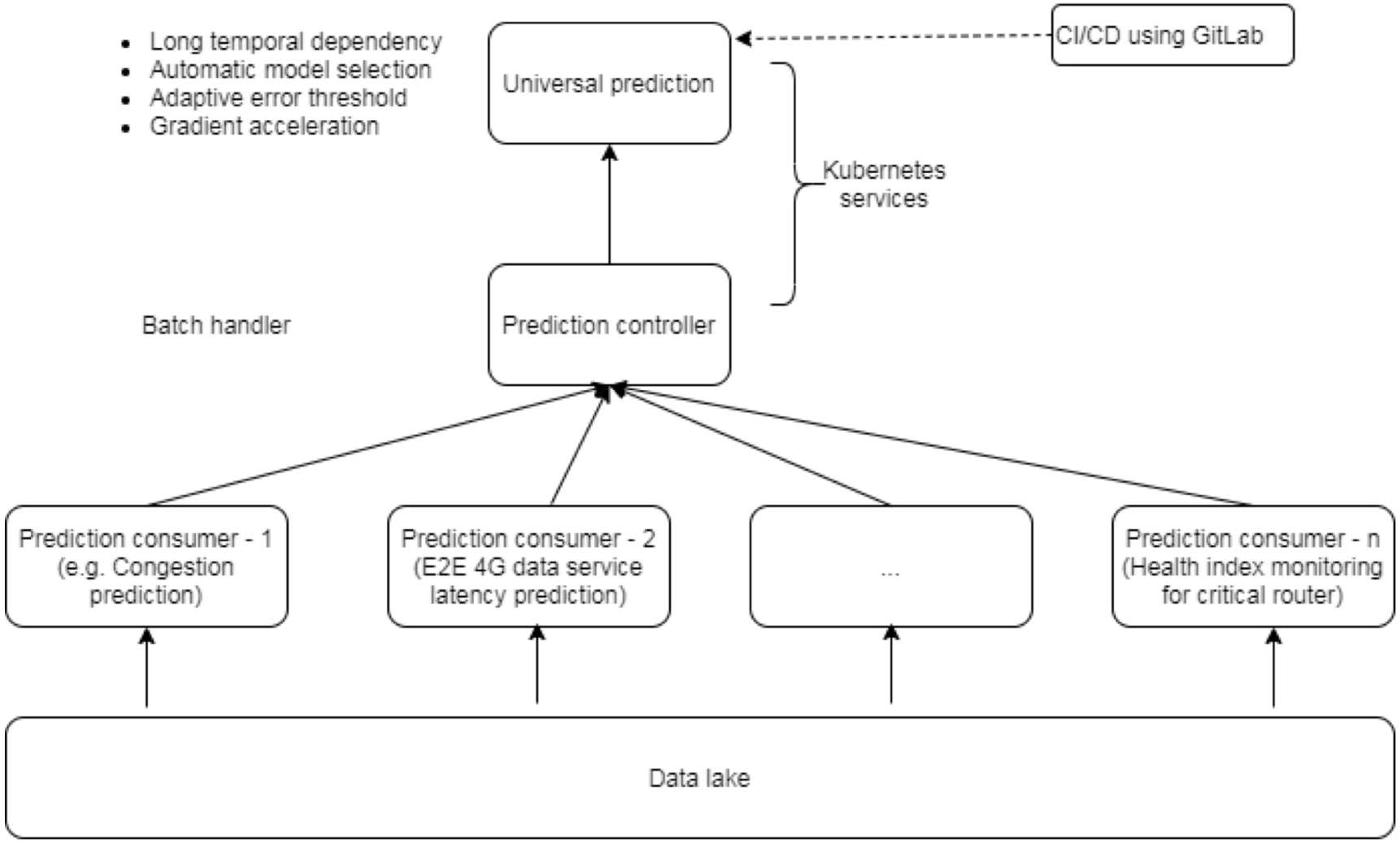
Alcatel·Lucent NOKIA HUAWEI cisco ECI THE ELASTIC NETWORK UTSTARCOM

Technology Differentiators

1. A novel mechanism to predict health for millions of equipment types, services or applications on daily basis
    a. Prediction algorithm always converges because of a novel transfer learning mechanism (Our invention – Initial weight assignment algorithm)
    b. Prediction algorithm converges very fast, thereby reducing hardware requirement (Our invention – New gradient acceleration algorithm, adaptive error threshold based on data characteristics and bounded-time prediction)
2. A new factor aggregation method for prediction at service (virtual service or network slice) level (Our invention – New multi-factor prediction algorithm)
3. Autonomous operation of algorithm needing no parameter change for different networks or different equipment (Our invention – Universal prediction)
4. Unique root cause prediction based on topology discovery and field based learning
5. Cloud native software – can run as edge + cloud configuration
6. AI at scale with small foot-print embedded algorithm

Our single most important contribution to predictive maintenance has been to discover a universal prediction algorithm based on transfer learning, which can predict whether we have small or large inter-failure gaps. With a lot of supporting data, or just the failure sequence, we are able to predict always and predict very fast.

Algorithmic structure



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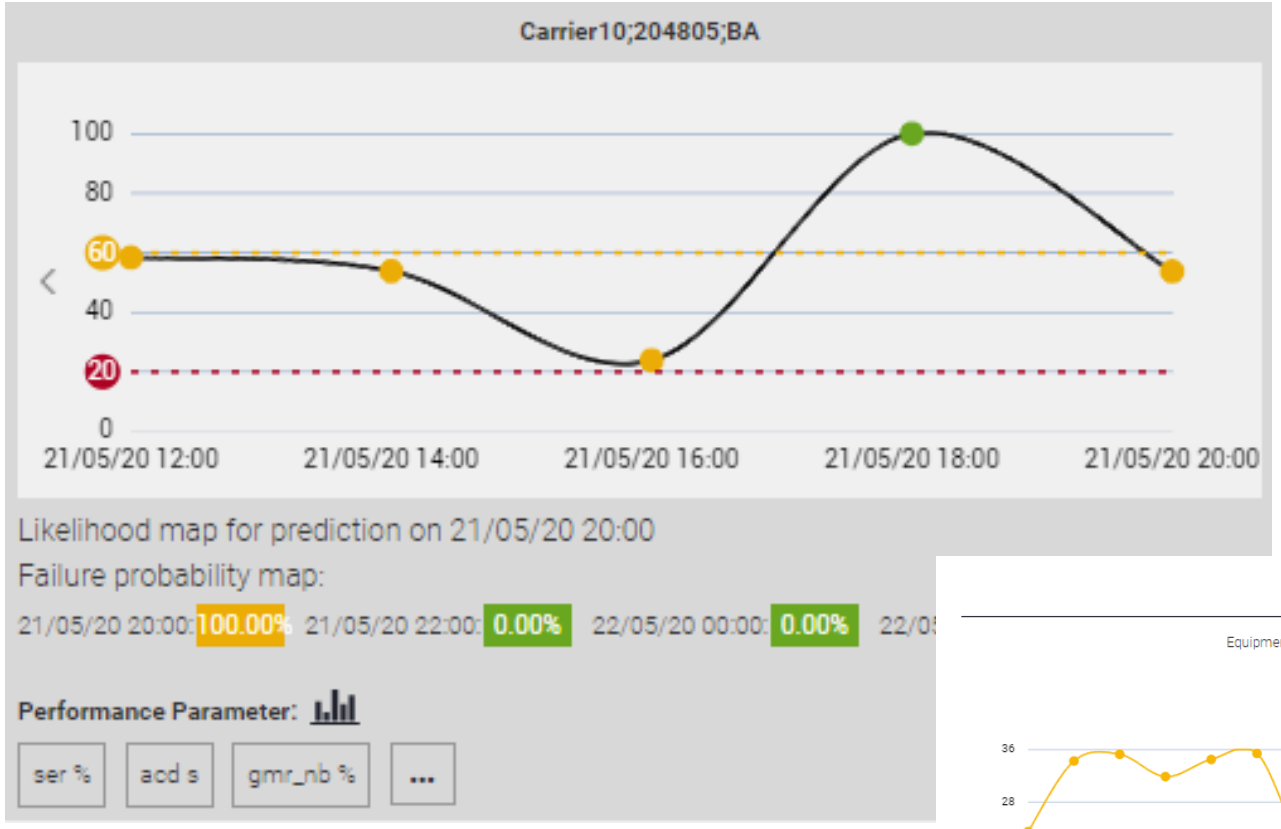
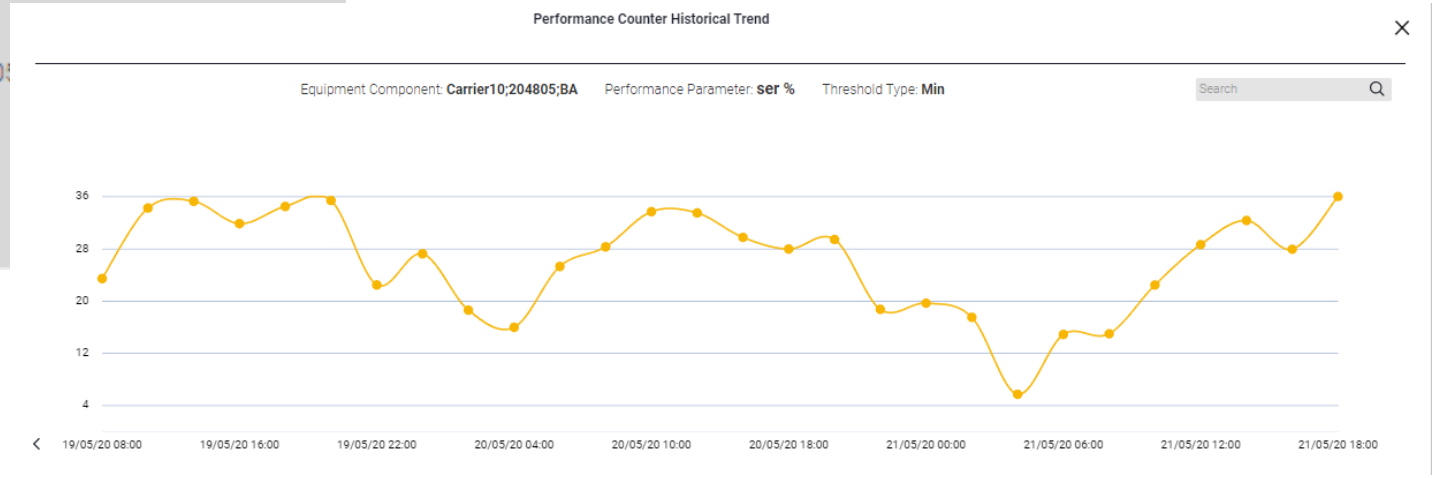
Health Index Tracking





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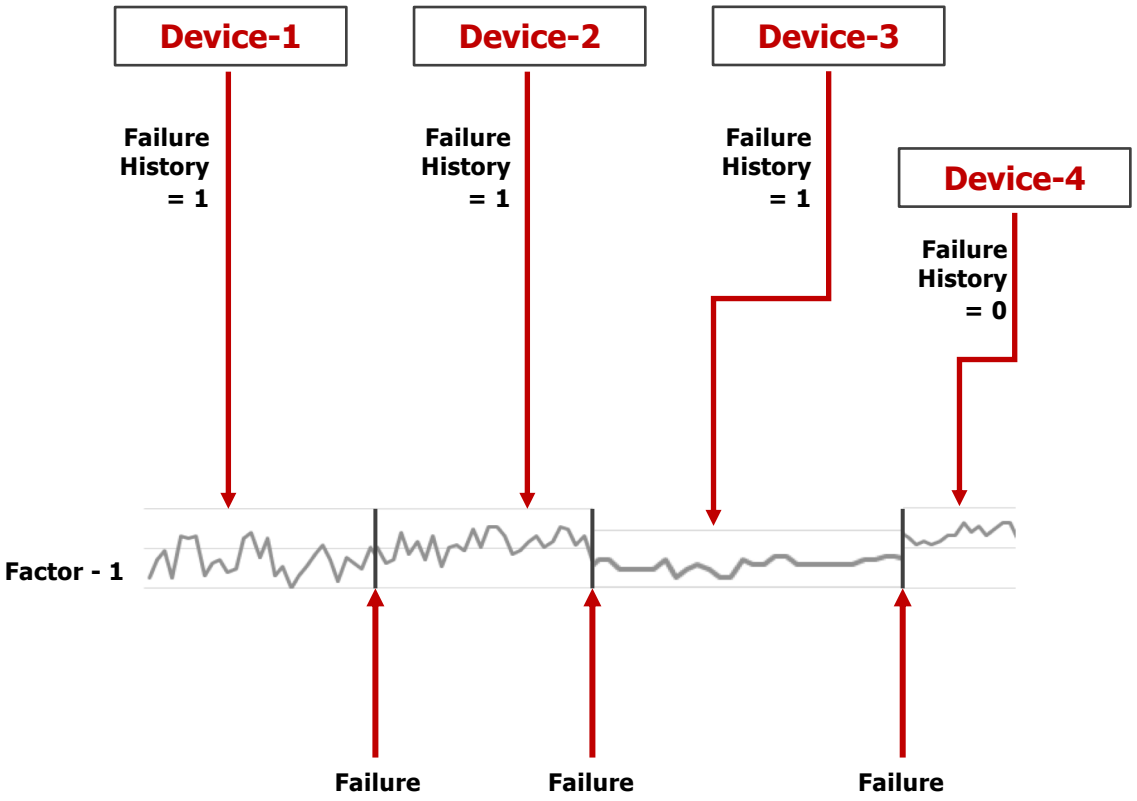
Rare fault prediction



- Rare Fault Prediction where the fault appears after long duration.
- Adequate history of failures may not be available
- Generates synthetic history based on similar equipment / service data
- Generate predictions with accuracy of 90%

