

SEMINAR SERIES

Seminar Series — Full Pack

Talks, case studies and discussion slides



PRESENTED BY
Presenter Name

MODULES
6

EDITION
2026

Course map

01

Cloud-Native Applications

02

Edge Computing

03

Augmented Reality

04

Quantum Computing

05

5G Technology

06

Machine Learning in
Healthcare

CLOUD-NATIVE APPLICATIONS

01



Microservices, containers and DevOps

Talk 1 · Cloud-Native Applications

Introduction

- Cloud-native apps are built to run on modern cloud platforms
- They use microservices, containers and automation
- They scale and update without downtime
- Most new software is designed this way



Image

Evolution

2000s

Virtual machines

Servers become software

2015

Orchestration

Managing containers at scale

2013

Containers

Lightweight packaging

2020s

Serverless

Functions on demand

Key concepts

01

Microservices

Small services that do one job each.

02

Containers

Packaged apps that run anywhere.

03

CI/CD

Automated build, test and deploy.

How it works

1

Code

Small, independent services

2

Package

Build container images

3

Deploy

Orchestrator runs them

4

Observe

Logs, metrics, traces

Architecture

Services, containers and an orchestrator.

Each microservice ships in its own container. An orchestrator schedules containers across machines, restarts failures and scales services up or down with traffic.



Architecture diagram

Applications



Image 1

E-commerce

Scale during big sales.



Image 2

Banking apps

Release features weekly.

