Survey on AI/ML-based Network Automation in Cellular Networks
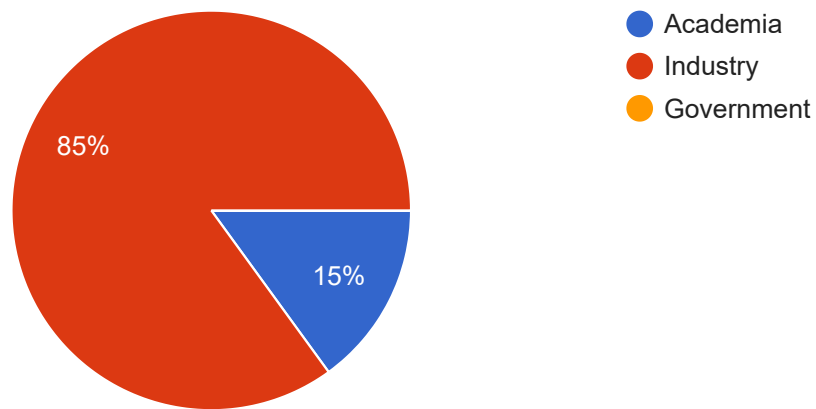
20 responses

Publish analytics

What is your primary affiliation?

Copy

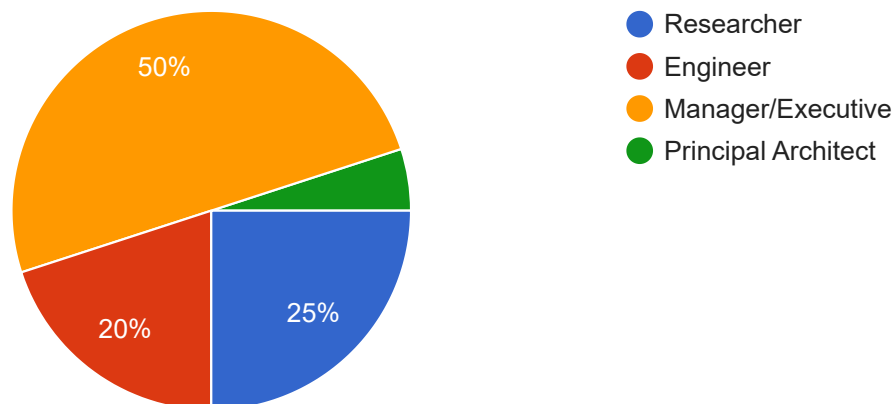20 responses

- Academia
- Industry
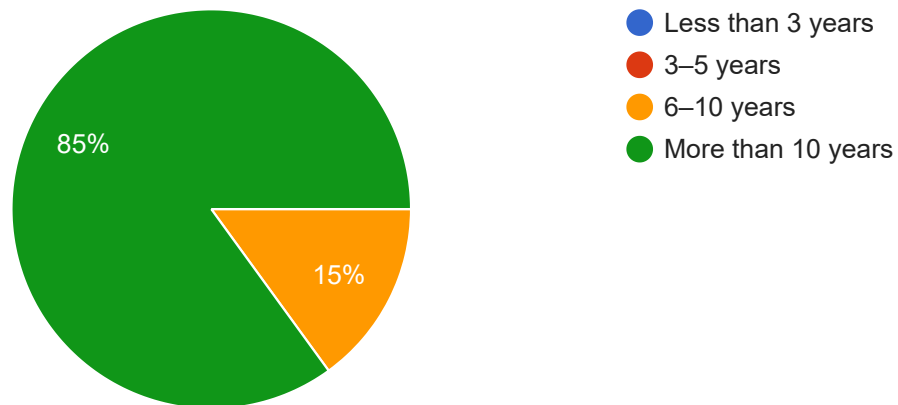- Government

85%

15%

What is your role?

Copy

20 responses

- Researcher
- Engineer
- Manager/Executive
- Principal Architect

50%

25%

20%

How many years of experience do you have in the telecom or wireless network domain?

Copy

20 responses

- 🔵 Less than 3 years
- 🔴 3–5 years
- 🟠 6–10 years
- 🟢 More than 10 years

85%

15%

How familiar are you with AI/ML technologies, especially in wireless networks?

Copy

20 responses

- 🔵 Not familiar
- 🔴 Somewhat familiar
- 🟠 Familiar
- 🟢 Very familiar

30%

35%

35%
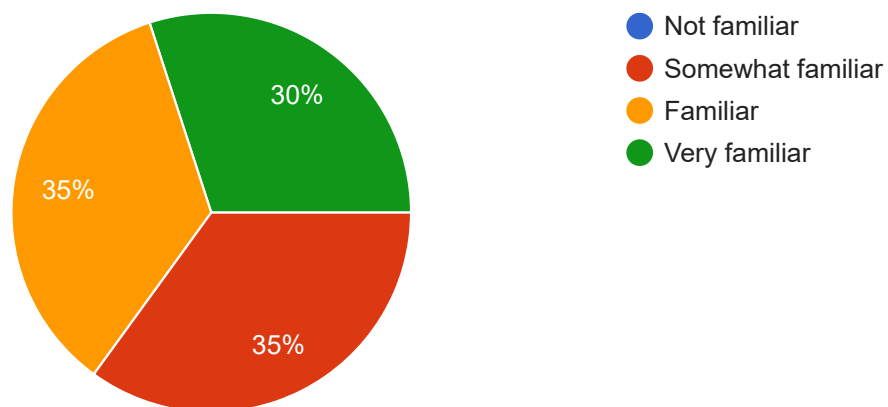
Have you recently worked on projects involving AI/ML techniques in wireless networks?

20 responses

Copy

Legend:
- Yes
- No

15%

85%
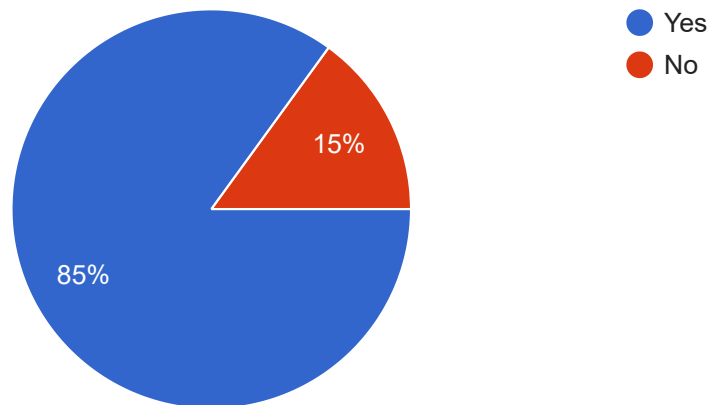
How familiar are you with Open RAN initiatives (e.g., O-RAN) and AI-RAN?