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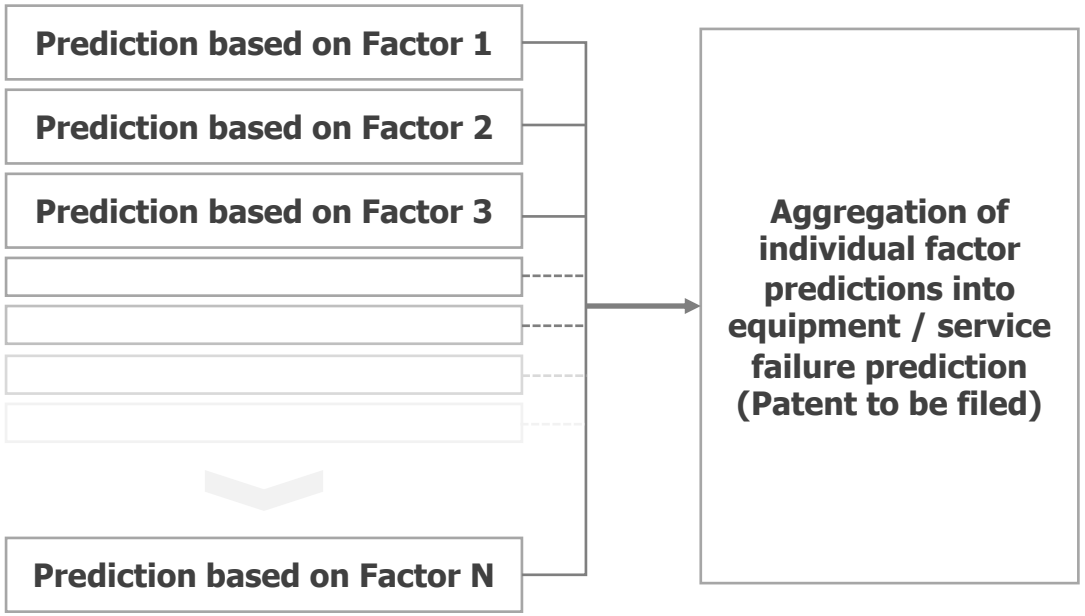
Faster prediction



- Multi-factor processing to enhance speed
- Enhanced scalability as additional factors only add additional sequences
- Best approach for 5G networks where network density is high and dynamic
- Individual predictions can be linked to root cause optimally

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Platform Status

1. Automated closed loop operation
   - Algorithmic auto prioritisation of predictions with support for policies

2. SIMD & GPU
   - Currently working with Intel for benchmarking on cascadelake processors with increased vectorization (>70%), aligned memory access and memory adjacency
   - Benchmarked on NVIDIA GPU; Performance in GPU is 3.5 times that of CPU when compared on equal cost basis

3. Cloud native deployment
   - Deployment in 3 clicks; Certified on Red Hat OpenShift multi-cloud platform, vmware telco cloud, windriver cloud platform and Robin.io multi-cloud platforms
   - Auto-scaling

4. Security (Tested and certified by KPMG on 03/2020)
   - Support for OWASP top 10 vulnerabilities
   - Penetration testing

5. Ready integrations to reduce go-live time
   - Remedy & ServiceNow (predictive ticket creation), Resolve & Cortex (RPA tools), Splunk (log collection) and OpenWeatherMap (weather data)

6. More protocol compliance (mainly for 5G – planned in R6.0, Dec, 2021)
   a. UiPath integration
   b. ONAP: VNF event streaming (VES)
   c. ETSI: ETSI GS NFV-SOL 005 V2.7.1 NFV-Protocols and Data models
   d. TMF: TMF-640 Service activation management

Inventions

Title	Status (USPTO)
Extracting rule specific data from a computer word (Rule execution)	Granted (10394523) https://patents.google.com/patent/US10394523B2
Number comparison during stream processing (Stream processing)	Granted (9851943) https://patents.google.com/patent/US9851943B2
Machine failure prediction involving long temporal dependency (Universal prediction)	Granted (10909458) https://patents.google.com/patent/US10909458B2
Machine failure prediction involving very long temporal dependency (Universal prediction)	Published
Automated stopping criteria for machine failure prediction problems with varying inter-failure gaps (Universal prediction)	Published
A novel gradient acceleration method for machine failure prediction using Recurrent Neural Network (Universal prediction)	Granted (11099552) https://patents.google.com/patent/US11099552B2
A novel way to solve generic prediction problem with long temporal dependency (Universal prediction)	Submitted
Novel bounded-time learning mechanism for machine failure prediction (Universal prediction)	Submitted

Current research: A novel gradient-free, instantaneous and human-like memory mechanism for generic prediction (patent drafting in progress)

Typical faults predicted - RAN

QoS

1. BASE STATION CONNECTIVITY DEGRADED
2. D-CHANNEL FAILURE
3. BCCH MISSING
4. CELL OPERATION DEGRADED
5. BASE STATION NOTIFICATION
6. WCDMA BASE STATION OUT OF USE
7. WCDMA CELL OUT OF USE
8. BTS O&M LINK FAILURE
9. CELL FAULTY
10. BASE STATION INFORMATION
11. BASE STATION OPERATION DEGRADED
12. BTS FAULTY
13. BASE STATION CONNECTIVITY PROBLEM
14. BASE STATION CONNECTIVITY LOST
15. BTS OPERATION DEGRADED
16. BCF FAULTY

Configuration

1. TX ANTENNA FAULTY
2. TX ANTENNA OR COMBINER CONNECTION FAULTY
3. DIVERSITY BRANCH LNA OUT OF ORDER IN ANTENNA FILTER UNIT
4. RECEIVING FAULT IN BASEBAND MODULE

Infra

1. POWER SUPPLY FAULT
2. TEMPERATURE CONTROLLING DEVICE FAULTY
3. BATTERY CHARGER FAILURE
4. INCOMING POWER LOST
5. MAINS BREAKDOWN WITH BATTERY BACK-UP
6. UNIT TEMPERATURE HIGH
7. EXTERNAL ALARM
8. FAULT IN COOLING FAN
9. CABINET TEMPERATURE TOO HIGH

Transmission

1. FAILURE IN WCDMA WBTS O&M CONNECTION
2. BTS O&M LINK FAILURE
3. BFD LINK FAILURE
4. IP BASED D-NBAP LINK FAILURE
5. PCM FAILURE

Typical KPIs predicted - RAN

2G

- Call Volume
- CSSR
- All call drop rate
- Handover success rate
- SDCCH Block Rate
- TCH Blocking Rate(%)
- TBF Establishment
- TBF Drop Rate
- Total Traffic in Erlang

3G

Total RRC Connection Requests(times)
RRC Connection Success Rate
PS Setup Success Rate
PS Attempts(times)
HSDPA Attempts(times)
HSDPA Establishment Succ Rate
HSUPA Attempts(times)
HSUPA Success Rate
DCH User Throughput DL(kbit/s)
DCH User Throughput UL(kbit/s)
HS User Throughput DL(kbit/s)
EUL User Throughput UL(kbit/s)
Total Data Volume in DL(KB)
Total Data Volume in UL(KB)
Total Data Volume of HS User in DL(KB)
Total Data Volume of HS User in UL(KB)
PS Dropped Calls(%)
HSDPA Dropped Calls(%)
PS R99 SHO Success Rate
HSDPA Inter RAT Handover Success Rate
Speech Call Volume(number)
Speech Setup Success Rate
CS64 Call Volume(number)
CS64 Setup Success Rate
Speech Dropped Calls(%)
CS64 Dropped Calls(%)
CS HHO Inter RAT Success Rate
CS SHO Success Rate
Maximum Cell Freq RTWP(dBm)
Minimum RTWP(dBm)
Average Cell Freq RTWP(dBm)
Cell Traffic Volume, speech(Erl)

4G

VoLTE_Drop Rate (%)
VoLTE Drops
VoLTE E-RAB Failures
Erab Retainability (%)
Random Access MSG2 Congestion (%)
Mobility Success (%)
Mean Downlink UE PDCP Throughput (mbps)
Accessibility (%)
Prb Available Dl
Prb Available Ul
PDCCH_Congestion
PS Retainability (%)
RACH Success (%)
RRC Success (%)
DL PDCP Cell Throughput (Mbps)

4G ORAN

Max UE Num
RRC Setup Success Rate (%)
ERAB Setup Success Rate (%)
S1 Signaling Connection Establishment (%)
VoLTE Setup Success Rate (%)
RRC Abnormal Release Rate (%)
Sector DL Throughput (Mbps)
Sector UL Throughput (Mbps)
Radio Network Availability Rate (%)
Intra Frequency Handover out Success Rate (%)
Inter Frequency Handover out Success Rate (%)
Accessibility (%)
CDR Increase (%)
Overall Handover Success Rate(%)
RRC Avg Conn
DL Traffic Volume (GB)
UL Traffic Volume (GB)
DL Peak Throughput (Kbps)
UL Peak Throughput (Kbps)
Total Traffic Volume (GB)
UL RSSI (dBm)
Erab Access Failure
Rach Msg 2
Rach Msg 1
RRC ASN Decode Error
RRC Security mode failure
RRC Connection setup time out
RRC Init cntxt timeout
RRC UE Capability Timeout

Microwave antenna line of sight issue and misalignment prediction

Due to line of sight issue or misalignment, signal strength can become low. Prediction of misalignment or line of sight issue is performed by finding patterns in alarms as well as performance counters related with signal strength.

- Typically, **bit error rate** alarms (gradually followed by **loss of frame** alarm and finally l**ink down** alarm) will appear when signal strength starts to go down. We predict misalignment based on patterns of BER and loss of frame alarms for a specific link.

- We also take **ES (Error second)**, **SES (Several Error Second)** and **UAS (Unavailable Seconds)** along with **Rx levels** (max and min) from performance monitoring systems. These are typically recorded every 15 minutes as well as 24-hrs basis. Again, we reinforce prediction of misalignment based on trends of these counters as well as their levels with respect to thresholds.

Typical faults predicted - Transport

Technologies: 1. Optics (SDH, etc.) 2. IP-MPLS 3. CEN

Fibre - Hardware

1. FAN-IN-TURBO
2. BIT-FAILED
3. LOW TX POWER
4. FAN-FAIL
5. CBUS-ERROR
6. PROGRAM FAIL ALARM
7. BIT DEGRADED
8. COMMUNICATION-FAIL
9. HARDWARE FAILURE
10. CARD-CTRL-FAIL
11. EQUIPMENT OUT
12. HARDWARE DEGRADATION
13. SFP-OUT
14. OA_LOW_GAIN

Fibre - Txn Media

1. RDI
2. OPTICAL LINE FAIL
3. BFD-RDI
4. SPAN_LOSS_HIGH
5. OTS_TIM
6. RX-OPOWER-LOW
7. LOSS OF MULTIPLEX SECTION
8. SHUTOFF THRESHOLD CROSSED
9. DOC ACTION- FAULT DETECTED
10. RX POWER LOW
11. HIGH RECEIVED SPAN LOSS
12. AUTOMATIC SHUTOFF
13. OSC_LOS
14. HIGH BACK REFLECTION
15. TIM
16. EXC-BER

Fibre - Infra

1. DC-IN-FAIL
2. HIGH TEMPERATURE
3. HEATER PROBLEM
4. DC_LOW(-48V)
5. TEMP HIGH
6. POWER FAILURE
7. TEMPERATURE OUT OF RANGE
8. SUBCARD_TEMP_OVER

MPLS - Hardware

1. PKT_INFRA-LINK-3-UPDOWN
2. SWT_SWITCH_DOWN
3. TV_CE_PERFORMANCE_INTERFACE
4. SWT_CEFC_STATUS_CHANGE
5. PLATFORM-SFP-2-LOW_RX_POWER_ALARM
6. FANFAILURE
7. C6KENV-SP-4
8. PLATFORM-INV-6
9. PLATFORM-ENVMON-FANTRAY_ALARM
10. CHASSISD_SNMP_TRAP6

MPLS - Infra

1. C7600_ENV-SP
2. TEMPERATURETHRESHOLDCROSSED

Typical KPIs predicted - Transport

Router / Switches

CPU / NPU / Routing Engine (Juniper) usage
Memory usage
Interface availability
Interface utilisation in %
Interface error
Interface speed

QoS

Policing and Shaping
CIR, PIR
Device Temperature
Chassis
Power Supply Failure

Firewalls

Intrusion Prevention
Evasion
Application Control
Firewall Policy Enforcement
Stability and Reliability

Typical faults predicted - Core

CS Core

1. Media Gateway Unavailable
2. Diameter Link Fault
3. M3UA Link Fault
4. Diameter LinkSet Fault
5. Diameter Peer Device Fault
6. Dynamic database is inconsistent
7. DPC subsystem is prohibited
8. Traffic Reaches the Peak
9. Route is prohibited
10. M3UA Application Server Inaccessible
11. M3UA Linkset Fault
12. MTP Destination Signaling Point Inaccessible
13. MTP Linkset Fault
14. Card is isolated from the system
15. MTP3 link set failure
16. Board fault

PS Core

1. Hardware Failure
2. IP Interface GxGy changed status to down
3. IP pool exhausted
4. Diameter Peer Down
5. IP Interface GaGz changed status to down
6. IP Interface Gi changed status to down
7. IP Interface GnS5S8 changed status to down
8. IP Interface IMS changed status to down
9. IP Interface Li changed status to down
10. Signaling path disconnected
11. IP Interface Ga changed status to down
12. IP Interface Gb changed status to down
13. IP Interface Gn changed status to down
14. IP Interface IuPS-CP changed status to down
15. Port Down due to Card Down

IMS

1. ICMP Error: Dest Unreachable
2. H.248 IP Connection Lost
3. Host of a SIP FQDN is unreachable
4. Link down fault in CSCF (237-1420)
5. Fault in CSCF (237-3101)
6. Fault in TSP (102-304)
7. Fault in TSP (128-255)
8. Fault in COMMON (236-1713)
9. Fault in COMMON (236-370)
10. Fault in DU (141-345)
11. Fault in DU (236-1050)
12. Fault in DU (102-201)
13. Fault in DU (141-9993)
14. Fault in TSP (102-401)
15. Fault in TSP (102-660)

Typical KPIs predicted - Core

CS Core

2G_PSR_NBH
3G_PSR_NBH
2G_LUSR_NBH
3G_LUSR_NBH
CSFB_SR_NBH
Peak Processer Load_NBH
Outgoing_HOSR_NBH
LU_Over_SGs_Interface_NBH
Total_VLR_NBH
MO_SMS_SR_NBH
MT_SMS_SR_NBH
MO SMS SR_CSFB_NBH
MT SMS SR_CSFB_NBH
Lost Calls
Trunk Group Circuit utilization
CST CORE<3sec
CST CORE 3-5 secs
CST CORE 5-7 secs
CST CORE>7secs
SCR
SCR_NBH
NBN - Network Busy Hour

PS Core

3G Attach Success Rate
3G PDP Success Rate
SGSN CPU Utilization
SGSN Memory Utilization
SGSN MAP Success Rate
SGSN Gn Throughput
GGSN CPU Utilization
GGSN Memory Utilization
GGSN Throughput
GGSN Active PDP count
2G Intra RAU Success Rate
3G_Intra_SGSN__RAU__Success_Rate
2G Inter RAU Success Rate
3G_Inter_SGSN__RAU__Success_Rate
GX and GY Success Rate - Init
GX and GY Success Rate - Upd
GX and GY Success Rate - Ter
3G PSR
2G PSR
BSC Throughput
RNC Throughput
GGSN Throughput
GGSN PDP SR