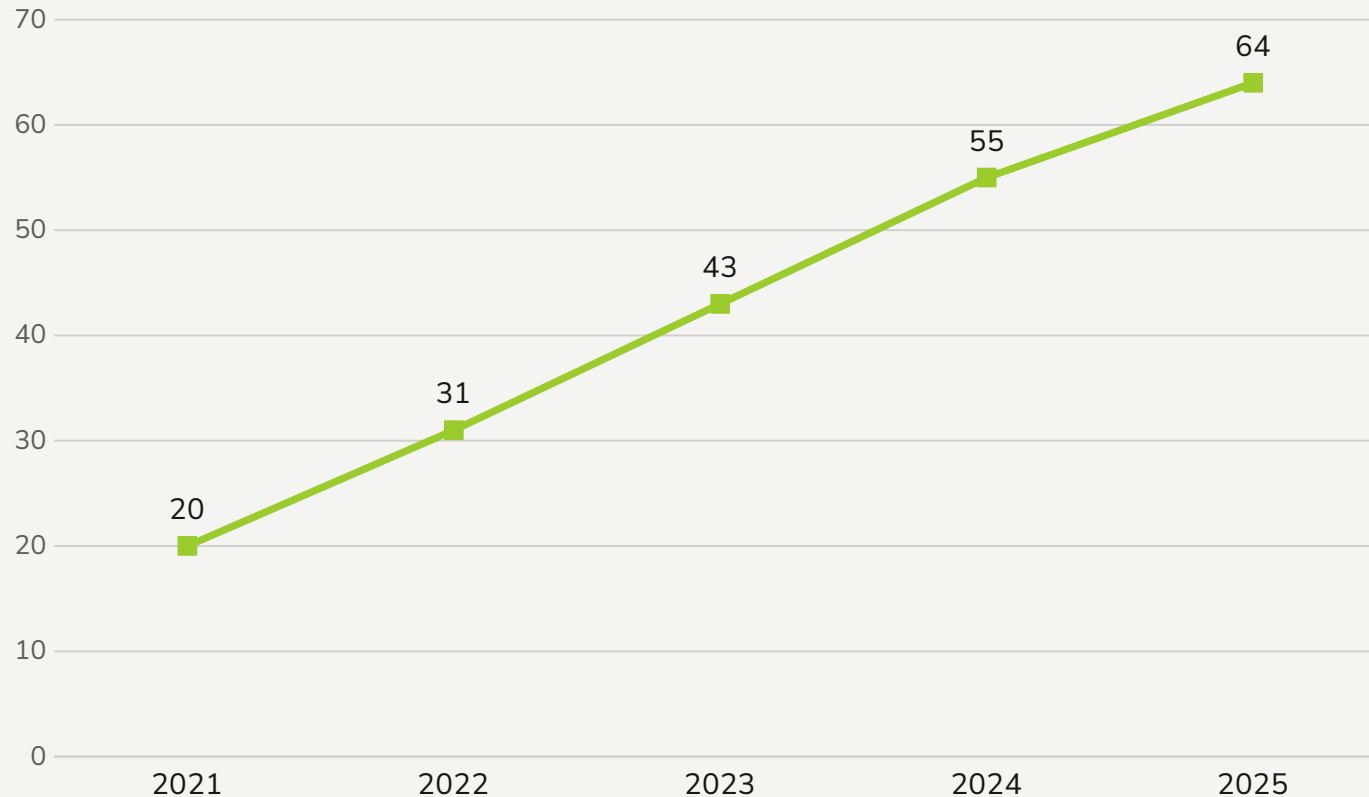


Image 3

Streaming

Serve millions at once.

Adoption trend



Organisations running containers in production (sample data).

Sample data for illustration — replace with your own figures.

Advantages and limitations

Advantages

- Scales with demand
- Faster releases
- Resilient to failures
- Portable across clouds

vs

Limitations

- More moving parts
- Needs DevOps skills
- Monitoring complexity
- Cost control

Open challenges

01

Complexity

Many services to manage.

02

Skills

Training needed.

03

Security

Supply-chain risks.

Conclusion

- Cloud-native is the default for new apps
- Automation is the real advantage
- Start simple and grow

References

- [1] Survey paper on the topic, IEEE Access, 2024.
- [2] Textbook chapter covering fundamentals, 2023.
- [3] Recent conference paper on applications, 2025.
- [4] Industry white paper (generic reference).

EDGE COMPUTING

02



Bringing computation closer to where data is created

Talk 2 · Edge Computing

Introduction

- Billions of devices now generate data at the network edge
- Sending everything to the cloud adds delay and cost
- Edge computing processes data near its source
- It powers real-time apps like autonomous vehicles and smart factories



Evolution

2000s

CDNs

Content cached near users

2016

MEC

Compute inside mobile
networks

2012

Fog computing

Cloud extended to the
network

2020s

AI at the edge

Models run on devices

Key concepts

01

Latency

Time for data to travel and be processed — the edge cuts it sharply.

02

Edge node

A small server or gateway close to the devices it serves.

03

Offloading

Deciding which tasks run locally and which in the cloud.

How it works

1 Sense

Devices collect data

2 Filter

Edge node cleans and aggregates

3 Decide

Local model acts instantly

4 Sync

Summaries go to the cloud

Architecture



Architecture diagram

Three tiers — device, edge and cloud — each doing what it does best.

Devices sense, edge nodes make time-critical decisions, and the cloud handles long-term storage, training and fleet-wide analytics.