20 responses

Copy

Legend:
- Not familiar
- Somewhat familiar
- Familiar
- Very familiar

55%

15%

30%
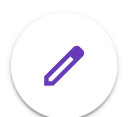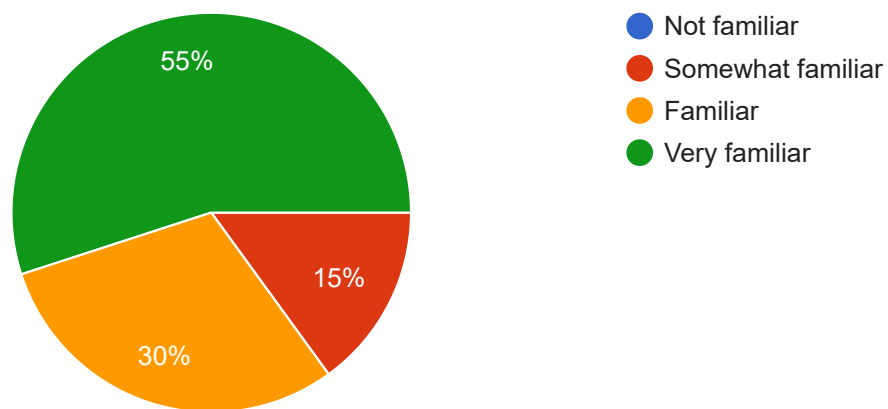
What is your level of understanding of AI/ML's role in network automation and zero-touch management?

Copy

20 responses

- None
- Basic
- Intermediate
- Advanced

45%
20%
35%

How often do you engage with real-world network deployment challenges?

Copy

20 responses

- Never
- Occasionally
- Frequently
- Always

45%
30%
20%

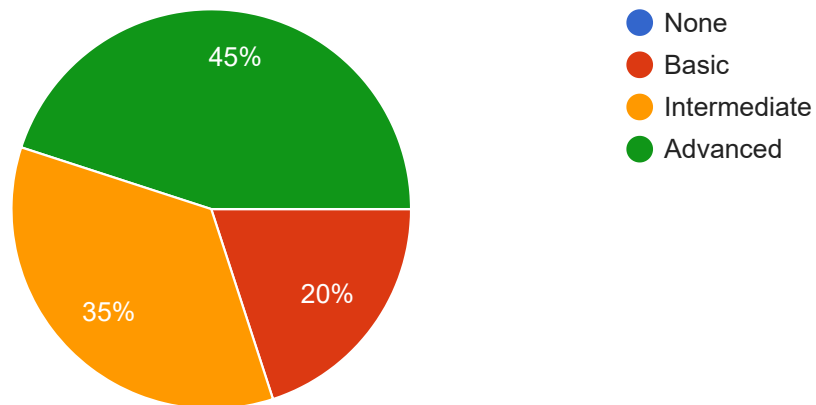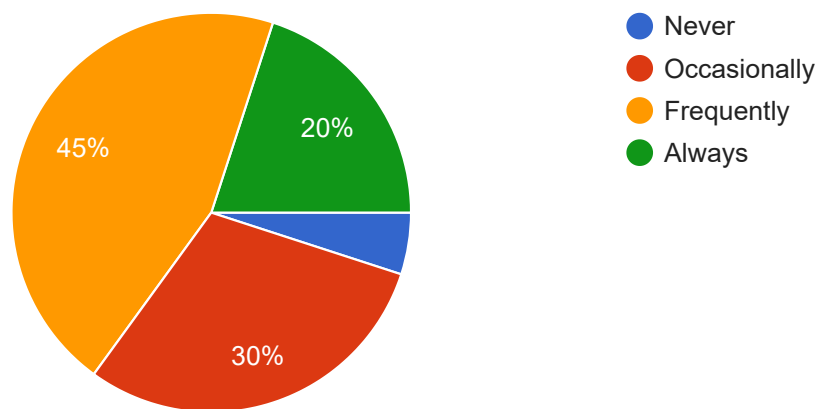## How important do you think AI/ML techniques is for the future of mobile networks (e.g., 6G)?

⧉ Copy

20 responses

Legend:
- 🔵 Not important
- 🔴 Somewhat important
- 🟠 Important
- 🟢 Very important

Pie chart values:
- 65%
- 25%
- 10%
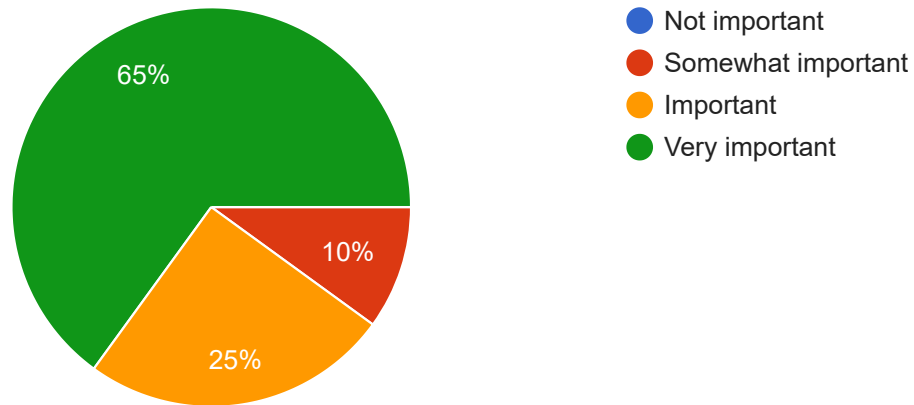
What motivates your interest in AI/ML for mobile network automation? (Select all that apply)