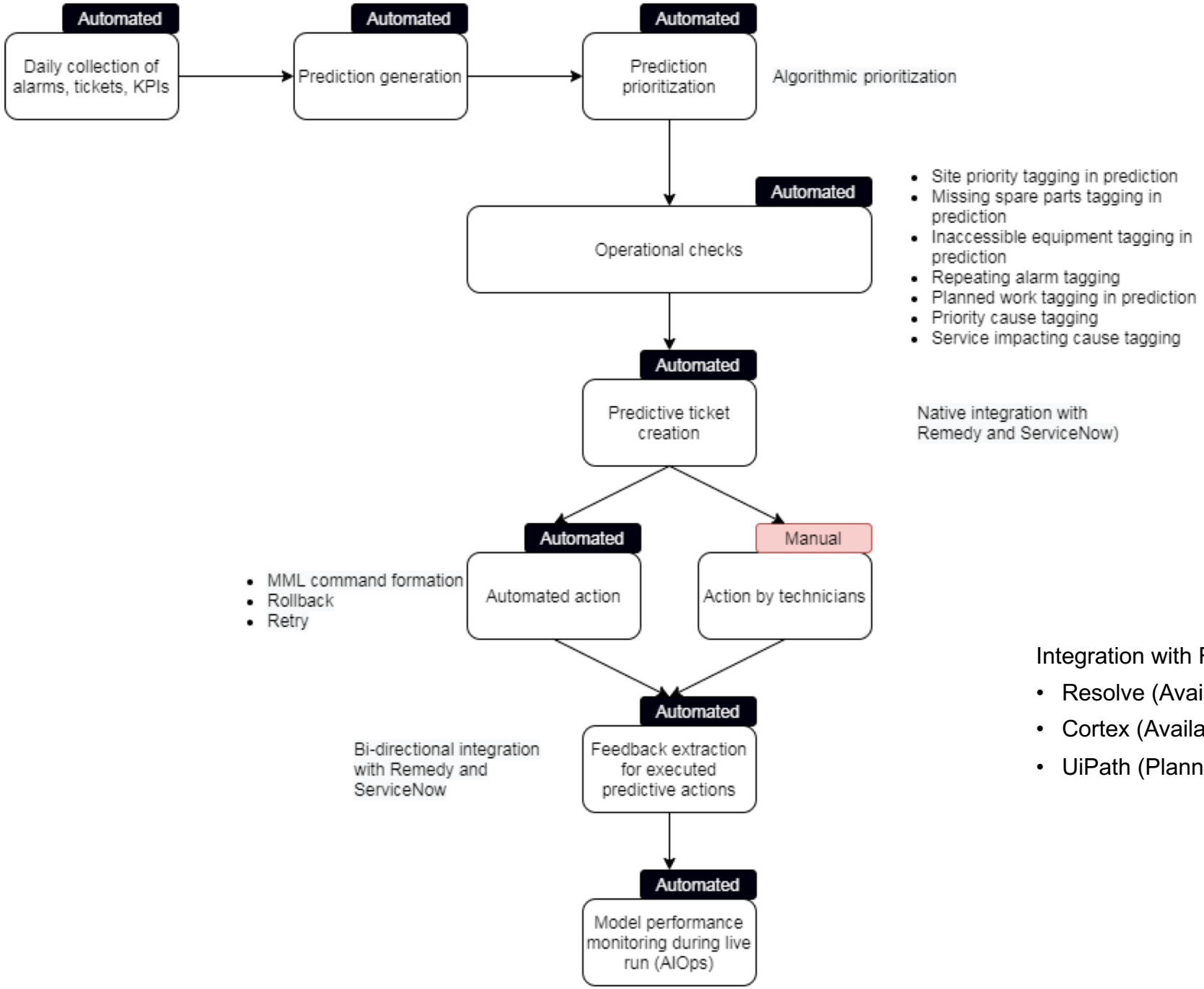
IMS Core

BHCA Per Subscriber
Total Traffic NBH
Total Traffic 24 Hrs
Early Session Setup Success Rate
Early Session Setup ORIG Success Rate
Early Session Setup TERM Success Rate
SRVCC Success Rate
Registration Success Rate_Gm_With Exclusion
TAS TADS %
TAS PS Fail TADS %
Call Setup Success Rate_New
Avg Call Setup time_New_Primary
SRVCC per User %
LTE to GSM Handover Success Ration (%)
SRVCC Iu-Relocation Success Ratio (%)
SRVCC Inter-MSC Iu Relocation Success Ratio(%)
Relocation (due to SRVCC) success rate to target RNC (%)
SRVCC A-Interface Relocation Success Ratio (%)
SRVCC Inter MSC A- Relocation Success Ratio (%)
Relocation (due to SRVCC) success rate to target BSC (%)
Incoming INVITE Success Ratio (%)
Outgoing INVITE Success Ratio (%)

Typical faults predicted – Passive Infra

AL01-DOPN	DOOR OPEN
AL02-MNSF	MAINS FAIL
AL03-DGON	DG ON LOAD
AL04-DFST	DG FAIL TO START
AL05-DFSP	DG FAIL TO STOP
AL06-LFLV	DG LOW FUEL
AL07-RCTF	RECTIFIER FAIL
AL08-SOBT	SITE ON BATTERY
AL09-BTFF	BATTERY FUSE FAIL
AL10-LDFF	LOAD FUSE FAIL
AL11-TPHG	HIGH TEMP.
AL12-FRSM	FIRE & SMOKE
AL13-BTLV	LOW BATTERY
AL14-ACFL	AC FAIL
AL15-ACBF	BOTH AC FAULTY
AL16-DGFT	DG FAULT
AL17-LLOP	DG LLOP
AL21-OP1D	BTS DOWN
AL21-ESMX	ESMX near low/high limit

Very little manual touch points



Integration with RPA tools:

- Resolve (Available)
- Cortex (Available)
- UiPath (Planned for R6.0, Dec, 2021)

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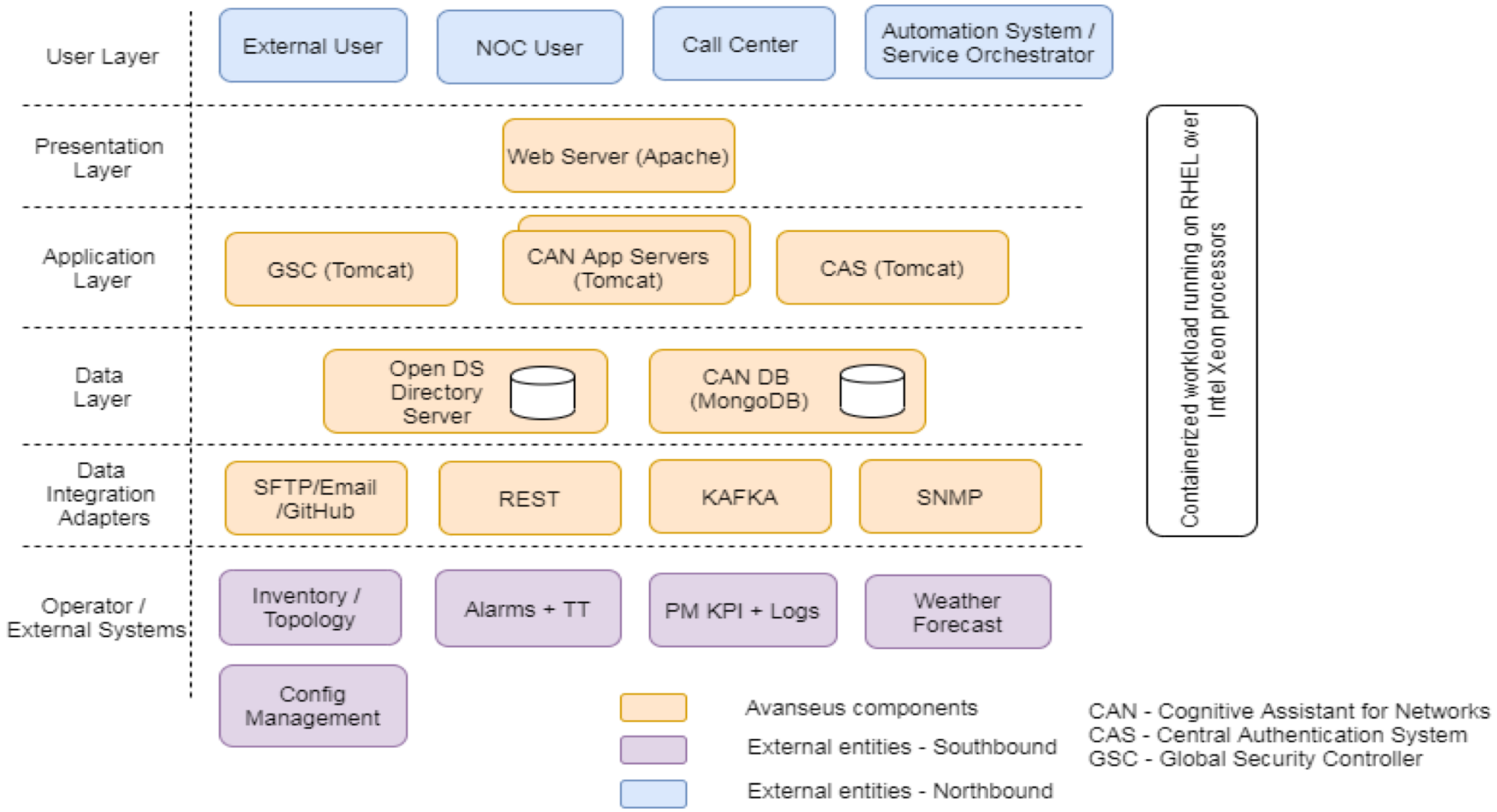
Solution architecture



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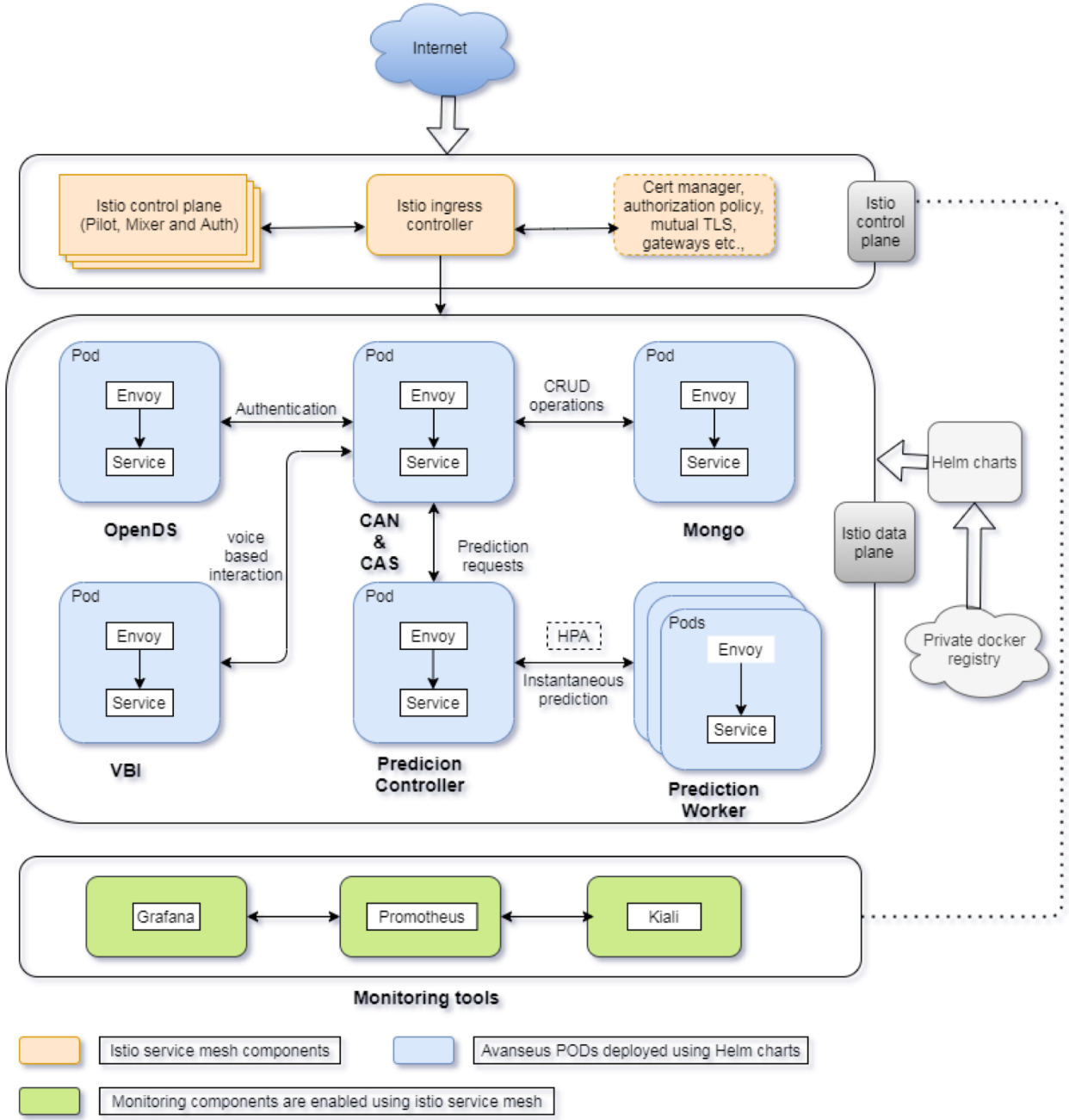
Cloud native packaging and deployment



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Commercial Customers

Mobile Network Operator (India)	Tier 1 Operator (350K nodes)	Core, Transport, Enterprise, Infra	Fault Prediction Degradation Prediction
Mobile Network Operator (Brazil)	Tier 1 Operator (180K nodes)	RAN, Core, Transport- IPTV Enterprise FTTH Access Network (ongoing)	Fault Prediction Degradation Prediction Customer Experience
Mobile Network Operator (Turkey)	Tier 1 Operator (120K nodes)	RAN, Core, Transport	Fault Prediction Degradation Prediction
Fixed Network Operator (UK)	Tier 1 Operator (35K nodes)	Fixed – Enterprise Customers	Fault Prediction Degradation Prediction
Mobile Network Operator (Germany)	Tier 1 Operator (160K nodes)	RAN, Core, Transmission, Infra	Fault Prediction Degradation Prediction
Mobile Network Operator (Sri Lanka)	Tier 2 Operator (21K nodes)	RAN, Core, Transport, Infra	Fault Prediction Degradation Prediction