Applications



Image 1

Smart factories

Machine faults detected in milliseconds



Image 2

Connected vehicles

Local processing for safety features

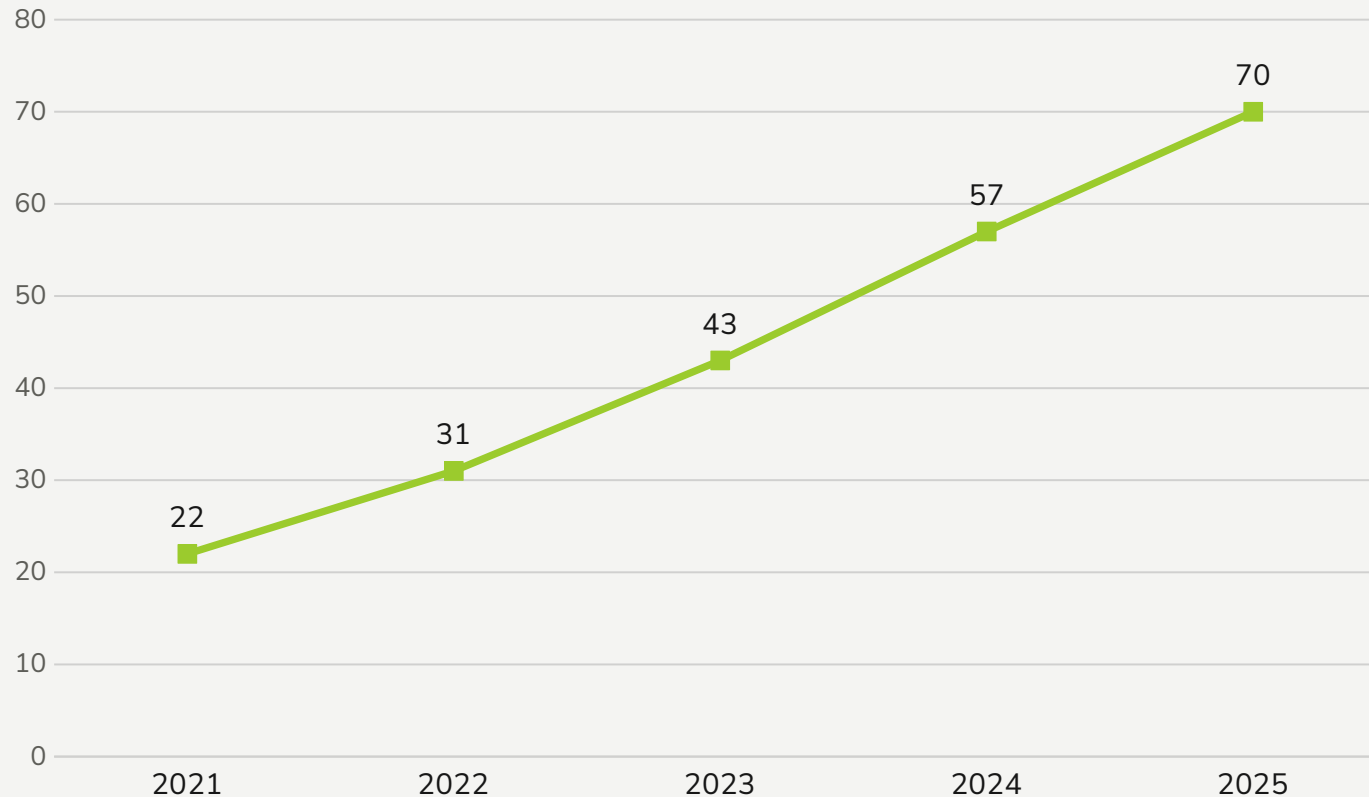


Image 3

Retail

In-store analytics without uploading video

Adoption trend



Adoption has grown steadily as 5G and low-power AI chips matured.

Sample data for illustration — replace with your own figures.

Advantages and limitations

Advantages

- Very low latency
- Lower bandwidth costs
- Better data privacy
- Works with poor connectivity

vs

Limitations

- Harder to manage many nodes
- Limited compute per node
- Physical security of devices
- Standards still evolving

Open challenges

01

Orchestration

Deploying updates to thousands of nodes.

02

Security

Protecting devices in the field.

03

Energy

Running models on tight power budgets.

Conclusion

- Edge computing complements, not replaces, the cloud
- It is key for real-time, privacy-sensitive applications
- Management and security are the main open problems

References

- [1] Survey paper on the topic, IEEE Access, 2024.
- [2] Textbook chapter covering fundamentals, 2023.
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AUGMENTED REALITY

03



Blending digital content with the real world

Talk 3 · Augmented Reality

Introduction

- AR overlays digital information on what we see
- It runs on phones, tablets and smart glasses
- Used in retail, education, maintenance and games
- Advances in sensors and AI make it practical



Evolution

1968

First headset

Early head-mounted display

2016

Mobile AR

Phone games go mainstream

1990s

The term AR

Coined for aircraft assembly

2020s

Smart glasses

Lighter wearable devices

Key concepts

01

Tracking

Knowing where the device is and what it sees.