⧉ Copy

20 responses

Category	Value
Improving efficiency and performance	19 (95%)
Reducing operational costs	16 (80%)
Enabling new capabilities	14 (70%)
Exploring research opportunities	10 (50%)
Unlocking new business models	12 (60%)
Automated testing	1 (5%)
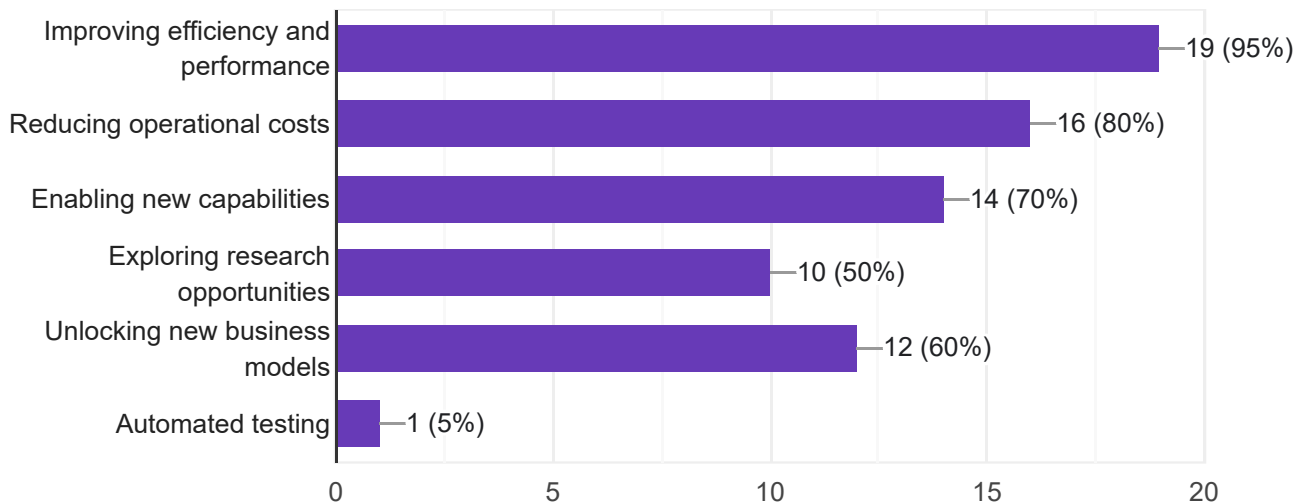
In which areas of network automation do you think AI/ML will have the most impact? (Select all that apply)   📋 Copy
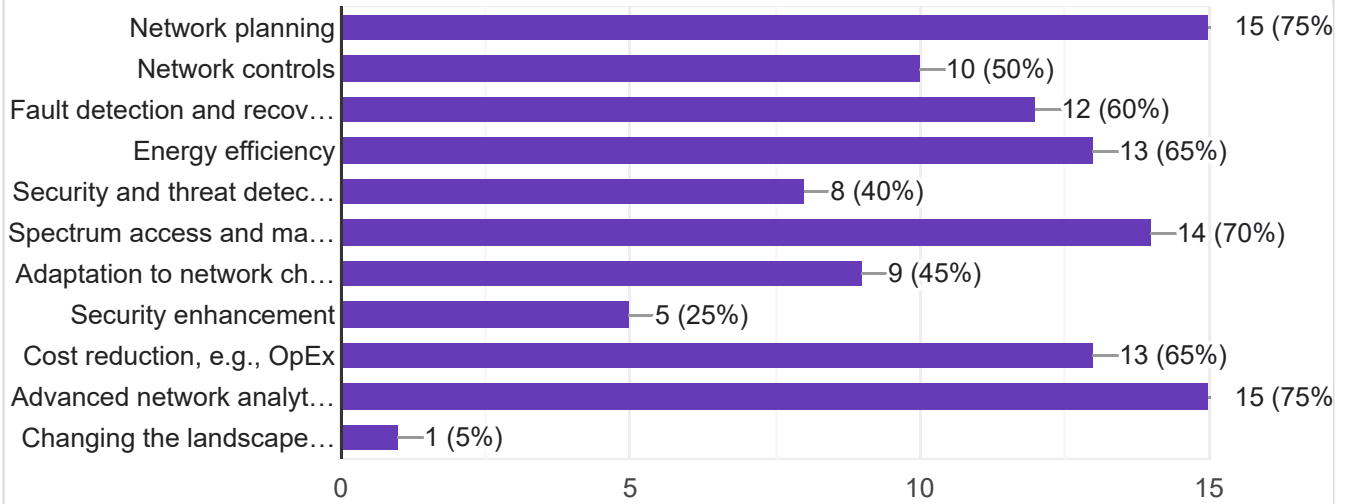
20 responses

Network planning	15 (75%)
Network controls	10 (50%)
Fault detection and recov…	12 (60%)
Energy efficiency	13 (65%)
Security and threat detec…	8 (40%)
Spectrum access and ma…	14 (70%)
Adaptation to network ch…	9 (45%)
Security enhancement	5 (25%)
Cost reduction, e.g., OpEx	13 (65%)
Advanced network analyt…	15 (75%)
Changing the landscape…	1 (5%)

X-axis: 0, 5, 10, 15

How promising is AI/ML for achieving zero-touch management in mobile networks?   📋 Copy

20 responses

- 🔵 Not promising
- 🔴 Somewhat promising
- 🟠 Promising
- 🟢 Very promising

Pie chart: 25%, 10%, 65%
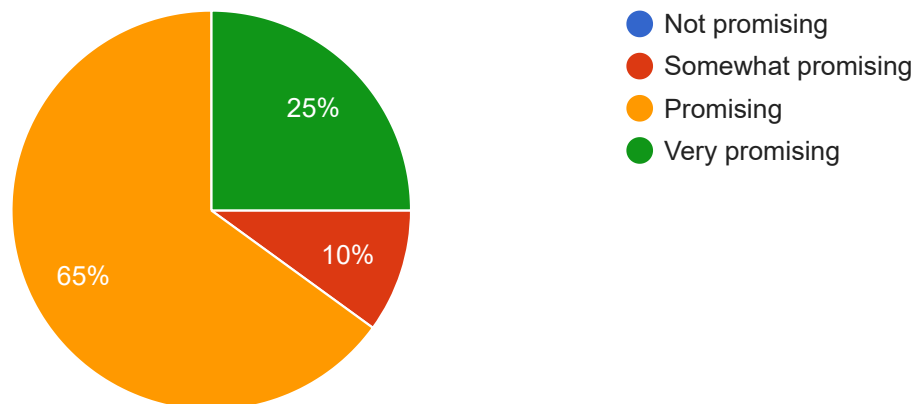
Which AI/ML techniques are you most optimistic about for network automation?

13 responses

reinforcement learning, LLM

Generative AI for service automation

LLM

DRL, Federated Learning

Learning patterns and history

Bayesian and Reinforcement Learning.

AI/ML algorithms running in Near-Real Time RIC based on O-RAN architecture

1. Deep Reinforcement learning, more specifically Deep Q Networks, for optimization
2. Generative Adversarial Network with LSTM for "impersonating" network, create "digital twin" and to test "optimizations" on twin.

DNN

Reinforcement learning for PL optimization. Gen-AI for NW planning.

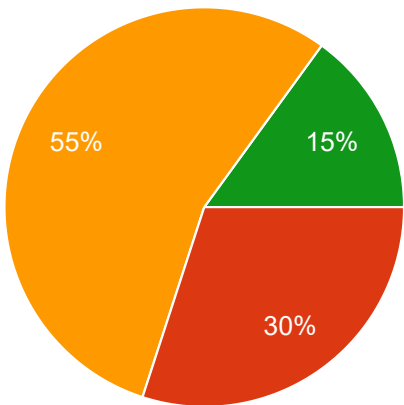Users use case prediction, then plan resources and QoS to it

date analytics

Not sure

How effective is AI/ML in improving network controls in real-world deployments?

Copy

20 responses

- Not effective
- Somewhat effective
- Effective
- Very effective

55%

15%

30%

What is your opinion on using digital twins for modeling and optimizing real-world networks?

