INTRACOM TELECOM

Technology Shaping the Future

AI-Powered Network Management: From Energy Savings to Proactive Customer Care

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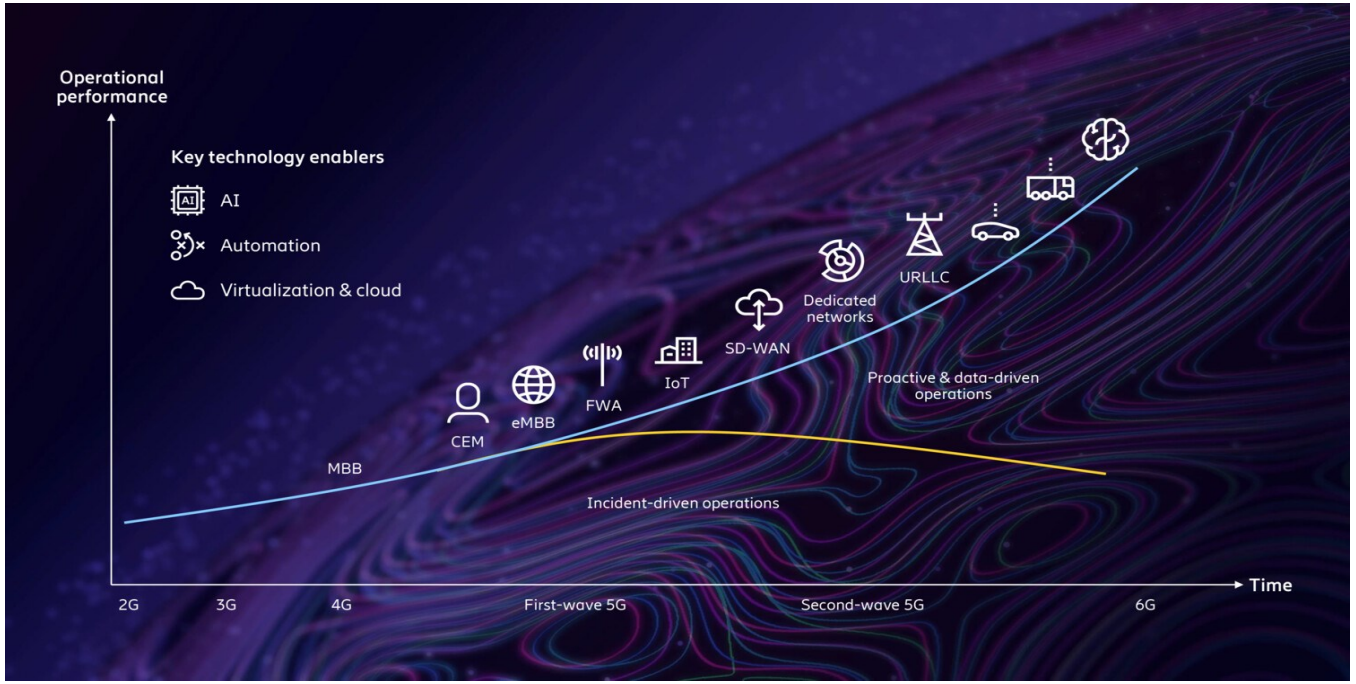
Introduction (1/3)
AI as an enabler for proactive network management

- **Traditional network management** is based on a **reactive approach** that relies on rule-based, incident-driven solutions. Nonetheless, **the continuously increasing network complexity (5G/FWA, diverse services, increased traffic volumes, virtualization, etc.)** calls for advanced data analytics to ensure efficient network management and increased operational performance.
- **Artificial Intelligence (AI)** shifts network management operations to a **proactive data-driven paradigm**:
  - Continuously analyze data and predict future performance so as to detect network issues and act accordingly (element failures/ suboptimal parameter configuration, etc.)
  - Provide a fast resolution of incidents:
    - Reduced operational costs
    - Reduced downtimes/ outages
    - Reduced lost revenue
    - Reduced negative brand impact
    - Enhanced system performance
- AI-based data-driven optimization offers:
  - Scalability
  - Continuous learning
  - Close-to-optimal performance