02

Rendering

Drawing 3D content aligned to the world.

03

Interaction

Touch, gaze, voice and gestures.

How it works

1 Capture

Camera sees the scene

2 Understand

Detect surfaces and objects

3 Anchor

Place digital content

4 Render

Show it in real time

Architecture

Camera, sensors and a real-time 3D engine.

An AR app combines camera frames with motion sensors to map the environment, then a 3D engine renders virtual objects that stay locked to real surfaces as the user moves.



Architecture diagram

Applications



Image 1

Retail

Try furniture or glasses at home.



Image 2

Education

3D models of the heart or planets.

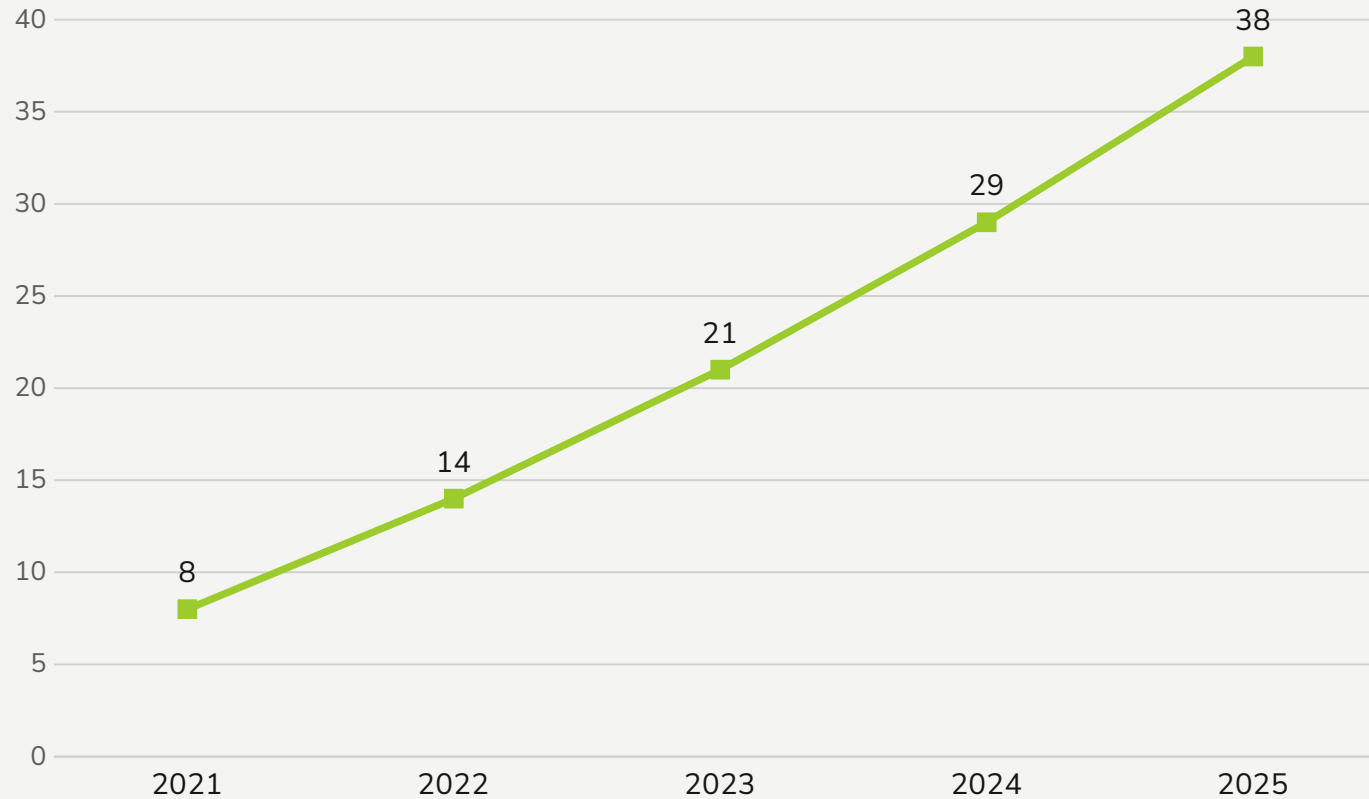


Image 3

Maintenance

Step-by-step repair overlays.