13 responses

interesting

very useful

Digital twins offer a lot of opportunity, but even with high-quality source data AI-based digital twins for mobile networks will still face issues of simulation results differing from real-world results. However, AI-based digital twins (assuming quality source data) can make the gap between simulation and real-world significantly smaller. Additionally, there will be issues with the compute resource requirements being prohibitive, if the use case requires a high level of fidelity/realism, even with AI inferencing and quality data.

Important but computation overhead is huge

Real-time DT is the most interesting.

Usefull

One can impersonate a real-world network by digitally twinning the network using Generative AI techniques and variants, which can be used, not only to learn/impute/forecast the entire state of the network, but also to test the optimization recommendation actions and evaluating them by "generating" PM/KPI observability data from the twin, before applying these changes on the actual production network.

Promising but still many challenging points

promising yet takes time for deployment

A necessity.

Very useful in most conditions
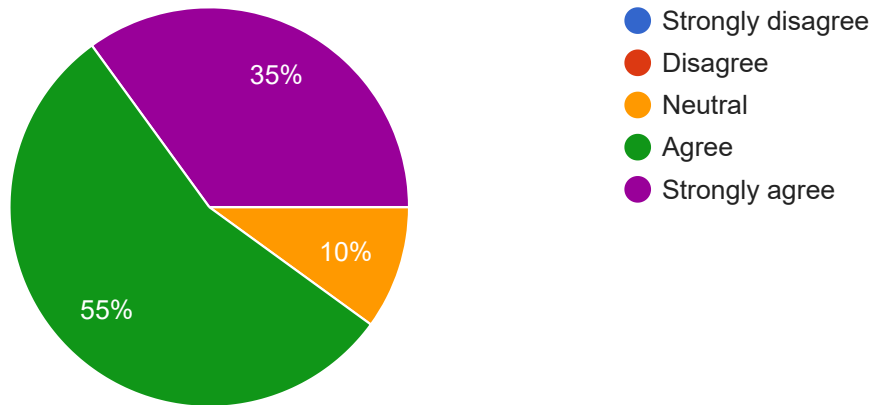
It is extremely important

Seems promising but too much hype.

Do you think AI/ML can help reduce operating expenses (OpEx) in mobile networks?

Copy

20 responses

- ● Strongly disagree
- ● Disagree
- ● Neutral
- ● Agree
- ● Strongly agree

35%
10%
55%

How critical is AI/ML in achieving network resilience during faults or unexpected events?

Copy

20 responses

- ● Not critical
- ● Somewhat critical
- ● Critical
- ● Very critical

30%
20%
45%
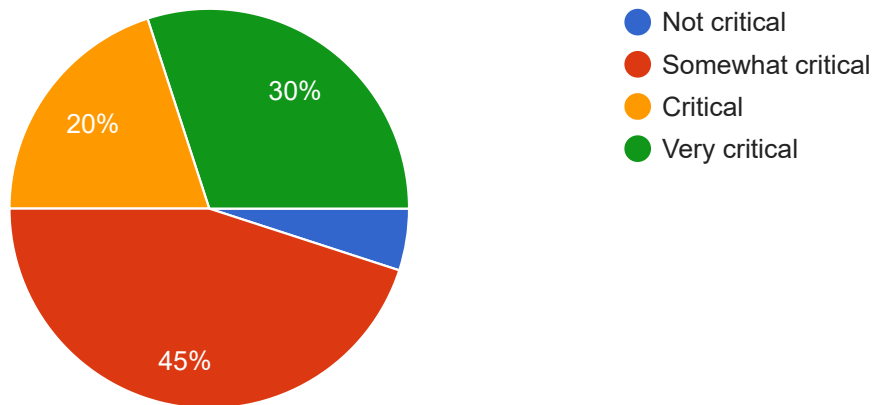
What business models do you think AI/ML can unlock new business models in the telecom sector?

11 responses

AI/ML can offer more business opportunities for converged communications and compute to enable low-latency applications and real-time control (particularly in industrial settings). However, identifying the value chain and necessary requirements to be successful, especially given availability of spectrum, regulatory requirements for network resilience and fair access, and willingness of operators to trust applications (even with sufficient security controls) to have access to or control network resources could be impediments.

create personalized service to users, for example, through TelecomGPT

surveillance security

AI inferencing business.

Share the computing infrastructure ro run AI for non-RAN applications (e.g. GPUs)

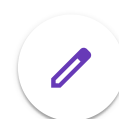Intelligence and 0-code pipelines

Enterprise and industrial networks

customized but dynamic service management

Gen-AI as-a-Service

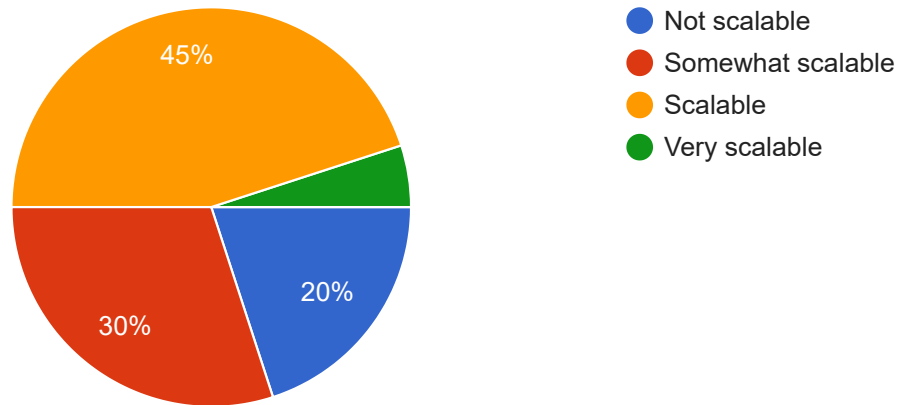Lower the bar to enter the telecommunications sector

None

How scalable are current AI/ML solutions for managing large-scale networks?
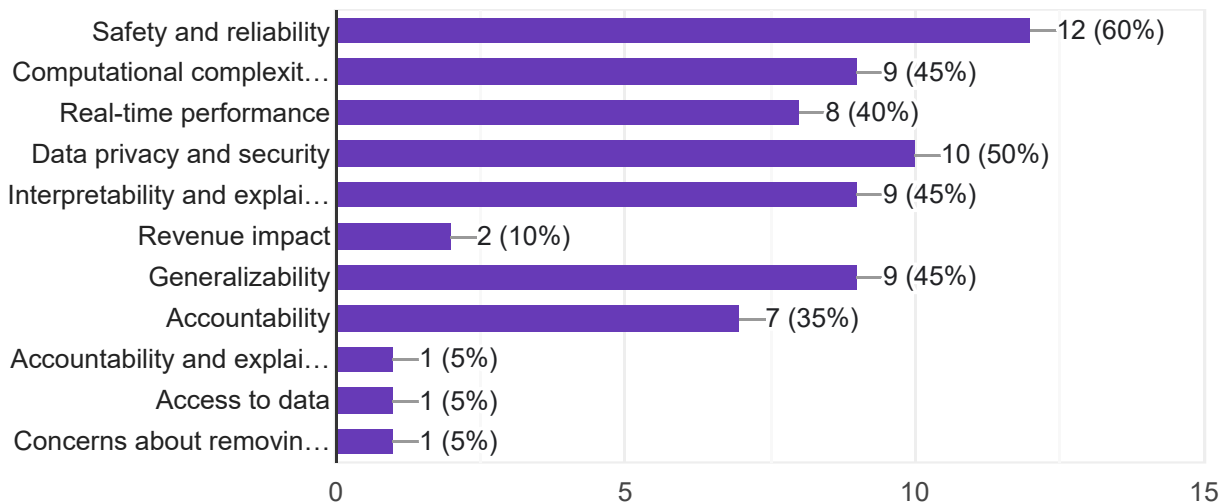
⧉ Copy