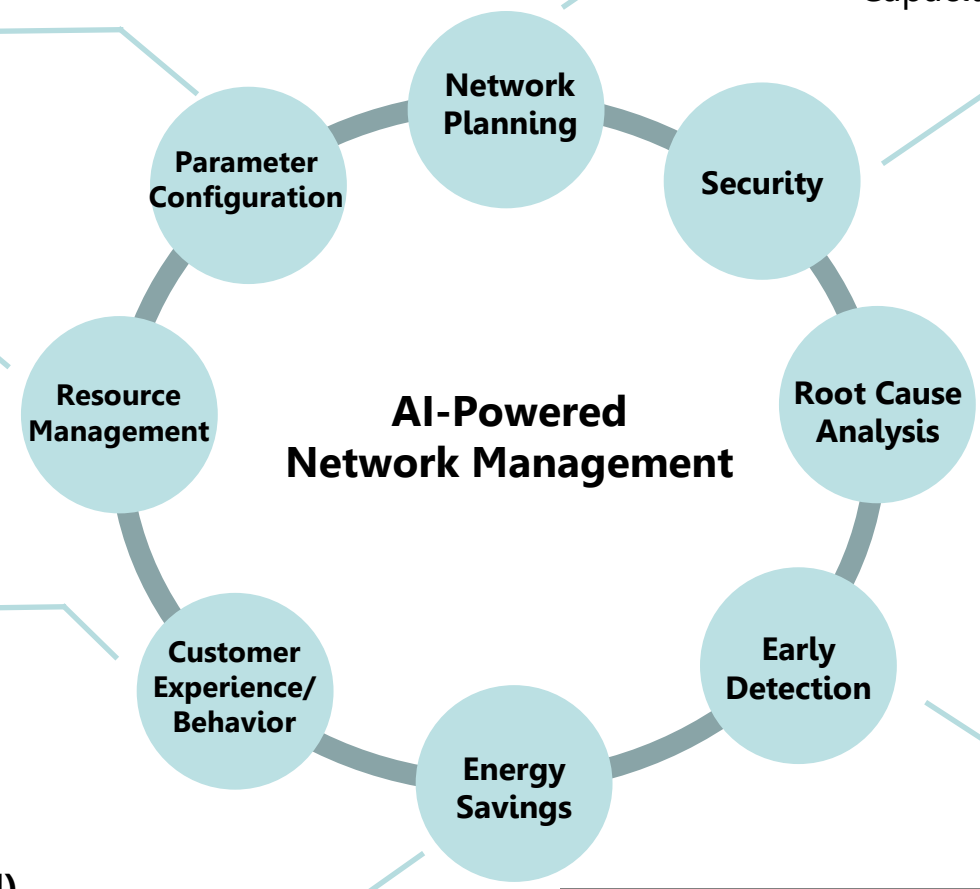


Source: https://www.ericsson.com/en/blog/2023/5/wake-up-neo-entering-the-matrix-behind-telecom-network-operations

Introduction (2/3)
AI Challenges

- AI benefits come with numerous challenges that need to be addressed for successful implementation:
  - **Data Quality**: Inaccurate or incomplete data can lead to incorrect predictions and suboptimal network performance
  - **Data Availability**: Data may not always available, especially when introducing a new AI-based feature.
    - **Digital Twins** provide a safe/ controlled environment for data generation/ model development and behavior testing before deploying the actual model to the live network.
  - **Data Correlation**: Information referring to the same user/ cell may be fragmented across different network sources and Performance Monitoring (PM) events.
    - Heavy correlation/ integration tasks are often required to create meaningful metrics per user/ cell.
  - **Multi-vendor**: Interoperability challenges can arise in multi-vendor environments where AI solutions need to work with different equipment and protocols.
  - **Scalability**: Ensuring scalability can be a challenge as the network traffic continues to grow.
  - **Privacy**: Handling sensitive network data while complying to privacy regulations can be complex. Data anonymization is crucial for privacy protection.
  - **Continuous Monitoring**: AI models require continuous monitoring, fine-tuning, retraining and validation to remain effective over time. A state-of-art MLOps platform is of paramount importance for a systemized way of working
  - **Explainability**: Understanding AI decisions is needed to strengthen service providers' trust in AI.