Adoption trend



Smartphone users trying AR features (sample data).

Sample data for illustration — replace with your own figures.

Advantages and limitations

Advantages

- Hands-on learning
- Fewer errors in field work
- Engaging marketing
- Works on existing phones

vs

Limitations

- Battery and heat
- Motion sickness for some
- Privacy of camera data
- Content is costly to create

Open challenges

01

Hardware

Glasses still bulky.

02

Content

3D assets take time.

03

Privacy

Always-on cameras.

Conclusion

- AR adds context to the real world
- Phones already make it accessible
- Hardware and content are the next frontiers

References

- [1] Survey paper on the topic, IEEE Access, 2024.
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QUANTUM COMPUTING

04



A beginner-friendly look at qubits and what they could change

Talk 4 · Quantum Computing

Introduction

- Classical computers use bits that are either 0 or 1
- Quantum computers use qubits that can be in superposition
- Some problems may become dramatically faster to solve
- Today's machines are still small and error-prone



Evolution

1981

The idea

Simulating physics with
quantum machines



1994

Shor's algorithm

Fast factoring in theory

2019

Early milestones

First narrow speed-up claims



2020s

NISQ era

Noisy, intermediate-scale
devices

Key concepts

01

Superposition

A qubit can represent 0 and 1 at the same time.

02

Entanglement

Qubits linked so one's state depends on another.

03

Interference

Amplifying right answers and cancelling wrong ones.

How it works

1 Initialise

Qubits prepared in a known state

2 Gates

Quantum gates create superposition

3 Entangle

Qubits linked into a circuit

4 Measure

Result read out as classical bits

Architecture



Architecture diagram

A quantum computer is a classical computer wrapped around a very cold, very quiet core.

Control electronics send precise pulses to qubits kept near absolute zero. Results are measured and post-processed classically, many times over.