20 responses

- 🔵 Not scalable
- 🔴 Somewhat scalable
- 🟠 Scalable
- 🟢 Very scalable

What are your biggest concerns about deploying AI/ML in wireless networks? (Select top 5 please)

⧉ Copy

20 responses

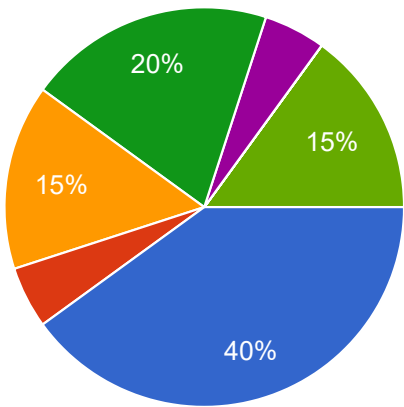| Concern	Count (%)
Safety and reliability	12 (60%)
Computational complexit…	9 (45%)
Real-time performance	8 (40%)
Data privacy and security	10 (50%)
Interpretability and explai…	9 (45%)
Revenue impact	2 (10%)
Generalizability	9 (45%)
Accountability	7 (35%)
Accountability and explai…	1 (5%)
Access to data	1 (5%)
Concerns about removin…	1 (5%)

Please select the most concern you believe about deploying AI/ML in wireless networks
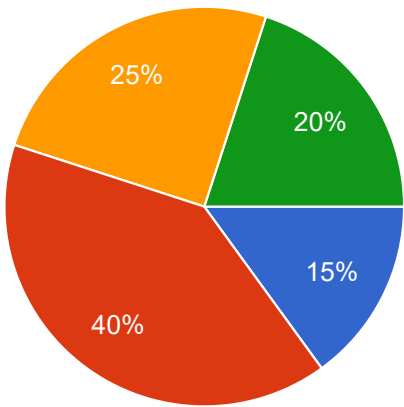
Copy

20 responses

- Safety and reliability
- Computational complexity and deploy costs
- Real-time performance
- Data privacy and security
- Interpretability and explainability
- Revenue impact
- Accountability
- Accountability and explainability

How concerned are you about the safety of AI/ML in real-world network management?
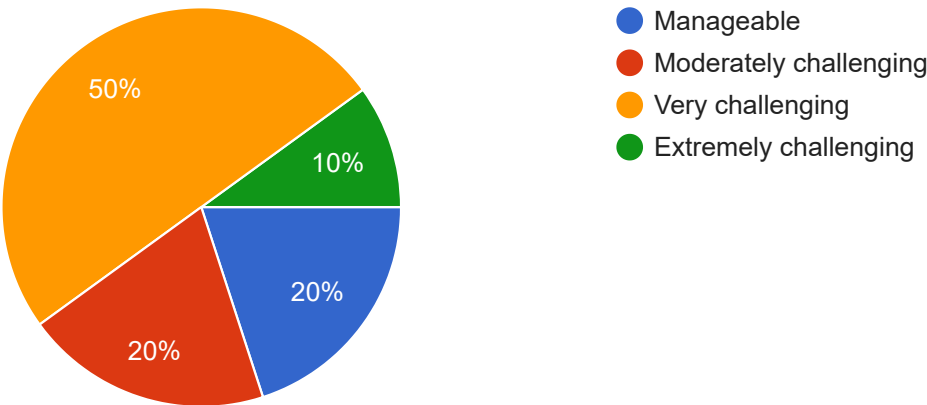
Copy

20 responses

- Not concerned
- Somewhat concerned
- Concerned
- Very concerned

How do you perceive the computational requirements of AI/ML for real-time network automation?

Copy

20 responses

- 🔵 Manageable
- 🔴 Moderately challenging
- 🟠 Very challenging
- 🟢 Extremely challenging

Do you think trust issues with AI/ML solutions hinder their adoption in mobile networks?

Copy

20 responses

- 🔵 Strongly disagree
- 🔴 Disagree
- 🟠 Neutral
- 🟢 Agree
- 🟣 Strongly agree
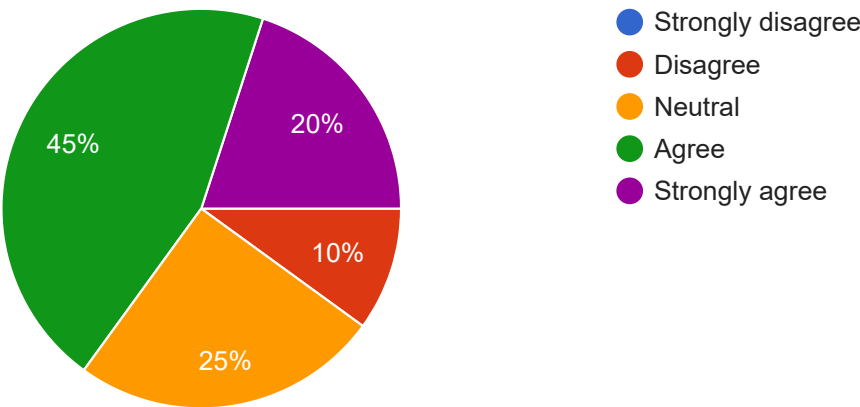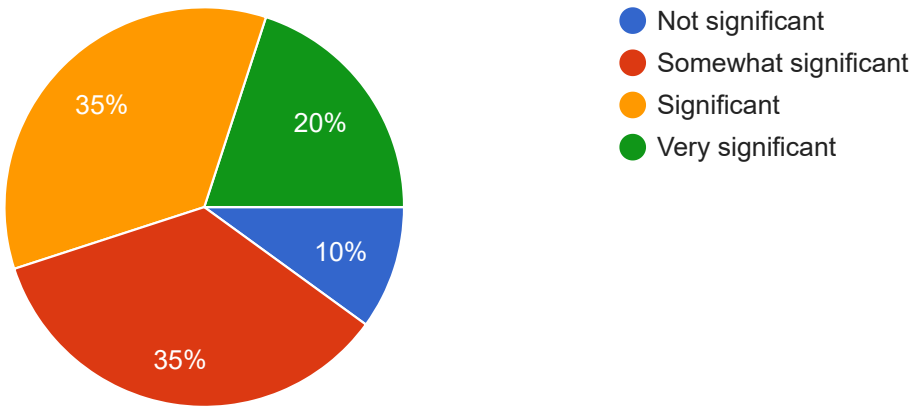
How significant is the lack of interpretability in AI/ML models for network automation?