Introduction (3/3)
AI-powered network management domains



Virtual Drive Test
Base Station Location Selection
Capacity Planning/ Forecasting

Traffic Pattern Anomaly Detection

Self Healing
Worse Cell CSI Analytics:
Coverage Holes, Overload, Interference, etc.

Traffic Congestion Prediction
Predictive Equipment Maintenance

Data Center Energy Savings (NFV-RI)
Base Station Energy Savings

Customer Satisfaction Index (CSI)
Subscriber Segmentation

Content Caching Delivery
Network Slicing
VIP Traffic Forecasting

Mobility Robustness Optimization
Cell Shaping
Interference Management

Intracom Telecom is active in most of these areas by both delivering software solutions to service providers and integrating AI in its own FWA portfolio

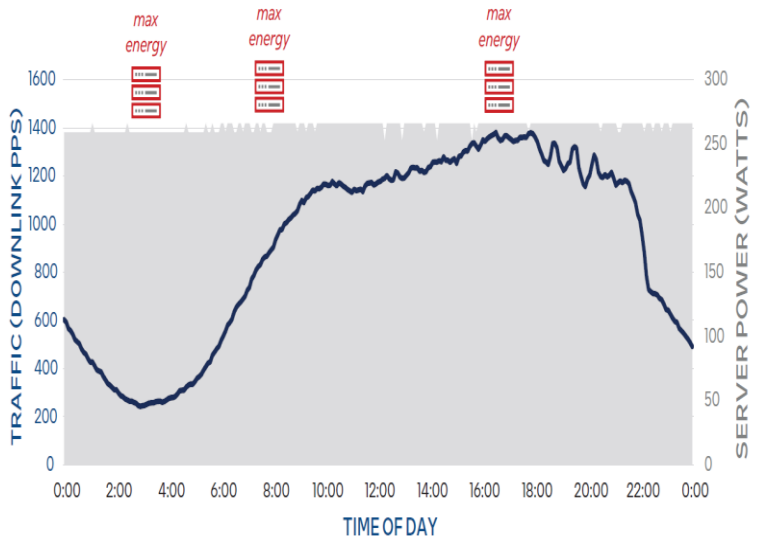
Intracom Telecom NFV-RI™ (1/4)
Business Challenge

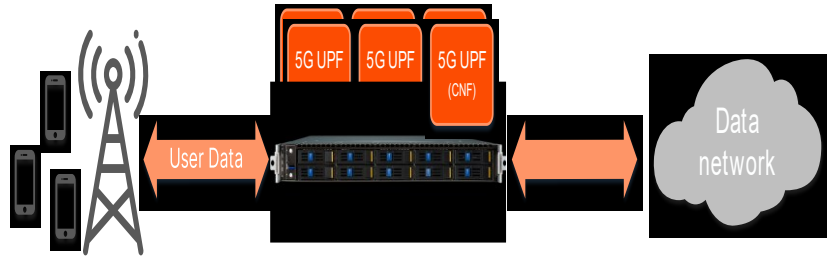
- **Data plane cloud-native network functions (CNFs)** use polling intensive frameworks (e.g. DPDK or VPP) for carrier-grade packet processing that ensures low latency, zero packet drop and high throughput.

- Examples of CNF:
  - **User Plane Function (UPF)** for 5G Core
  - **Serving/Packet Data Network Gateway (S/PGW)** for Evolved packet Core (EPC)
  - **Centralized Unit – User Plane (CU-UP)** for a virtualized Radio Access Network (vRAN**)**

- The **high polling intensity forces the CPU cores of the CNFs** to be at the highest frequencies all time, even during off-peak/idle periods, resulting in maximum power consumption.

- **Intracom Telecom NFV-RI™** provides **AI-driven** closed-loop mechanisms to **dynamically manage the power consumption of CNFs** in line with their load, while guaranteeing zero packet drops.