800K+ Nodes under prediction

Benefit from Avanseus predictive maintenance (Widely deployed in Europe, Americas and APAC)

Cost drivers (target - 30% reduction overall)

- Reduction in network failure & outages
- Reduction in high priority service impacting tickets / WOs
- Reduction in overall tickets / WOs (high priority Service impacting + low priority nonservice impacting)
- Reduction in field visit travel costs
- Efficiency in NOC Operation
- Reduction in customer complaints on network related issues

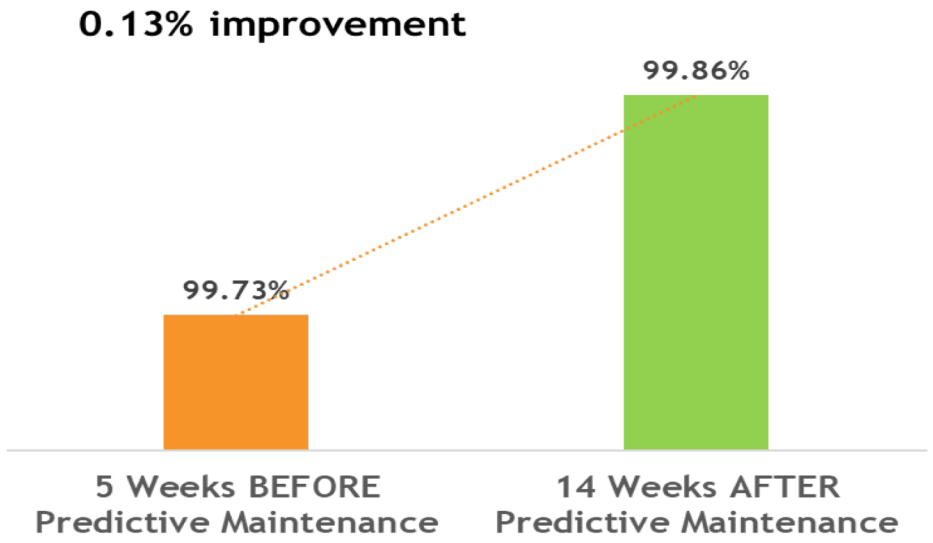
Revenue drivers (operators to estimate)

- Increase in network uptime (~0.12% in matured stable European network)
- Improvement in network quality

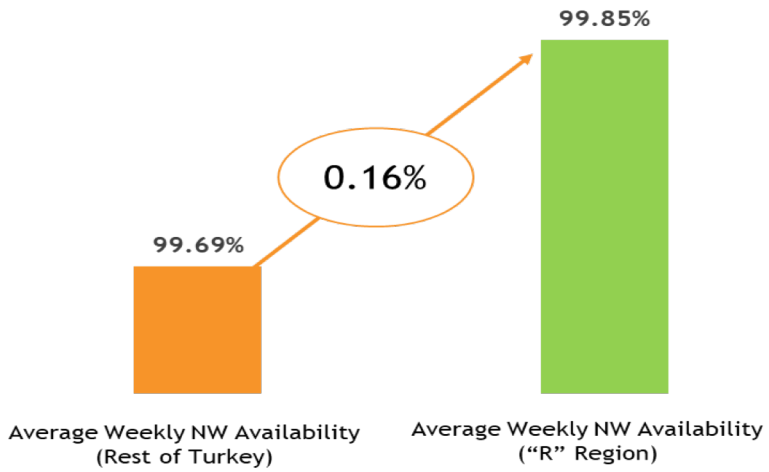
Loyalty drivers (Churn reduction – operators to estimate)

- Improvement in customer satisfaction

Sample Network availability improvement trend due to predictive action (0.16% improvement)



Operator in Spain



Operator in Turkey

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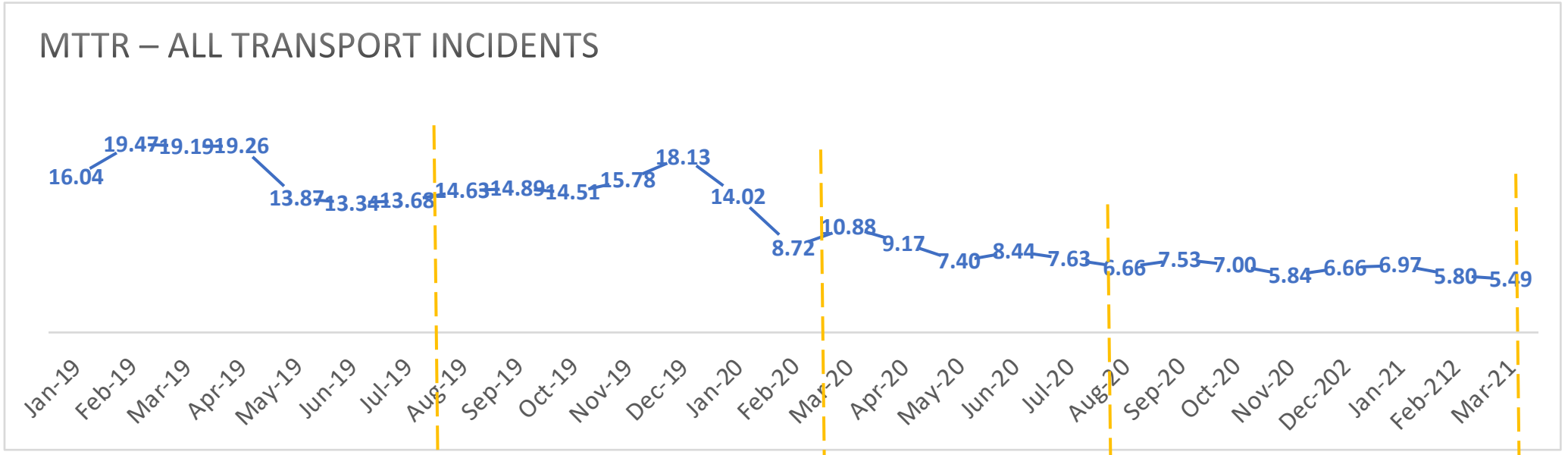
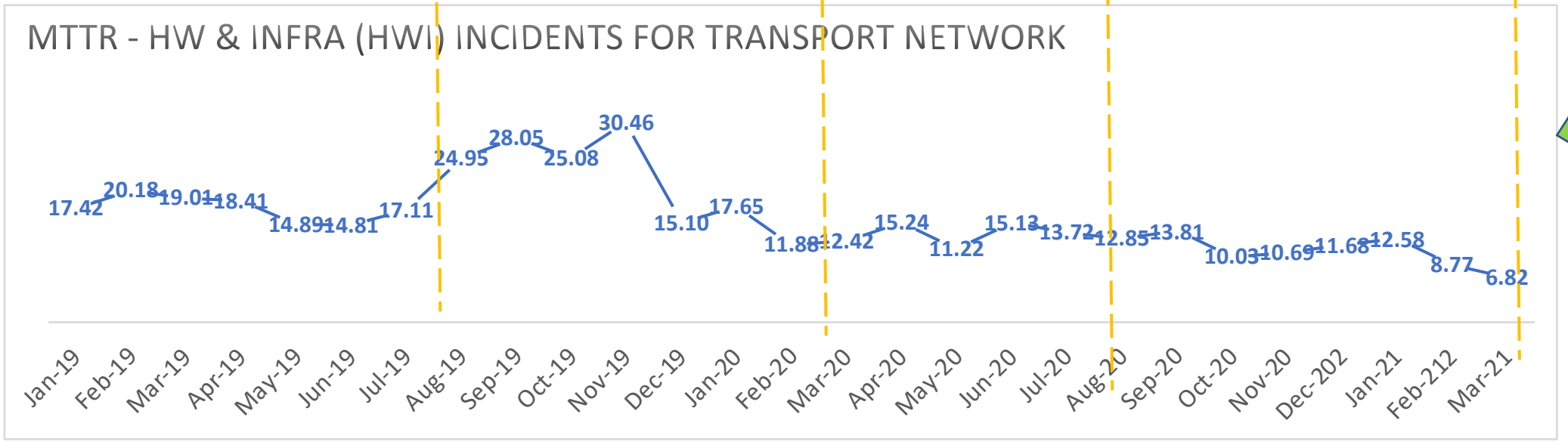
Sample MTTR reduction trend due to predictive action (50% reduction)





Aug-Mar 2019-20 v/s Aug-Mar 2020-21

▼ **47%** (-9.8 Hrs)

MTTR is at **its lowest levels in the last 2 yrs.** through the use of Avanseus Predictive Maintenance

A Large Operator (India)

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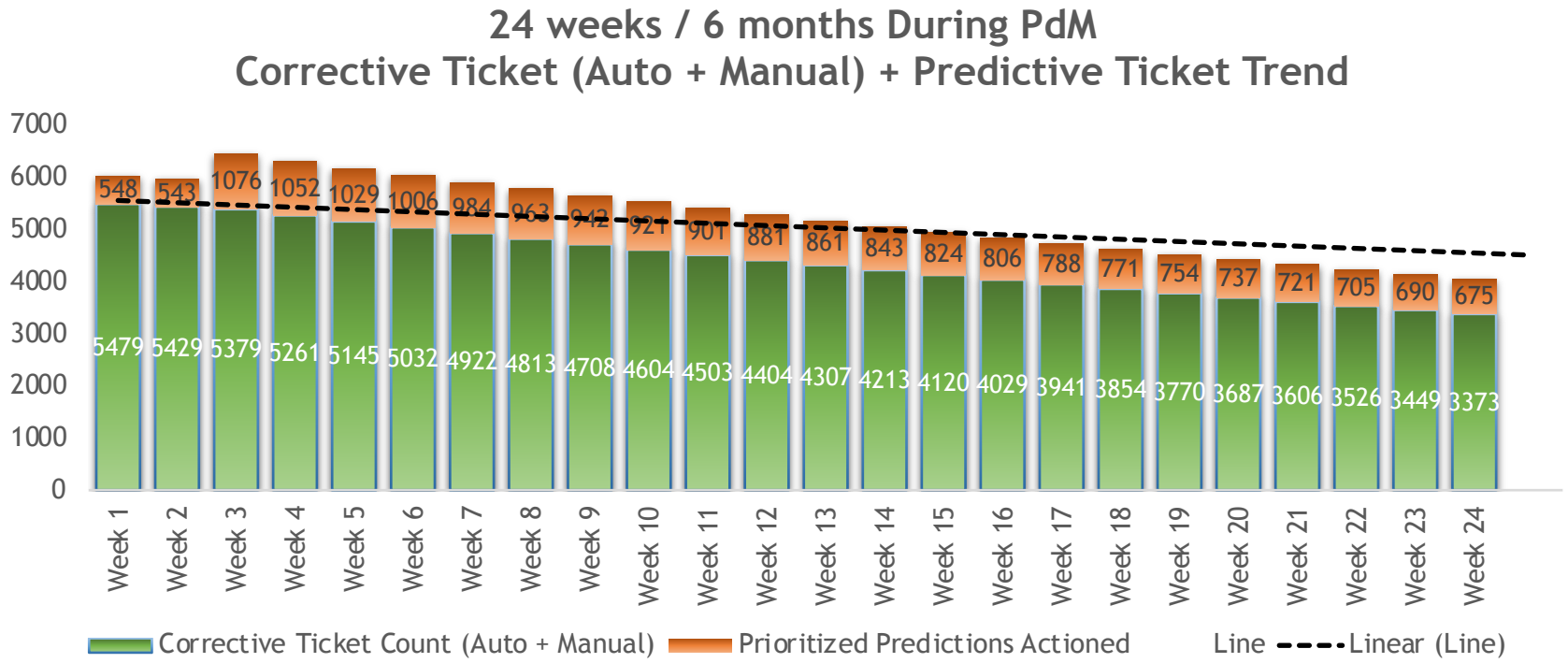
Alarm reduction trend due to predictive action (28% reduction)

Overall alarms' impact measured against site/equipment where predictive tickets are created

	Alarms Reduction			Days Before			Days After		
Period	30	60	90	30	60	90	30	60	90
Mar-21	-67%			113.944			37.275		
Feb-21	-58%	-73%		61.379	39.130		25.631	10.744	
Jan-21	-57%	-58%	-59%	42.318	27.323	19.249	18.181	11.534	7.966
Dec-20	-37%	-60%	-27%	24.949	24.674	13.409	15.717	9.883	9.761
Nov-20	-32%	13%	66%	18.177	12.821	8.713	12.365	14.546	14.424
Oct-20	-46%	-39%	-15%	51.185	39.976	25.074	27.856	24.409	21.361
Sep-20	-70%	-75%	-52%	74.017	49.277	30.347	22.341	12.538	14.429
Aug-20	-42%	-30%	-2%	13.792	10.350	6.645	8.064	7.266	6.540
Total	**-58%**	**-55%**	**-28%**	**399.761**	**203.551**	**103.437**	**167.430**	**90.920**	**74.481**