Copy

20 responses

- Not significant
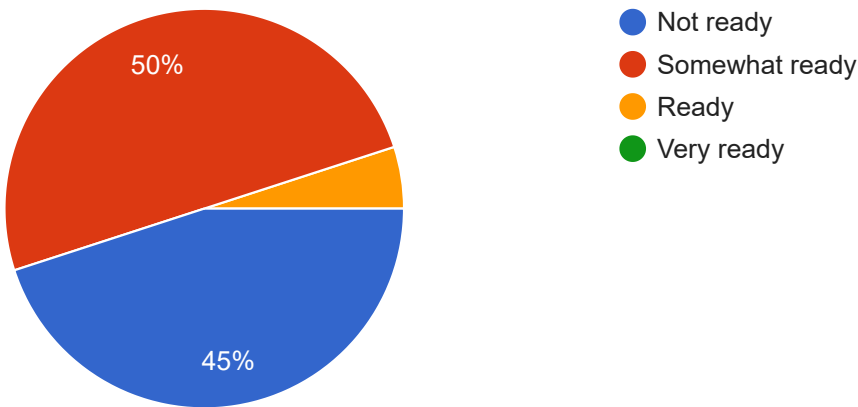- Somewhat significant
- Significant
- Very significant

35% | 20% | 10% | 35%

How would you rate the industry's readiness to deploy AI/ML in real-world network automation?

Copy

20 responses

- Not ready
- Somewhat ready
- Ready
- Very ready

50% | 45%

What role does the explainability of AI/ML models play in gaining trust for deployment?

8 responses

The telecom industry is historically very risk adverse when it comes to adopting new technology in production networks. Additionally, today's mobile telecom networks (e.g. 5G), especially in countries with networks that have very large geographic footprints, such as the United States, China, and India, are incredibly complex operations where small changes can have cascading impacts across the entire network. Network operators will want to have the ability to understand decision-making in network AI/ML models, both to determine capabilities and to allow human intervention in case of automated changes resulting in adverse network impacts. Without such explainability, there will be little trust and network operators will limit the scope of control AI/ML models will have on live network operation.

It's the foundation of trust

Major role.

Significant role, if the AI/ML models can explain data-driven analytics that are in-line with domain understanding

Some insights on why/how it's improving networks

Black box models do not inspire trust.

The mentor

Can reduce the hesitance in adaptation

How concerned are you about the impact of AI/ML deployment on operational revenue?

Copy

20 responses

Legend:
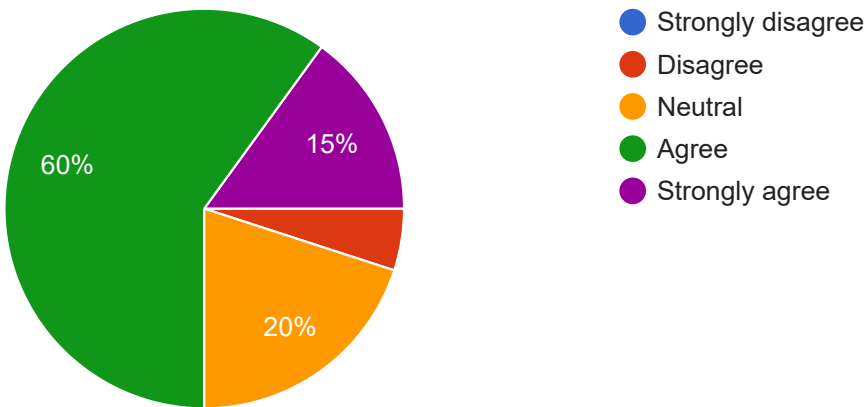- Not concerned
- Somewhat concerned
- Concerned
- Very concerned

40%
40%
20%
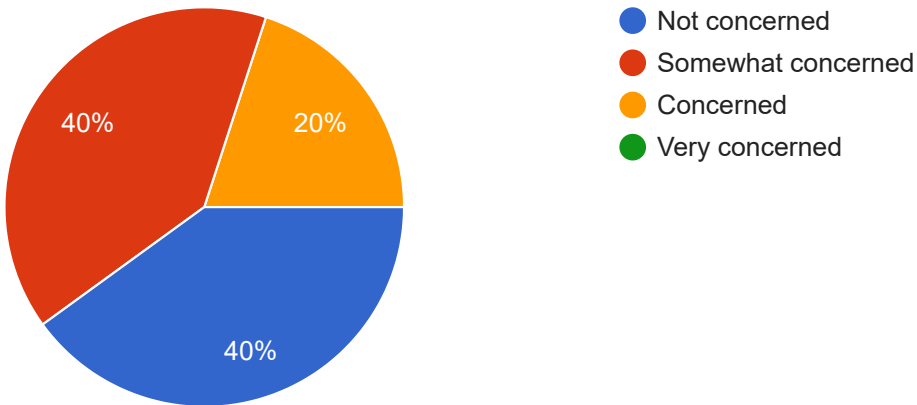
Should accountability mechanisms be mandatory for AI/ML deployment in wireless networks?

Copy

20 responses

Legend:
- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

60%
20%
15%

What strategies do you think can improve trust in AI/ML for mobile networks? (Select all that apply)

⧉ Copy

20 responses

Explainable and interpretable AI	16 (80%)
Human-in-the-loop AI	9 (45%)
Standards and certifications	10 (50%)
Robustness improvements	10 (50%)
People will assess the true value of it and the trade o…	1 (5%)
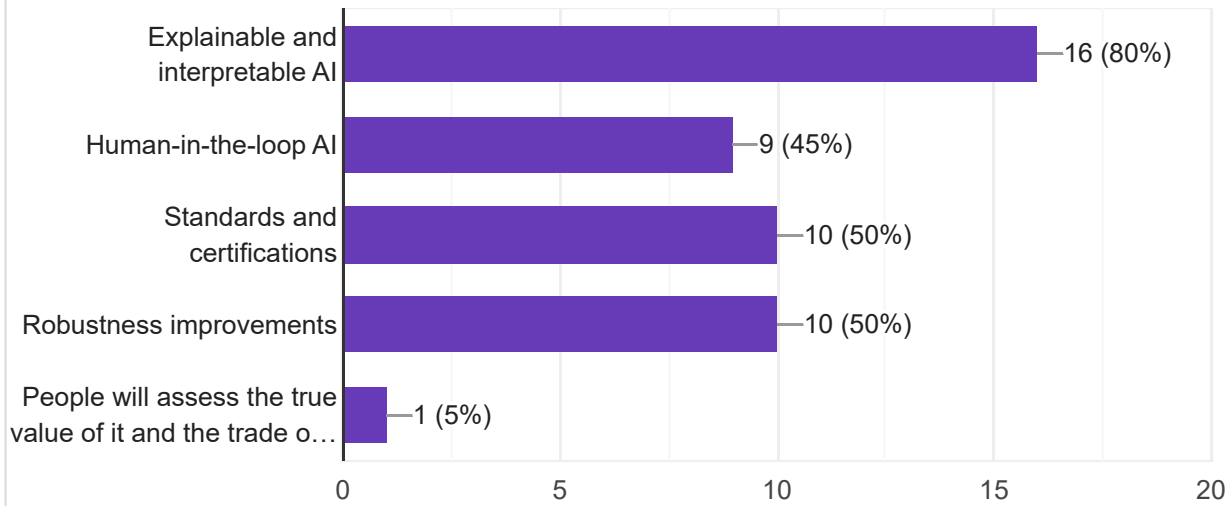
How important is human oversight in the deployment of AI/ML for wireless networks?