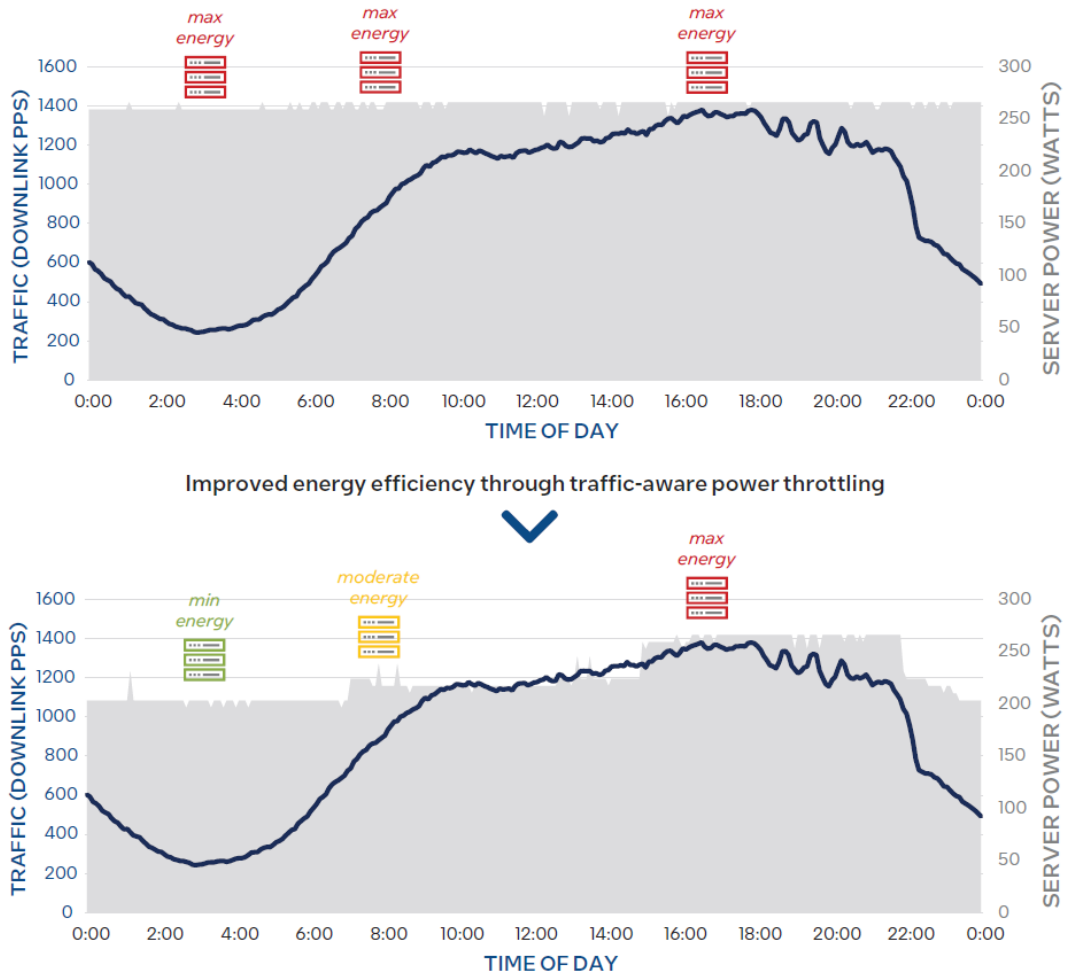
Intracom Telecom NFV-RI™ (2/4)
Solution Description

- **Intracom Telecom's NFV-RI™ dynamically selects the most efficient CPU frequency** for polling-intensive CNFs based on their **current and anticipated demand**, while guaranteeing zero packet drops.

- Data plane servers operate at significantly less power during periods with moderate or light traffic, contributing to **energy savings that can be as high as 30-45%.**

- The solution **does not require any modification on the CNFs**, as it leverages targeted platform telemetry and AI techniques to:
  - Deduce how loaded these will be in the next time window
  - Identify which is the least CPU frequency they will need to keep processing packets without drops

- Decisions are made independently for every Pod of the CNF on the server.