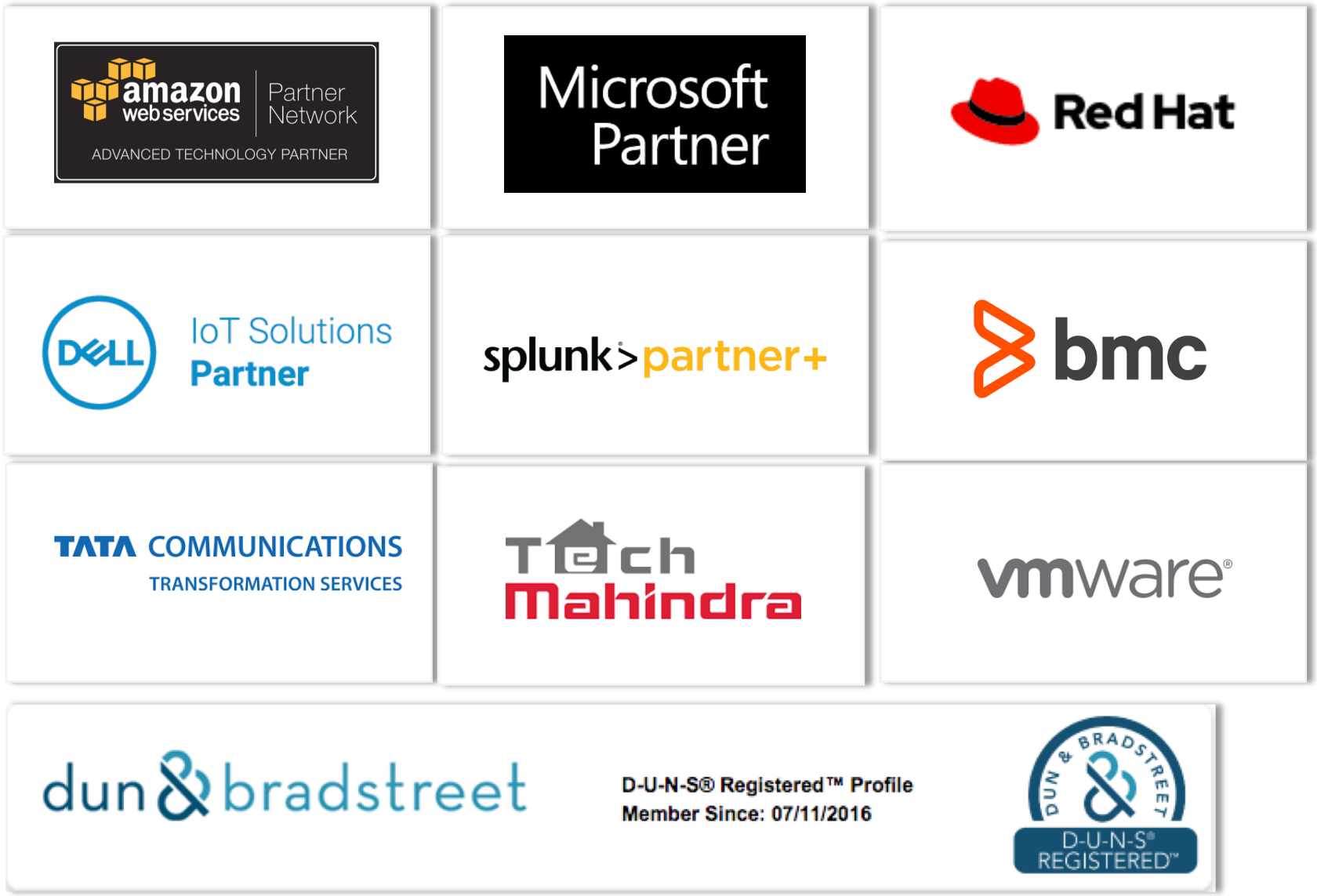
A Large Operator (Brazil)

Overall Trouble Tickets Trend with predictive operation in a typical mature network



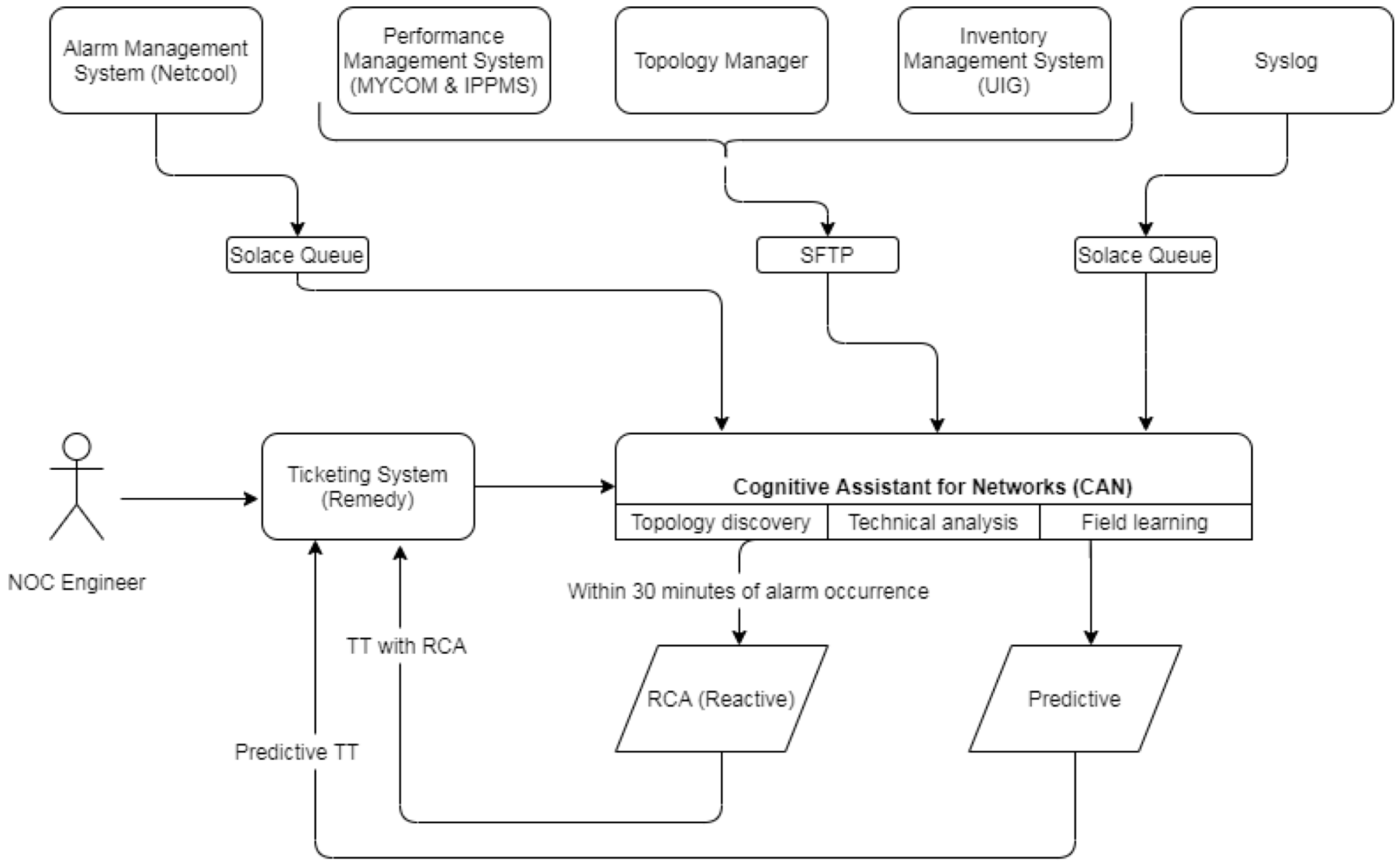
Note: Incident counts used are for illustrative purpose only

Avanseus - Identify with the Best



Backup

Real-time RCA of Reactive Incidents



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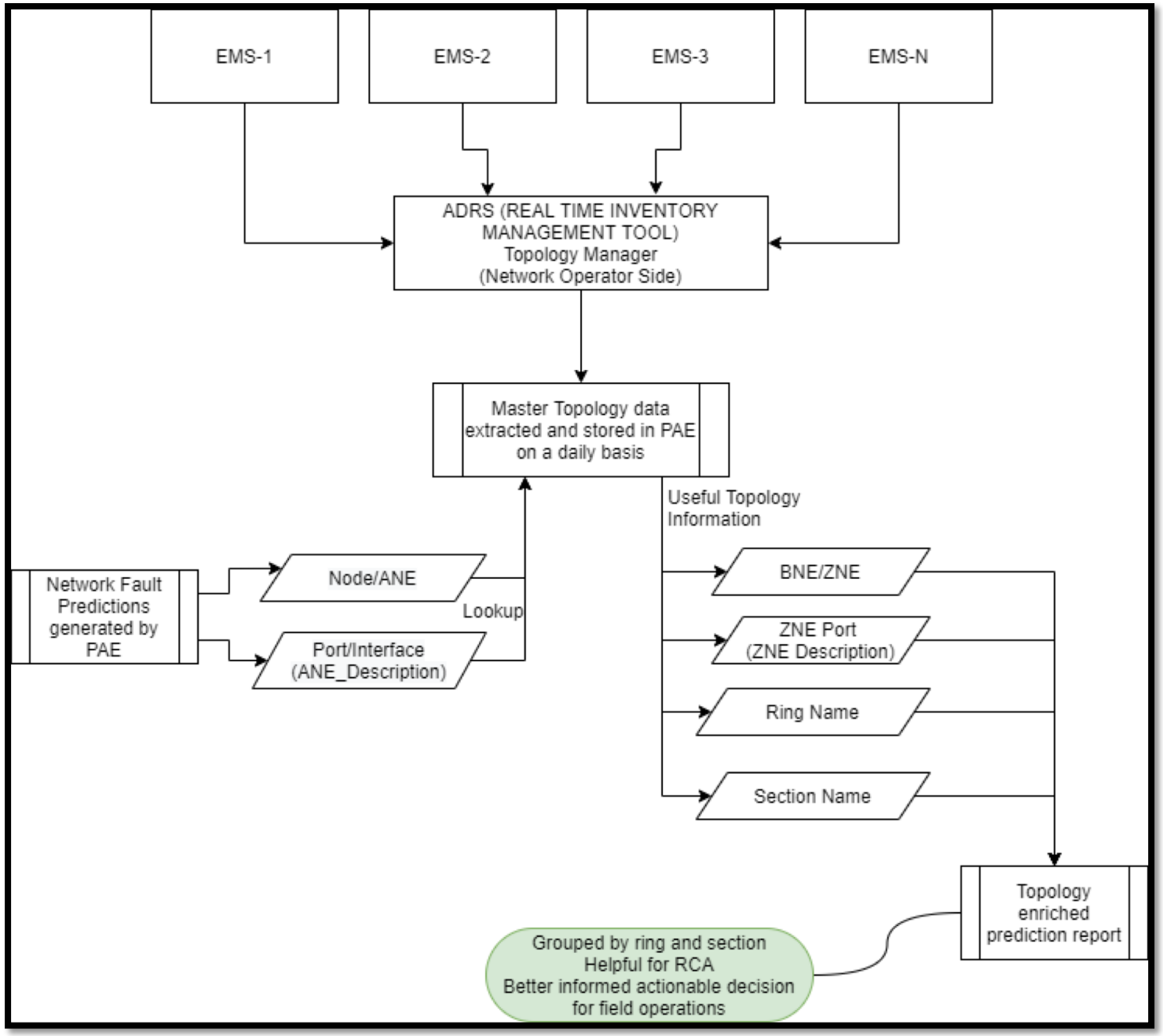
Topology use - Transport



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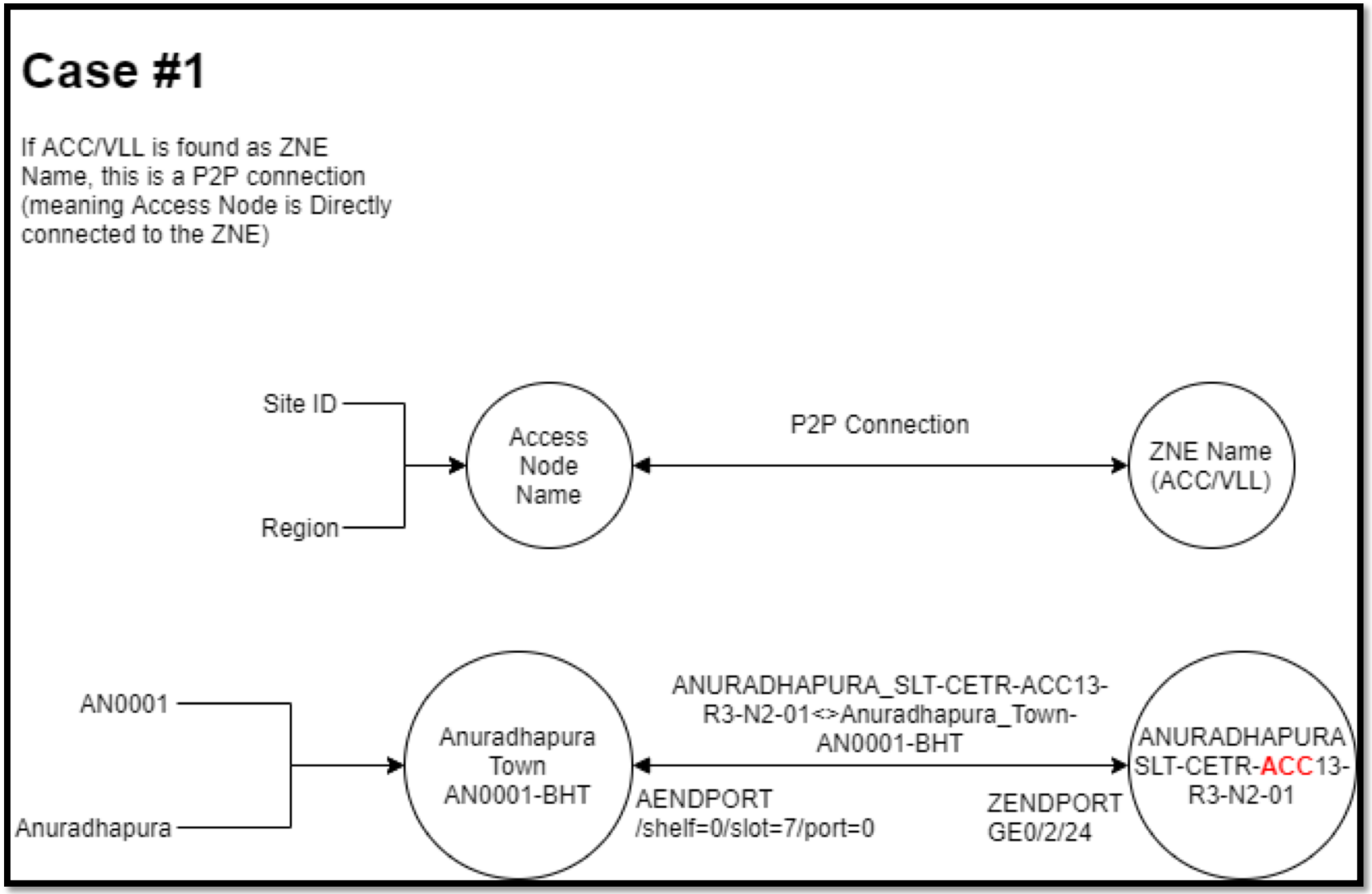
Topology Manager Master Data

ALOCATION_CODE	ALOCATION	BCUSTOMERNAME
BLOCATION_CODE	APORT	ACUSTOMERNAME
ANE_DESCRIPTION	APORTTYPE	SECTIONNAME
ZNE_DESCRIPTION	APORTRATE	A_PTP_NAMEPTPNBIPORTION
TP_LINK_ZENDEMSPORTION	BNE	Z_PTP_NAMEPTPNBIPORTION
TP_LINK_AENDEMSPORTION	BVENDOR	A_LAT
TP_LINK_LABLE	BNETYPE	A_LONGITUDE
INVOLVEDTOPOLOGYLABEL	BLOCATION	A_SITEID
LINKNAME	ZPORT	B_LAT
ALARM_IDENTIFIER	ZPORTTYPE	B_LONGITUDE
MEDIA OWNER	ZPORTRATE	B_SITEID
MEDIA OPERATOR	TOPOLOGYNAME	ASTATE
TERRITORY	RINGNAME	ATELECOM_CIRCLE
AREAMANAGERNAME	RINGTOPOLOGY	BSTATE
AREAMANAGERNO	RINGPROTECTION	BTELECOM_CIRCLE
TP_LINK_DIRECTION	RINGTECHNOLOGY	A_MAC_ADDRESS
TP_LINK_LAYERRATE	RINGNETWORKGROUP	Z_MAC_ADDRESS
ANE	RINGTIERTYPE	ADRS_RINGNAME
AVENDOR	ACITY	
ANETYPE	BCITY	