⧉ Copy

20 responses

- 🔵 Not important
- 🔴 Somewhat important
- 🟠 Important
- 🟢 Very important

Very important: 30%
Somewhat important: 35%
Important: 35%
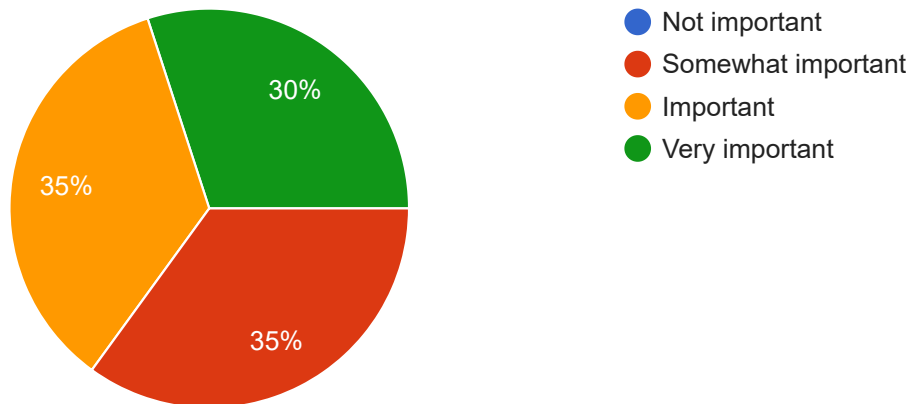
Do you think integrating domain knowledge into AI/ML models improves their performance and trustworthiness?

Copy

20 responses

- ● Strongly disagree
- ● Disagree
- ● Neutral
- ● Agree
- ● Strongly agree

45%

10%

45%
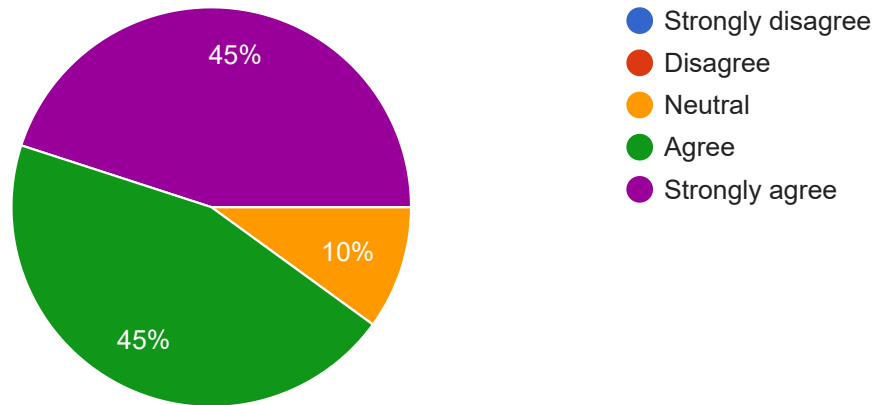
How valuable is the concept of a certificate center for verifying and certifying AI/ML solutions?

Copy

20 responses

- ● Not valuable
- ● Somewhat valuable
- ● Valuable
- ● Very valuable

60%

10%

25%
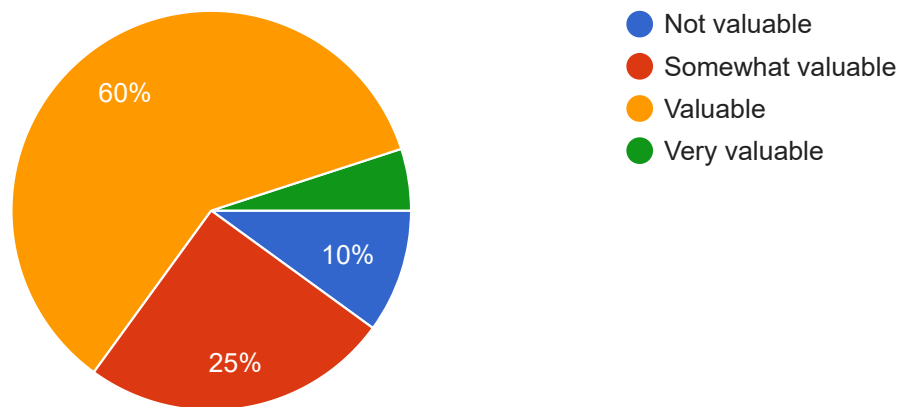
What standards should the telecom industry adopt to ensure the trustworthiness of AI/ML solutions?

8 responses

Whatever 3GPP defines. Criteria of PASS should be different depending on the scenarios
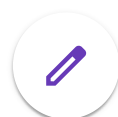
Any relevant standards.

3GPP related standards

3GPP SA5 primarily, O-RAN WG10

Not a single SDO, each has their own view and framework, that's why very hard to achieve

Trustworthy training

Ethnic

Not that different from general industry

What key areas of research are needed to advance AI/ML in mobile network automation?

11 responses

1) Trustworthiness/verifiability of performance
2) Efficiency gains to reduce compute requirements and improving real-time responsiveness
3) Architectures for training and operationalizing AI/ML in real-world networks
4) Data types and fidelity requirements for telecom AI/ML training and operation; impacts of data generated for AI/ML network management (that is, management plane traffic; not user plane traffic) on overall network performance.

New applications that existing non-AI/ML solutions cannot solve, either due problem complexity or computation complexity

The industry needs a real world testbed with real world commercial traffic.

testing and experimentation

1. Random Forest regression/classification with SHAP for non-linear predictions, causation using Feature Importance scores and explainability
2. Long Short Term Memory with Deep Recurrent Neural Network for forecasting and alerting KPI degradations or events
3. Deep Reinforcement learning, in particular Deep Q Network or DDPG variants, for optimization recommendations.
4. Generative Adversarial Networks with LSTM variants for multi-dimensional imputations and digital twin.
5. Spectral clustering for clustering/grouping network entities with similarities and inter-dependencies.
6. Deep NLP, such as BERT, to deal with unstructured data, such as logs.
7. Generative Pre-trained transformer for explainable chatbots to Ops teams

Access to right feature sets, distributed AI/ML computation

Safety and Trust

Real time performance improvement and reliability

Curated training

Event correlation, message pattern recognition

Robustness

How do you envision academia and industry collaborating on AI/ML for wireless networks?