Intracom Telecom NFV-RI™ (3/4)
Indicative dashboard from an operator case study

2 x Intel® Xeon® Platinum 8470N @ 1.7GHz

# Running UPFs	Packet Size	Total Logical Cores	UPF Logical Cores	OS + Intracom NFV-RI™ Logical Cores	Idle Logical Cores
8	1.46 KiB	208	192	16	30

Live Stats

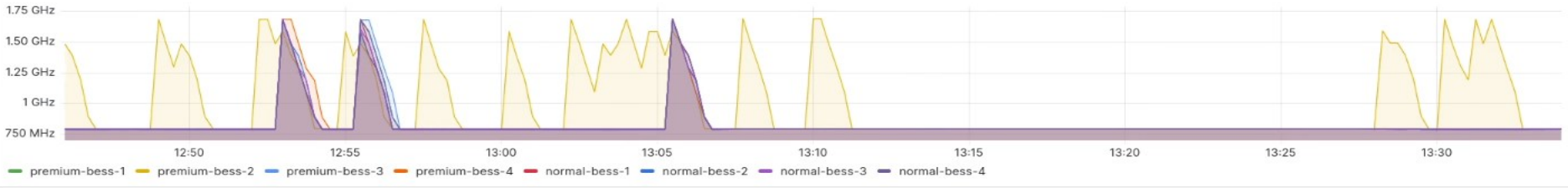
UPF Dropped Packets Constraint Satisfaction

UPFs Throughput Stacked

Server Power Saving Pct Running Avg

45.7%

Intracom NFV-RI™ Managed UPF CPU Frequency



Unoptimized Server Power Dr...

785 W

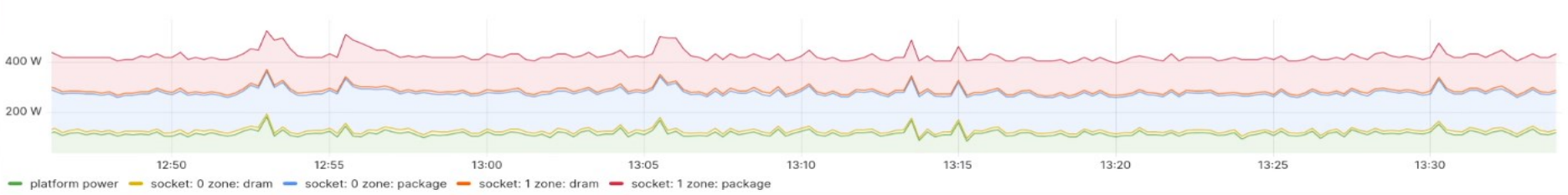
Server Power Draw Running ...

426 W

Server Current Power Draw

434 W

Power Draw Breakdown



Annual Savings

Estimated Annual Power Cost...

€789.68

Estimated Annual CO2 Emissi...

988 kg

NFV-RI
RESOURCE INTELLIGENCE

Intracom Telecom NFV-RI™ (4/4)
Product Highlight

tmforum 2020

1st PoC with **Cosmote** (award-winning TMF Catalyst)

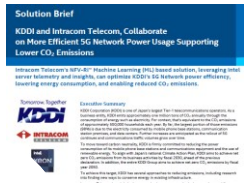
Showcased **14%** average energy savings (24h) in a **SPGW-U** prototype

MWC Barcelona 2022

Joint demo with **Intel** and leading industry vendors

Showcased **29-31%** average energy savings (24h) for commercial **5G UPF** deployment

Major PoC with **KDDI**

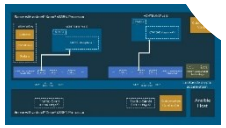


KDDI 2022

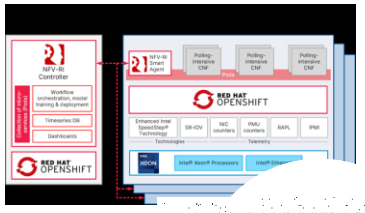
Up to **37%** average energy savings (24h) in **5G UPFs**