E2E Topology Scenarios



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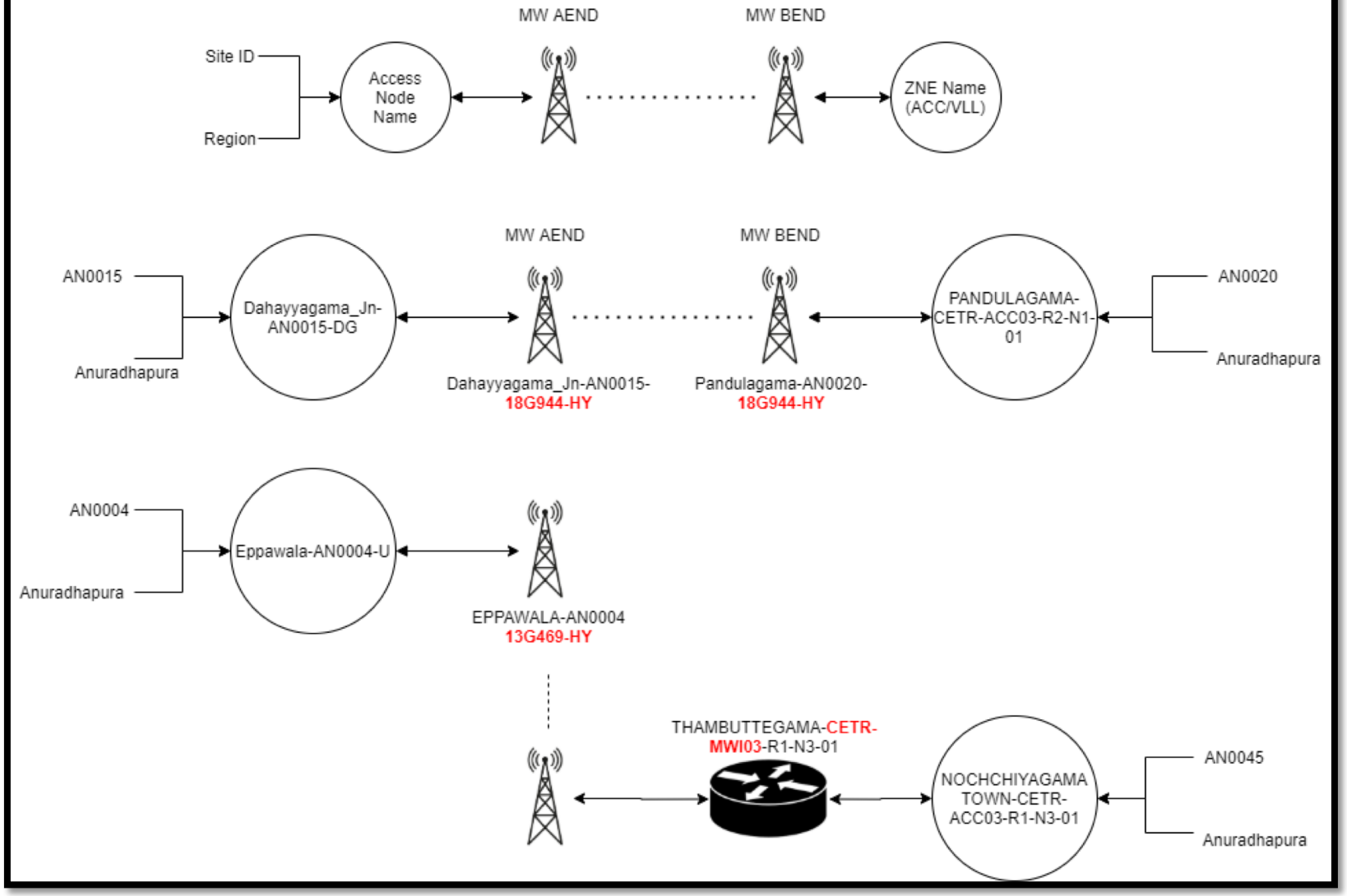
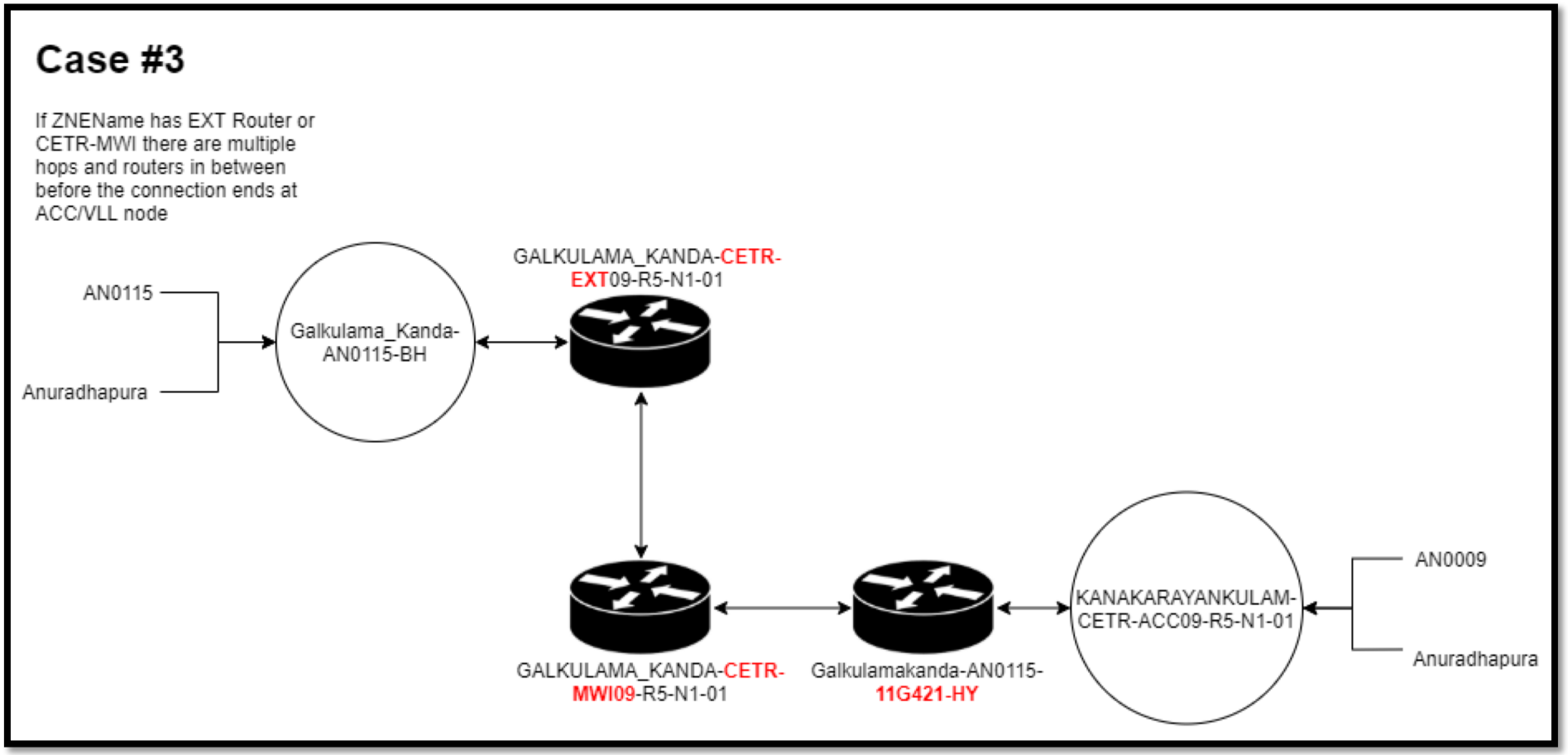
E2E Topology Scenarios

Case #2

If ZNEName has HY, this is a Hop Reference Link connection



E2E Topology Scenarios



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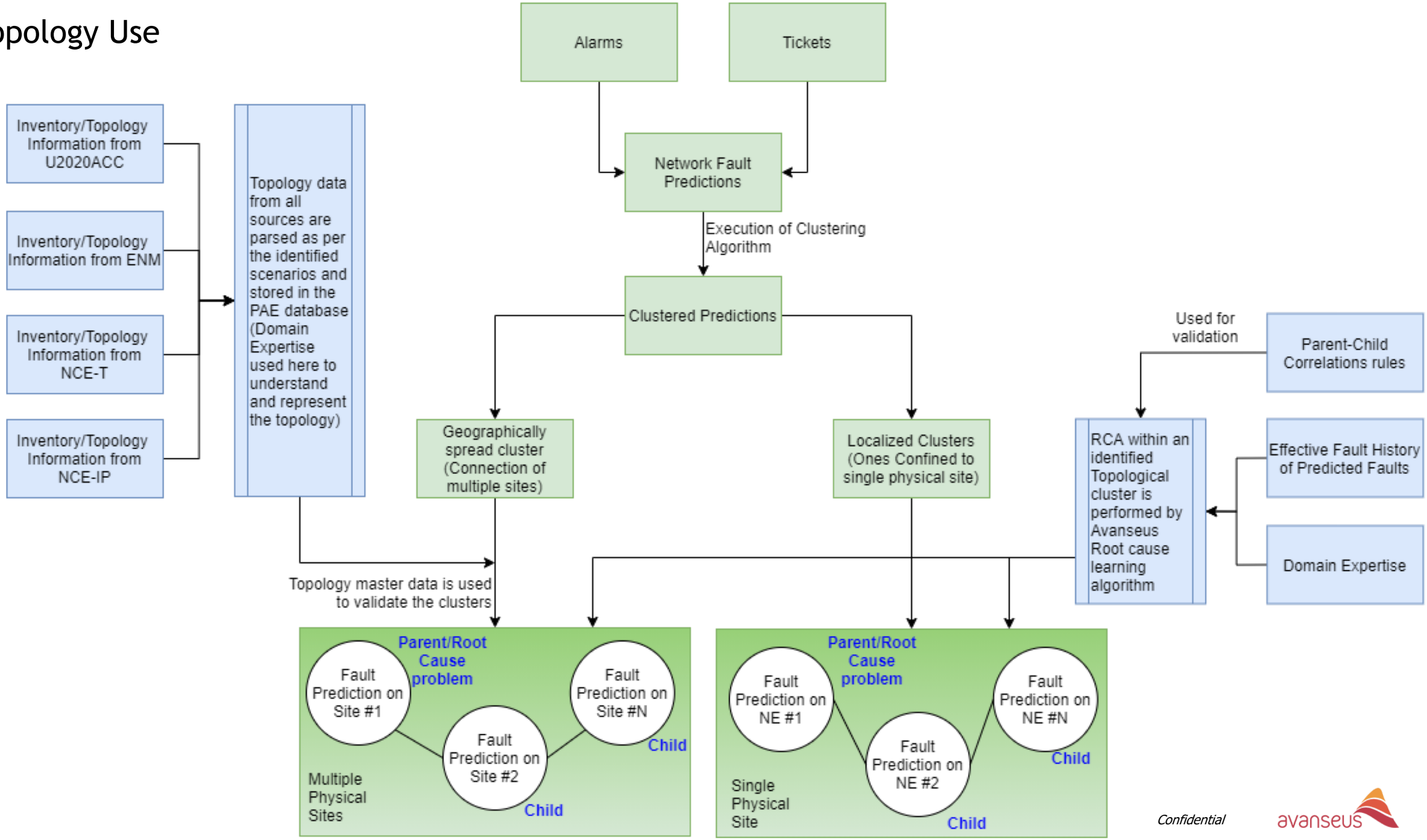
Topology Use



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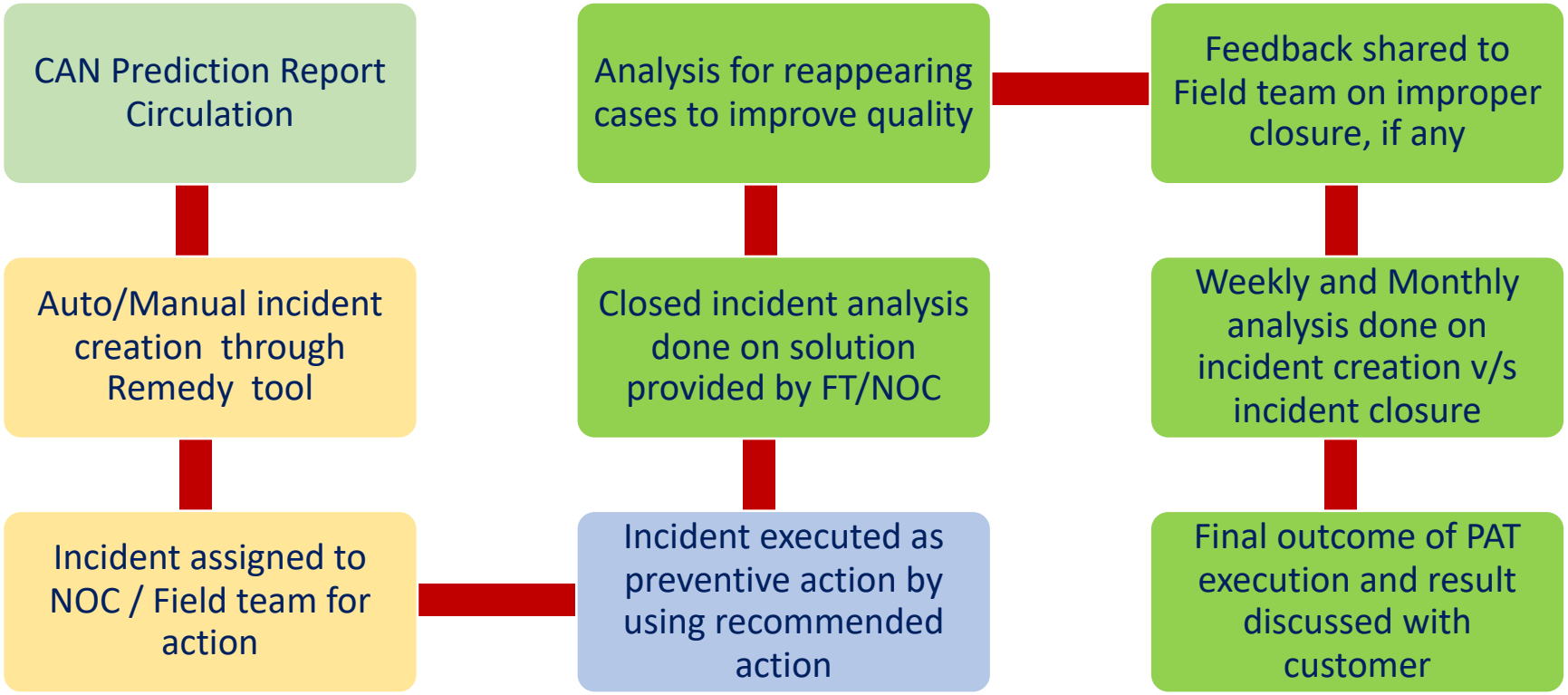
Predictive Ticket Execution Process Flow