10 responses

Industry and Academia should collaborate on operationalizing academic innovations into industry, and industry better communicating the key challenges of AI/ML network implementation to academia to maximize the impact of academic research on the topic.

Algorithms / simulations by academia, small scale filed trial by academia + industry, large field trial by industry

Academia can collaborate with industry for setting up test beds and emulation systems to mimmic the real world.

very important

Academia should seriously evolve to focus on addressing "REAL-WORLD PROBLEMS and telco operational strategies" from the field, and not conduct research purely for the sake of publishing papers. With Open RAN and data accessibility, academia shall hopefully evolve in the right direction, when it comes to telco.

Academia should strive to build more complex and more realistic testbed and ground research on them

Good opportunity but data sharing is very challenging due to security, privacy and so on

To address product deliverables.

Work closely together

Academic ideas finding way to startups which can try to push the industry

What challenges do you foresee in developing and deploying trustworthy AI-native solutions?

9 responses

1) accuracy verification - how to ensure the AI solution is "right" especially in complex systems
2) edge-case testing - ability to understand how an AI solution responds to unexpected or improper input data (i.e., breaking the model and understanding why it broke)

Lack of explainability
Lack of theoretical guarantees of network performance

Explainability

lack of data

1. Access to telco data and adoption of proper dataset preparation techniques with solid knowledge on data statistics.
2. Trust issues - Challenge in trusting optimization recommendation agents that tend to be "exploratory" in the initial stages to introduce sufficient variability in the parameters being optimized in the field, before "exploiting" its learnings towards generating informed inferences. Operations teams see high risk in "Exploratory" actions to introduce parameter variability.

Not verified in the real world

Absence of curated training data.

Able to understand the real world operation scenarios. Maintain user privacy

Not sure

What future trends do you predict for AI/ML in the telecom sector?

8 responses

Shold be deplorable in both core and edge

AI/ML will become pervasive in every layer of the telecom network.

Networks becoming more autonomous, and younger telco professionals leveraging AI
tools towards gaining as much expertise as highly-experienced senior telco
professionals

More safe

Research centric in short term. But industry interest has been increasing greatly and
more need revenue drive interception

HIL control with evolution to closed control loops.

It will be a part of day-to-day operation

SON being updated with Ai/ML

Are there unexplored opportunities in AI-native network automation that excite you?

6 responses

Would be highly interested to see some killer applications of AI-native network. To date, the use cases are not far from 4G/5G.

Yes, the use of GenAI to automate network operations.

Causation and explainability, Forecasting and alerts, Recommendations and Optimization, Multi-dimensional imputation, Digital twins, Clustering - all these remain relatively unexplored, when it comes to field telco operations in production.
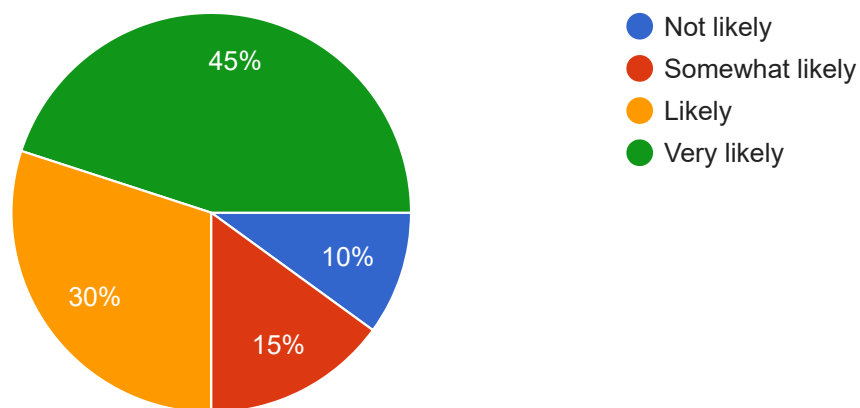
making NFs as autonomous agents

Self healing network

Not sure

Do you think AI-native solutions will play a role in achieving 6G goals?

⧉ Copy

20 responses

- 🔵 Not likely
- 🔴 Somewhat likely
- 🟠 Likely
- 🟢 Very likely

Pie chart values: 45%, 10%, 15%, 30%

How could open-source platforms promote AI/ML adoption in wireless networks?

9 responses

Open source platforms can enable a common framework for development and innovation, but to be impactful the community of support needs to evaluate the ability to translate innovations on the open source platform to real-world production networks (either real-world commercial systems leveraging open-source platforms, with or without modifications; or interoperability/portability between open-source and proprietary platforms)

Very important to go open source. With AL/ML, we need to ensure reproducibility, especially with different datasets.

Open source platforms help in moving fast with innovations and experimentations.

OpenAirInterface (OAI) is the best solution open-source to test and develop AI/ML algorithms

Accelerate

Not really

I think they are *required*. Black-boxes are not auditable. Audits are a requirement for mission critical infra.

With standards but provide opportunities to customize

The problem is not platform but lack of open access data

What are the biggest hurdles for deploying AI-native solutions in real-world networks?

11 responses

Safety and reliability

1) Trust - it will be difficult to deploy AI solutions with any sort of scale/control/impact unless the network operator can trust that the AI solution will be stable in real-world operation
2) Return on Investment - will the cost to build, deploy, and operate the AI solution result in meaningful reduction in operating costs or a meaningful increase in revenue (whether that be through new service offerings or increasing the capacity of existing infrastructure).

No agreement on datasets (for instance, statistical channel model or site-specific ray-tracing channel models) and a lack of uniform framework to evaluate how good an AI-native solution is.

The operational concerns and the fear of losing control by the operational teams are the big impediments for AI/ML's adoption.

security

1. Access to telco data and adoption of proper dataset preparation techniques with solid knowledge on data statistics.
2. Trust issues - Challenge in trusting optimization recommendation agents that tend to be "exploratory" in the initial stages to introduce sufficient variability in the parameters being optimized in the field, before "exploiting" its learnings towards generating informed inferences. Operations teams see high risk in "Exploratory" actions to introduce parameter variability.

You haven't defined AI-native, so hard to respond to this.

Safety and compute resources

Energy efficiency.

The trust and fear of losing the jobs

Access to field data

Do you have any additional comments or suggestions regarding AI/ML for mobile network automation?

3 responses

No

1. AI is only as good as the data you can access and the dataset that you prepare.
2. AI is science. Practice the science properly, else the science wouldn't work, especially for large-scale operational telco.

Google Forms