ANGACOM 2022

Joint demo with **Intel**

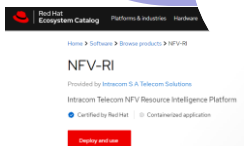


Showcased **30%** average energy savings (24h) in **vCMTS** server



Partnership with **Red Hat**

Red Hat 2022



Fully **integrated** & **certified** for Red Hat Openshift
+ listed on Red Hat's Ecosystem Catalog

MWC Barcelona 2023

Joint demo with **Red Hat**

Reference Architecture for energy-efficient 5G data plane over OpenShift

Dynamic Data-Center Sizing first demo

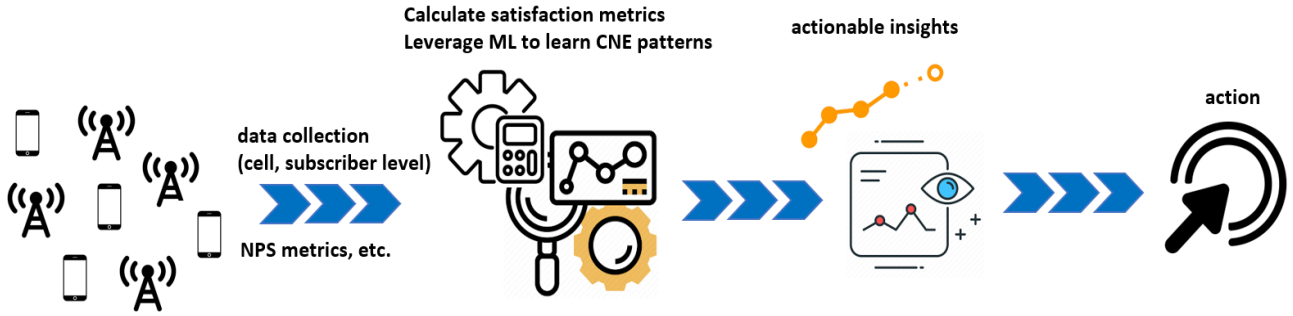
tmforum dtw 2023

Intracom Telecom Cognitiva Mobile CSI Suite (1/3)

Overview

- The **Cognitiva Mobile CSI suite** is a **Customer Network Experience** (CNE) platform that defines a Customer Satisfaction Index (CSI) used for proactive care.

CSI < 50 → Extremely Dissatisfied
50 ≤ CSI < 75 → Dissatisfied
75 ≤ CSI < 85 → Neutral
85 ≤ CSI < 95 → Satisfied
95 ≤ CSI → Extremely Satisfied



Unified framework for proactive CNE management & provisioning

- CSI reflects the **degree of user satisfaction** at subscriber and cell level across **different services (voice, data)** and **technologies (2G/3G/4G)** by correlating relevant key performance indicators (throughput, latency, retainability, accessibility, etc.)

- Unified framework that leverages CSI values, AI and Net Promoter Score (NPS) to deliver **accurate Customer Network Experience (CNE) predictions**, derive **actionable insights** and **proactive actions**

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ENTERPRISE-READY AI APPLICATIONS

Intracom Telecom Cognitiva Mobile CSI Suite (2/3)

Capabilities & Benefits

Capabilities:

- Performance Monitoring
- Worse Cell CSI
- Worse Subscriber CSI
- Traffic/ CSI Forecasting
- Anomaly Detection
- Root Cause Analysis
- Subscriber Segmentation