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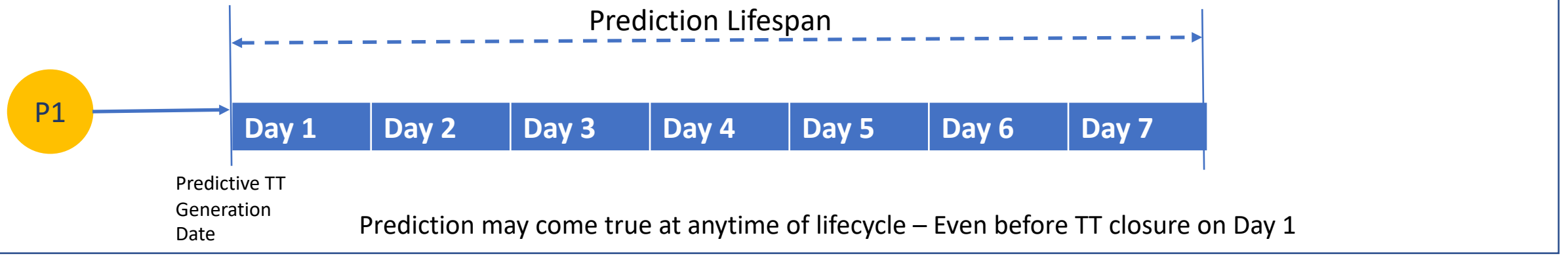
48-Hr Leap Predictions

Standard Prediction Cycle



Prediction may come true at anytime of lifecycle – Even before TT closure on Day 1

Leap Prediction Cycle

Helps Field & NOC teams prevent predicted failure by taking pro-active action within 48-hrs of TT generation

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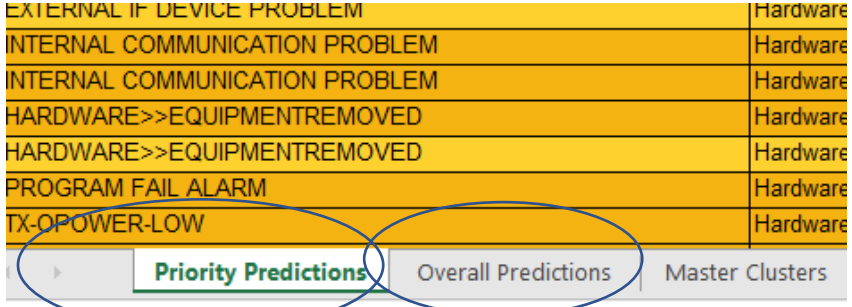
Priority and Overall predictions, Recommended action mapping

Alarm	Domain	Shortlist	Actionable	Priority	Category	Action_FIELD	Action_NOC	PNum
APPCODE-MISMATCH	1000	Y	YES	Critical	Hardware	PMT done on node and site infra condition improved	Check logs for infra issues and Hardware reset or need to be replaced	P2
DOC ACTION- FAULT DETECTED	1000	Y	YES	Critical	Txn Media	Patch need to be cable cleaned and rerouted/FIBER RECTIFICATION	FIBER CUT /SPAN & HARDWARE ISSUE NEED TO CHECK	P2
BIT DEGRADED	1000	Y	YES	Critical	Hardware	PMT on node Patch cable properly rerouted / Hardware Need to be replaced	Checklogs for HW related issues and bit codes	P1
CARD FAILURE	1000	Y	YES	Critical	Hardware	PMT on node Patch cable properly rerouted / Hardware Need to be replace	Checklogs for infra issues and Hardware reset or need to be replace	P1

Transport Domain	Types of Alarms	Shortlisted by Customer Team	Shortlisted as Actionable(Priority) by Customer Team
SDH/OTN	1866	1453	196
MPLS	225	199	92
CEN	369	213	59
Grand Total	**2460**	**1865**	**347**



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Prediction report – Action recommendation related fields

Following additional fields are included in prediction report. Prediction report format is configurable and finalized based on joint discussion with NOC and Field teams.

TECHNICAL RCA - included as recommended action for predictions based on fault traces
RECOMMENDED ACTION – FIELD - Recommended Action to be taken by the field team to resolve the predicted cause
RECOMMENDED ACTION – NOC - Recommended Action to be taken by the NOC team to resolve the predicted cause
RESOLUTION CATEGORIZATION - Top 5 resolution categorization from the previous remedy ticket incidents for that Node + Cause in past 180 days

CLUSTER	TECHNICAL RCA	RECOMMENDED ACTION - FIELD	RECOMMENDED ACTION - NOC	RESOLUTION CATEGORIZATION	
UnClustered		PMT on node Patch cable properly rerouted / H	Checklogs for infra issues and Hardware reset o	Soft Fault fluctuation>>Fluctuation	74
UnClustered	Need to check transmit power of th	PMT need to be done on node and site infra cor	Checksection span , attuneutaors &internal pat		67
UnClustered		NOC action required.	1-BFD configuration need to check by NOC.	CEN Media Problem>>Tx Media ProblemCEN M	60
UnClustered		1- Check for Attenuator2-Check for SFP3-Check	1-Alarms on Device2-Current Power Value.		55
UnClustered		1- Check for Attenuator2-Check for SFP3-Check	1-Alarms on Device2-Current Power Value.		55
39		Fiber PMT/RECTFICATION TO BE NEED	Checksection span , internal patching loss , po		51
38		PMT on node Patch cable properly rerouted / H	Checklogs for infra issues and Hardware reset o		48
UnClustered	Need to check Power failure.	Fiber PMT/RECTFICATION TO BE NEED	Checksection span , internal patching loss , po		40
UnClustered		PMT on node Patch cable properly rerouted / H	Checklogs for infra issues and Hardware reset o		33
UnClustered	Need to check Transmission path.	PMT on node Patch cable properly rerouted / H	Checklogs for infra issues and Hardware reset o		32
UnClustered		1-Vendor health checkup observation2-Check for	1-Alarms on Device2- Vendor health checkup ob		32
UnClustered		1-Vendor health checkup observation2-Check for	1-Alarms on Device2- Vendor health checkup ob		31

Priority Predictions | **Overall Predictions** | Master Clusters | GLOSSARY

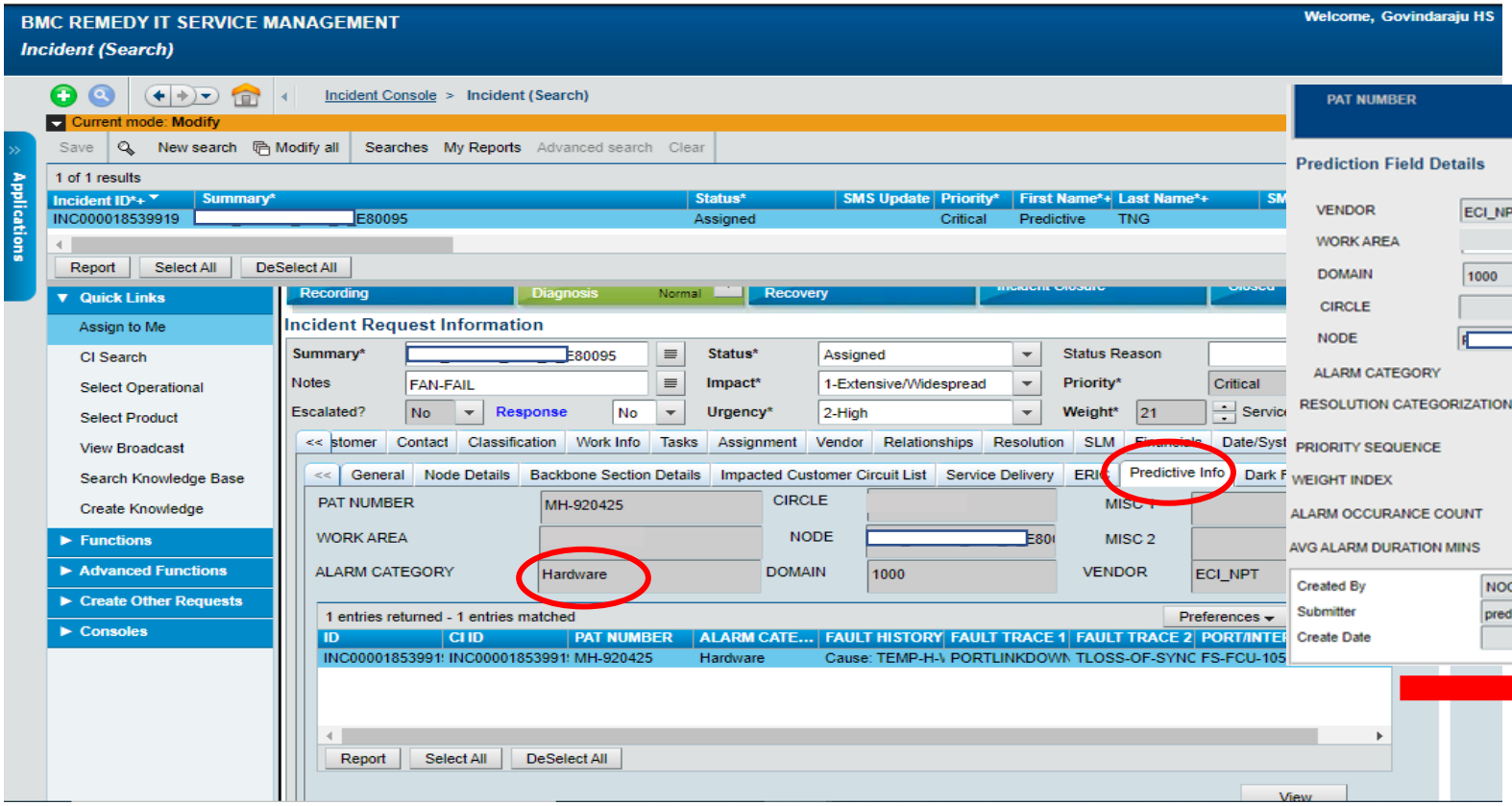
Analysis of predictive actions

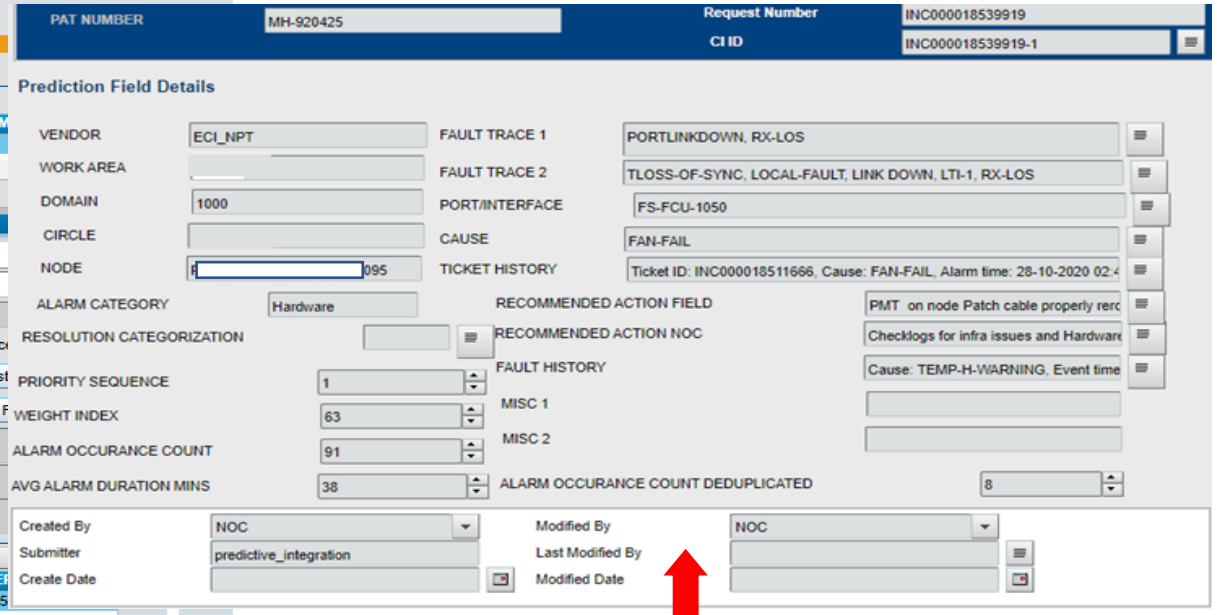
For every priority predicted fault for which Auto TT is created, operationalization team checks what was the action taken by NOC/Field team, and when it was resolved, and after it was resolved, whether the predicted fault appeared or not. This way continuous improvement process is established to increase percentage of correct actions for predictive tickets.