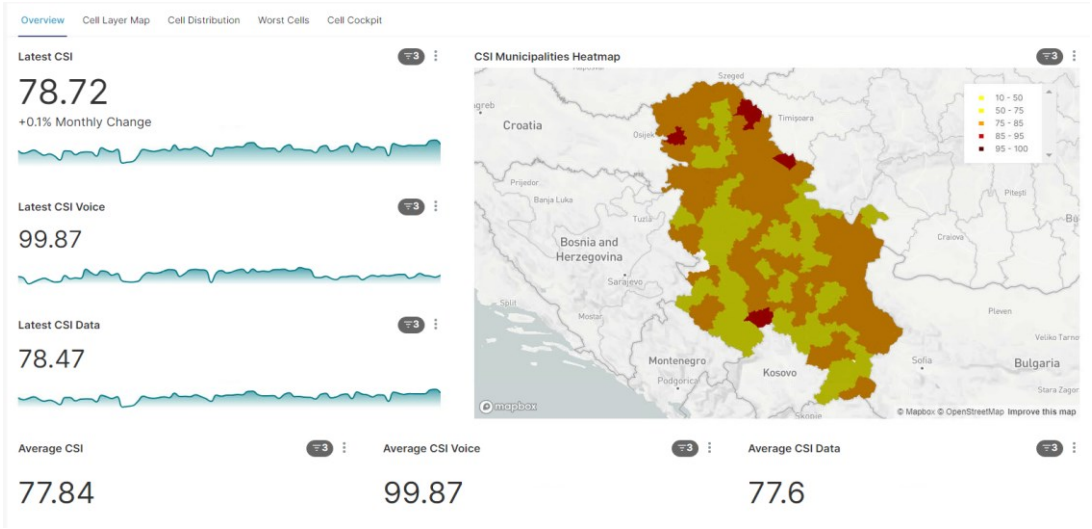
Benefits:

- Loyalty-centric network planning
- Faster troubleshooting reducing response times to service degradation before becoming customer complaints
- Marketing campaign management for retention/ upsell opportunities

COGNITIVA
ENTERPRISE-READY AI APPLICATIONS

Intracom Telecom Cognitiva Mobile CSI Suite (3/3)
A Serbian operator case study

CSI Analytics

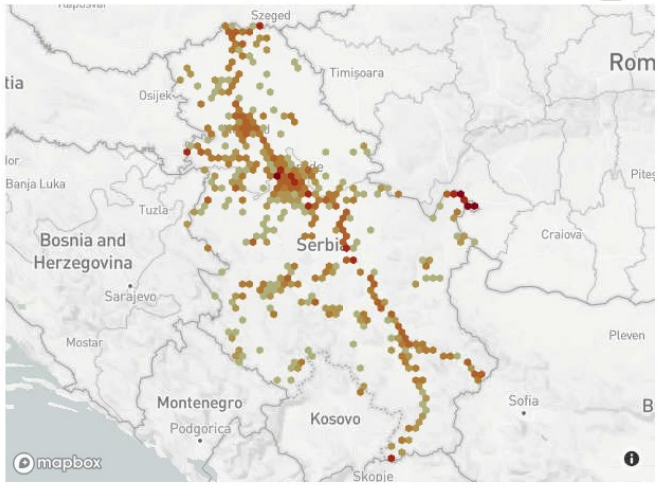


Traffic Analytics

Worse Cell CSI Reporting

CSI	CSI data	CSI voice	Total Calls	Voice Retainability	Voice Accessibility	DL Volume GB	UL Volume GB	RTT ms	DL Throughput Mbps	UL Throughput Mbps
45.01	44.22	99.87	47.5k	0.9994	0.9971	4.39k	421.55	62.71	3.02	1.51
45	44.46	99.79	41.7k	0.9987	0.9962	5.43k	542.79	57.05	3.14	1.31
44.98	44.46	99.77	40.8k	0.9985	0.9958	4.68k	465.57	59.44	3.5	1.03
44.96	44.37	99.87	83.2k	0.9995	0.9967	8.41k	869.66	60.98	3.45	1.06
44.87	44.14	99.92	70.9k	0.9996	0.9981	5.24k	587.1	64.07	2.46	1.88
44.86	44.31	98.95	397	0.9862	0.9972	32.06	3.89	74.32	8.97	0.7539
44.83	44.04	99.63	26.7k	0.9968	0.995	2.47k	278.94	51.57	5.21	1.17
44.79	43.65	99.69	53.8k	0.9994	0.991	3.16k	321.58	61	3.13	1.27
44.57	44.06	99.77	47.9k	0.9978	0.9974	4.83k	509.17	54.91	4.11	1.01
44.56	43.83	99.83	97.5k	0.9992	0.9961	5.91k	1.31k	59.48	3.06	2.31
44.56	43.19	99.8	51.7k	0.9994	0.9949	2.82k	259.48	55.81	3.28	1.36
44.55	43.95	99.6	71.1k	0.9955	0.9971	6.17k	559.47	60.76	3.94	0.9349
44.55	43.97	98.92	46.9k	0.988	0.9921	4.16k	452.2	61.89	4.46	1.02
44.55	44.22	99.58	44.4k	0.995	0.9979	9.8k	681.73	65.93	4.39	0.7697
44.5	43.98	99.65	34.7k	0.9972	0.9948	3.72k	309.12	60.87	4.36	0.827
44.46	44.02	99.69	43k	0.9979	0.9945	5.51k	403.36	60.17	4.38	0.6518
44.42	43.56	99.81	61.6k	0.9993	0.9952	3.93k	384.35	54.05	3.65	1.15
44.41	43.64	99.85	69.3k	0.9986	0.9981	4.87k	643.98	69.14	2.8	2.13
44.41	43.97	99.85	79k	0.9985	0.9987	7.88k	863.66	60.23	3.45	1.09
44.38	43.12	99.79	52.4k	0.9996	0.9938	2.98k	292.33	54.17	3.63	1.31
44.34	43.66	99.77	46.6k	0.999	0.9946	5.16k	418	65.68	4.03	0.8089
44.32	43.53	99.63	6.06k	0.9987	0.9908	595.28	55.61	47.39	3.68	1.45
44.28	43.03	99.77	12.5k	0.9989	0.9949	509.89	71.34	63.84	1.96	2.73

Worst Subscriber CSI Heatmap



Customer Segmentation

CSI Voice Worst Subscribers

Show 200 entries

imsi	CSI Voice	Min CSI Voice	Max CSI Voice	Retainability	Accessibility	Call Attempts	Call Attempts GSM	Call Attempts UMTS	Call Attempts LTE
000B00FD1C75454	76.77	76.77	76.77	1	0.2	5	5	0	0
000BD539F45E3E2	76.77	76.77	76.77	1	0.2	5	5	0	0
0019A8C0975D06C	76.77	76.77	76.77	1	0.2	10	10	0	0
002161F6E5DFD6A	65.66	65.66	65.66	0.5	1	4	4	0	0
0022556A63F57A2	75.76	75.76	75.76	1	0.1667	12	12	0	0
002C2B642D318F5	73.46	73.46	73.46	1	0.0909	11	11	0	0
003F19689782CBF	72.73	72.73	72.73	0.6	1	5	5	0	0
00BE28039BE55A5	53.87	53.87	53.87	0.3333	1	3	3	0	0
00D44D4ADE172B7	70.73	70.73	70.73	1	760u	1.32k	1.32k	0	0
00D8D83782D58A4	74.5	74.5	74.5	1	0.125	8	8	0	0
00E2F36D74E9137	75.49	75.49	75.49	1	0.1579	38	38	0	0
00E7B65F4C9512A	76.77								0
00FCD3DAD00BD24	73.9								0
0105928D2C21C88	76.77								0
0108B985FED6EAF	75.04								0
011B78E80EA3ACE	73.79								0
012901B641FB215	70.68								0

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ENTERPRISE-READY AI APPLICATIONS

Wrap Up

- Given the continuously increasing network complexity, AI is the key technology enabler for efficient network management ensuring better scalability and proactive decision making.

- Nonetheless, a successful AI implementation requires cautious planning considering numerous factors such as data availability/ quality, multi-vendor, privacy concerns, continuous monitoring, etc.

- Intracom Telecom is very active in the domain of AI-powered network management by delivering AI software solutions to service providers as well as integrating AI into its own FWA portfolio.

- **Example highlight use cases:**
  - **NFV Resource Intelligence**: NFV-RI™ can achieve **data center energy savings up to 30-45%** by dynamically selecting the most efficient CPU frequency according to current and predicted traffic demands

NFV-RI
RESOURCE INTELLIGENCE

COGNITIVA
ENTERPRISE-READY AI APPLICATIONS

  - **Cognitiva Mobile CSI Suite:** A unified framework for cellular network management enabling **proactive customer care, loyalty-driven network planning, faster troubleshooting and customer segmentation**.

thank you

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