NODE	PORT/INTERFACE	CAUSE	ALARM CATEGORY	RECOMMENDED ACTION - FIELD	RECOMMENDED ACTION - NOC	PAT RESOLVE STATUS	TICKET CREATION DATE	TICKET RESOLVE DATE	Is PAT created before SLA	Is PAT resolved before SLA	PAT Incident No.	Action Taken on Predictive TT
CDS_BILD_MGR_A	I3-PIM2_63	BIT FAILED	Hardware	PMT on node Patch cable properly r	Checklogs for HW related i	APPEARED AFTER TT CLOSURE	10-10-2020 05:1	12-10-2020 13	Yes	No	INC000001809469	Infra PMT /card JOJI
GAJ_TNGUP_BAS_	I10-OTR64 2-1	LOW TX POWEF	Hardware	Hardware Need to be replaced	Checklogs for HW related i	APPEARED AFTER TT CLOSURE	12-10-2020 04:3	16-10-2020 0C	Yes	No	INC000001813524	Infra PMT Done
RMP_CVL_A_E46(	I12-OTR64 2-1	TYPE MISMATCI	Hardware	PMT on node Patch cable properly r	Checklogs for infra issues a	APPEARED AFTER TT CLOSURE	13-10-2020 05:2	16-10-2020 0C	Yes	No	INC000001816850	Infra PMT Done
JEW_BCLUP_GBN	I3-PIM2_63	BIT FAILED	Hardware	PMT on node Patch cable properly r	Checklogs for HW related i	APPEARED AFTER TT CLOSURE	14-10-2020 04:5	16-10-2020 0C	Yes	No	INC000001819423	Infra PMT Done
ETW_BSNL_NSC_A	ES1-PE1_32	CBUS-ERROR	Hardware	PMT on node Patch cable properly r	Checklogs for HW related i	APPEARED AFTER TT CLOSURE	15-10-2020 05:2	17-10-2020 19	Yes	No	INC000001822081	Infra PMT Done
DND_BCLUA_ABR	I12-OTR64 2-1	TYPE MISMATCI	Hardware	PMT on node Patch cable properly r	Checklogs for infra issues a	APPEARED AFTER TT CLOSURE	15-10-2020 05:1	19-10-2020 14	Yes	No	INC000001822055	Patchable Change/Clean
AGS_BCLUP_TAC_	I3-OTR1 8	LOW TX POWEF	Hardware	Hardware Need to be replaced	Checklogs for HW related i	APPEARED AFTER TT CLOSURE	15-10-2020 04:5	16-10-2020 0C	Yes	Yes	INC000001822022	Infra PMT Done
RZR-BCLUP-HMM-	FAN-1-6,EQPT	FANSPEEDHIGH	Infra	Maintained the Temp / AC Filter Clea	FAN MODE CHECK / FAN CAF	APPEARED AFTER TT CLOSURE	15-10-2020 04:5	16-10-2020 0C	Yes	Yes	INC000001822023	Infra PMT Done
HCK_BCLUP_BHD	QB-SIM64Q	BIT FAILED	Hardware	PMT on node Patch cable properly r	Checklogs for HW related i	APPEARED AFTER TT CLOSURE	11-10-2020 05:0	12-10-2020 13	Yes	Yes	INC000001811694	Fber PMT
SHN_TNGUP_GGH	EXTERNAL ALARM UI	DC_LOW(-48V)	Infra	Infra issue need to be cleared	Checkfor Power card alarm	APPEARED BEFORE TT CLOSURE	09-10-2020 05:2	12-10-2020 13	Yes	No	INC000001807158	Infra PMT /card JOJI
DND_BCLUA_NJP_	MS-MCP64	CARD-LOCK-OP	Hardware	PMT on node Patch cable properly r	Checklogs for infra issues a	APPEARED BEFORE TT CLOSURE	10-10-2020 05:2	19-10-2020 14	Yes	No	INC000001809464	Card JOJI
BJR_TNGUP_BRW	I1-OTR64 2-1	LOW TX POWEF	Hardware	Hardware Need to be replaced	Checklogs for HW related i	DID NOT APPEAR AFTER TT CLOSURE	09-10-2020 05:0	19-10-2020 14	Yes	No	INC000001807138	Attenuator changed
TUN-BCLUP-ING-T	SHELF-2,EQPT	CONTCOM	Hardware	PMT on node Patch cable properly r	Checklogs for infra issues a	DID NOT APPEAR AFTER TT CLOSURE	10-10-2020 05:1	14-10-2020 21	Yes	No	INC000001809470	Infra PMT Done
BJR_TNGUP_BRW	I1-OTR64 2-1	TYPE MISMATCI	Hardware	PMT on node Patch cable properly r	Checklogs for infra issues a	DID NOT APPEAR AFTER TT CLOSURE	11-10-2020 04:5	19-10-2020 14	Yes	No	INC000001811683	Patchable Change/Clean
GEE_BCLUP_KNO_	SLOT-U0	BIT DEGRADED	Hardware	PMT on node Patch cable properly r	Checklogs for HW related i	DID NOT APPEAR AFTER TT CLOSURE	11-10-2020 05:0	17-10-2020 19	Yes	No	INC000001811692	Infra PMT Done
GEE_BCLUP_KNO_	SLOT-U0	BIT DEGRADED	Hardware	PMT on node Patch cable properly r	Checklogs for HW related i	DID NOT APPEAR AFTER TT CLOSURE	11-10-2020 04:5	17-10-2020 19	Yes	No	INC000001811684	Infra PMT Done
MBD_BCLUP_NMI	TS3-DMFE_4_L1	CARD-FAIL	Hardware	PMT on node Patch cable properly r	Checklogs for infra issues a	DID NOT APPEAR AFTER TT CLOSURE	11-10-2020 04:5	12-10-2020 13	Yes	Yes	INC000001811697	Infra PMT
RIE-BLUP-VKA-T-A	SHELF-2,EQPT	CONTCOM	Hardware	PMT on node Patch cable properly r	Checklogs for infra issues a	DID NOT APPEAR AFTER TT CLOSURE	11-10-2020 04:4	12-10-2020 13	Yes	Yes	INC000001811696	Infra PMT /card JOJI
MBD_BCLUP_NMI	TS3-DMFE_4_L1	BIT-FAIL	Hardware	PMT on node Patch cable properly r	Checklogs for HW related i	DID NOT APPEAR AFTER TT CLOSURE	15-10-2020 05:2	16-10-2020 0C	Yes	Yes	INC000001822080	Infra PMT Done

Predictive ticket integration to Remedy

Transport Fault Prediction = NODE ID + PORT ID + ALARM/CAUSE => E.g. PUN_SMT_A_E81 + 10GE-MOE PORT 3 + FAN-FAIL





Predictive Child Incident (CI) Details

All the fields, like Domain, Circle, Cause, Alarm category, Recommended Action – NOC, Recommended Action - Field, Fault traces, are sent to Remedy while generating predictive TT

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Reporting - to track progress of predictive actions

Daily

- Automated email notification to NOC team about predictive TT count and top 5 causes of TTs opened
- Notification about TTs opened on individual Circle Telegram groups
- Status update of TTs opened and closed within and outside SLA

Weekly

- Predictive Action-taking Scorecard across Circles and Clusters
- Predictive TT Matching Reports and analysis

Monthly

- Predictive Action-taking Scorecard across Circles and Clusters
- Predictive impact analysis on Reactive TT – trend Charts

Cluster wise performance - 14th Oct to 24th Oct, 11 AM.

Cluster	Total Opened	Closed With Action	Open
Aurangabad	101	52	49
Dhule	48	42	6
Goa	89	63	26
Nagpur	45	37	8
Pune	93	36	57
Solapur	79	67	12
Total	455	297	158

*Please close max. TTs within 48 Hrs of opening.

MH Circle (26th Oct 2020)	
	No.of predictive TTs opened = 35
AURANGABAD	3
DHULE	3
GOA	9
NAGPUR	6
PUNE	6
SOLAPUR	8

Please close all these predictive TTs latest by 27th Oct 2020 (11:59:59 p.m.)

Sr.No.	Circle	Cluster	TT Closed WITH ACTION taken				TT closed within 48Hrs.				Correct Action Taking Rate			
			11-17 Oct Score	18-24 Oct Score	%Vari	Trend	11-17 Oct Score	18-24 Oct Score	%Vari	Trend	27 Sep -03 Oct Score	04-10 Oct Score	%Vari	Trend
1	Circle 1	Cluster 1	100%	100%	0%	–	24%	100%	76%	▲	0%	67%	67%	▲
		Cluster 2	67%	90%	23%	▲	67%	67%	0%	–	14%	47%	32%	▲
2	Circle 2	Cluster 1	100%	100%	0%	–	64%	50%	-14%	▼	25%	12%	-13%	▼
		Cluster 2	33%	26%	-7%	▼	0%	0%	0%	–	0%	0%	0%	–
		Cluster 3	100%	100%	0%	–	50%	30%	-20%	▼	22%	13%	-9%	▼
		Cluster 4	0%	17%	17%	▲	0%	0%	0%	–	0%	31%	31%	▲
		Cluster 5	0%	0%	0%	–	0%	0%	0%	–	0%	0%	0%	–
		Cluster 6	100%	100%	0%	–	94%	88%	-6%	▼	30%	29%	-1%	▼
		Cluster 7	0%	17%	17%	▲	0%	33%	33%	▲	50%	33%	-17%	▼
3	Circle 3	Cluster 1	100%	100%	0%	–	17%	48%	31%	▲	0%	62%	62%	▲
		Cluster 2	100%	100%	0%	–	55%	57%	2%	▲	51%	47%	-5%	▼
		Cluster 3	100%	48%	-53%	▼	23%	68%	46%	▲	38%	50%	12%	▲
		Cluster 4	96%	100%	4%	▲	57%	72%	16%	▲	72%	60%	-12%	▼

Sr.No.	Circle	Cluster	TT Closed WITH ACTION taken				TT closed within 48Hrs.				Correct Action Taking Rate		
			1-31st July Score	1-31st Aug Score	1-30th Sep Score	1-28th Oct Score	1-31st July Score	1-31st Aug Score	1-30th Sep Score	1-22nd Oct Score	1-31st July Score	1-29th Aug Score	1-30th Sep Score
1	Circle 1	Cluster 1	86%	75%	60%	60%	34%	31%	33%	51%	53%	49%	45%
		Cluster 2	92%	94%	96%	87%	27%	60%	41%	58%	43%	67%	78%
2	Circle 2	Cluster 1	82%	99%	83%	98%	29%	91%	58%	75%	77%	79%	80%
		Cluster 2	8%	52%	0%	37%	62%	19%	0%	0%	28%	14%	0%
		Cluster 3	100%	99%	99%	96%	57%	58%	43%	47%	47%	16%	22%
		Cluster 4	79%	30%	11%	51%	6%	8%	0%	19%	66%	43%	64%
		Cluster 5	0%	39%	33%	21%	0%	14%	57%	0%	0%	48%	63%
		Cluster 6	100%	31%	67%	98%	6%	82%	23%	75%	82%	22%	52%
		Cluster 7	0%	58%	37%	49%	0%	12%	31%	0%	0%	32%	51%

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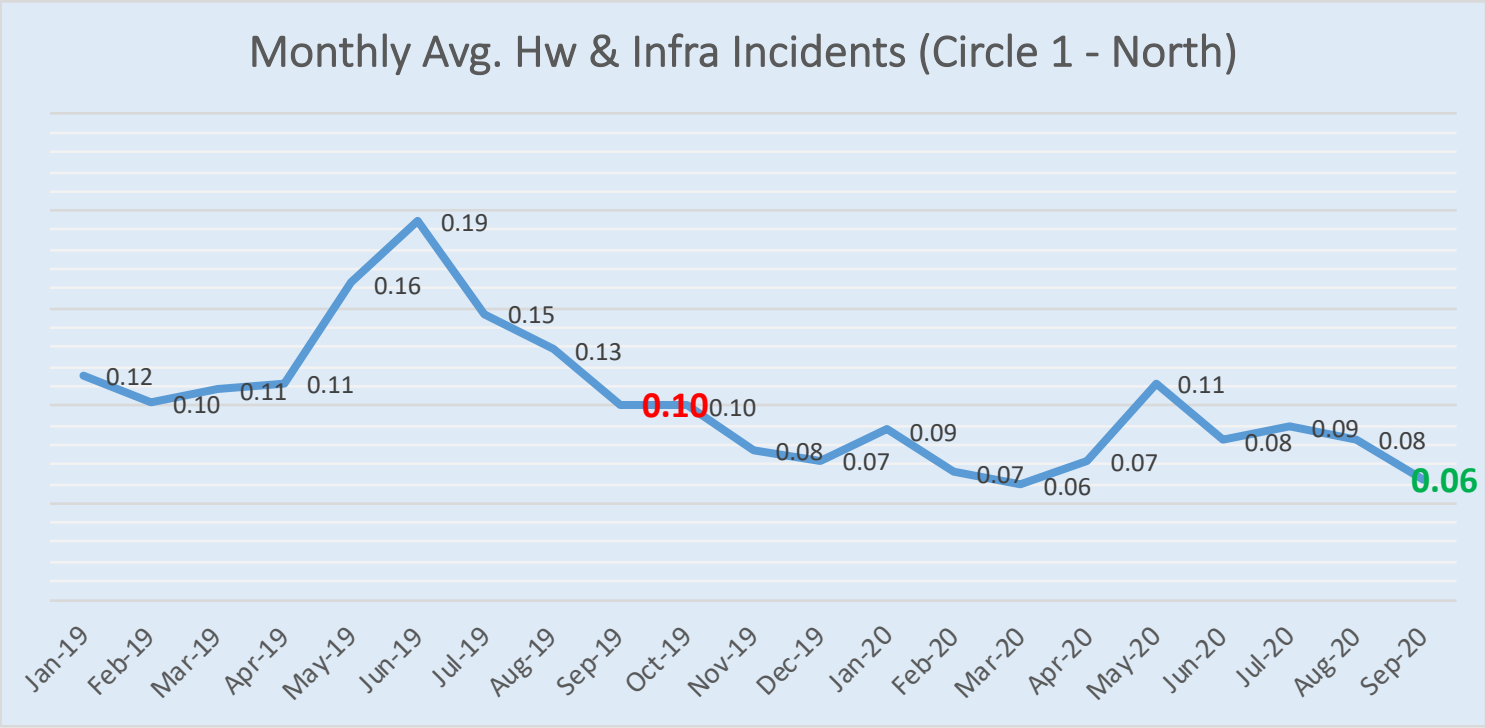
Sample trend monitoring



Monthly Avg. Hardware & Infra Failures	
Sep'20 v/s Sep'19	Sep'20 v/s Jul'20
40%	33%

Note:

- Actions on Automated Predictive TTs start date – 14th Jul 2020

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Sample PM activity checklist (predicted fault wise)

Temperature
1. Check list - Air-conditioning System
a. Verification of the setpoint temperature definition (on / off)
b. Verification of fan speed
c. Setpoint check of the Air A start temperature
2. Check list - Air Conditioning System
a. Temperature setpoint check on / off
b. Indoor / outdoor temperature measurements
c. Cold test (verify correct operation of AA)
3. Review of the equipment fan (RBS, UPS ...)
4. Cleaning of the ventilation systems is required
5. Verification of the existence of new equipment at the site and possible impact
6. Report to Deployment the need for air conditioning improvements
Antennas
1. Measure antenna cables locally (confirming remote measurements by ANOC)
2. Check the connectors and connections to the antenna system
3. Check filters and combiners
4. Check the alignment of the antenna
5. Check for obstructions in the radiant system
6. Communicate to Deployment problems detected and suggestions for improvement
7. If necessary, change cables, connectors, antennas

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