Applications



Image 1

Drug discovery

Simulating molecules more accurately



Image 2

Optimisation

Logistics and scheduling problems

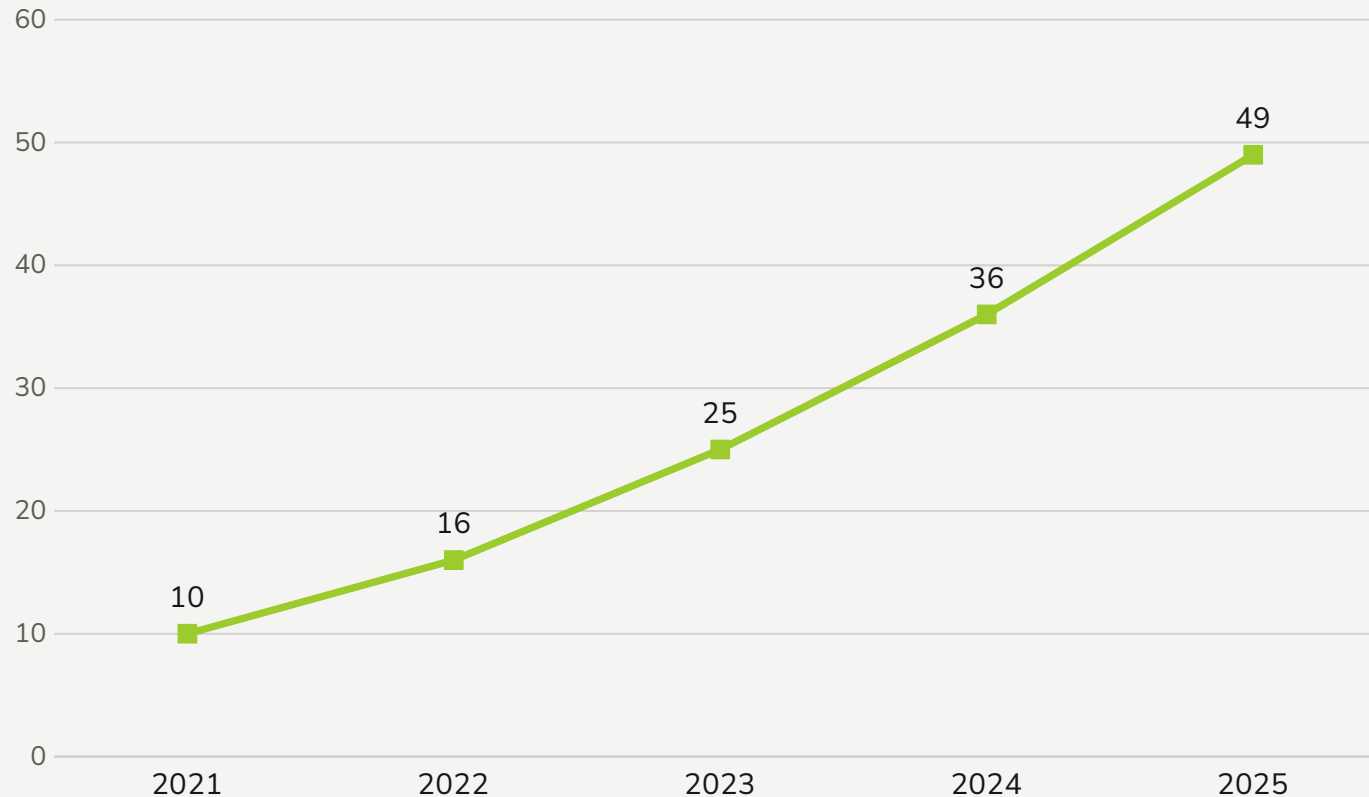


Image 3

Cryptography

New, quantum-safe security methods

Adoption trend



Research activity keeps rising, though practical advantage is still limited to narrow tasks.

Sample data for illustration — replace with your own figures.

Advantages and limitations

Advantages

- Potential speed-ups for some problems
- Natural fit for simulating chemistry
- Drives new cryptography

vs

Limitations

- Qubits are fragile and noisy
- Needs extreme cooling
- Few useful algorithms so far

Open challenges

01

Error correction

Many physical qubits per reliable qubit.

02

Scaling

From hundreds to millions of qubits.

03

Software

Tools and skills are still scarce.

Conclusion

- Qubits use superposition and entanglement
- Real advantage is narrow but growing
- Error correction is the key milestone to watch

References

- [1] Survey paper on the topic, IEEE Access, 2024.
- [2] Textbook chapter covering fundamentals, 2023.
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5G TECHNOLOGY

05



The next generation of mobile networks

Talk 5 · 5G Technology

Introduction

- 5G is the fifth generation of cellular networks
- It offers far higher speeds and lower latency
- It connects many more devices per square kilometre
- It enables new services from smart factories to remote surgery



Image

Evolution

1G

1980s

Analogue voice calls

4G

2010s

Fast mobile broadband

2G–3G

1990s–2000s

SMS and mobile internet

5G

2020s

Ultra-fast, low-latency
networks

Key concepts

01

mmWave

High-frequency bands with huge capacity but short range.

02

Massive MIMO

Many antennas serve many users at once.

03

Network slicing

Virtual networks tailored for each service.

How it works

1

Device

Phone or sensor connects

2

Small cell

Dense radio nodes nearby

3

Core

Cloud-native 5G core

4

Service

Apps with low latency

Architecture

A cloud-native core and dense small cells.

5G separates the radio from a software-defined core, so operators can create network slices with guaranteed speed and latency for different uses, from video to industrial control.



Architecture diagram

Applications



Image 1

Smart factories

Wireless robots and sensors.



Image 2

Telemedicine

Remote consultations and monitoring.

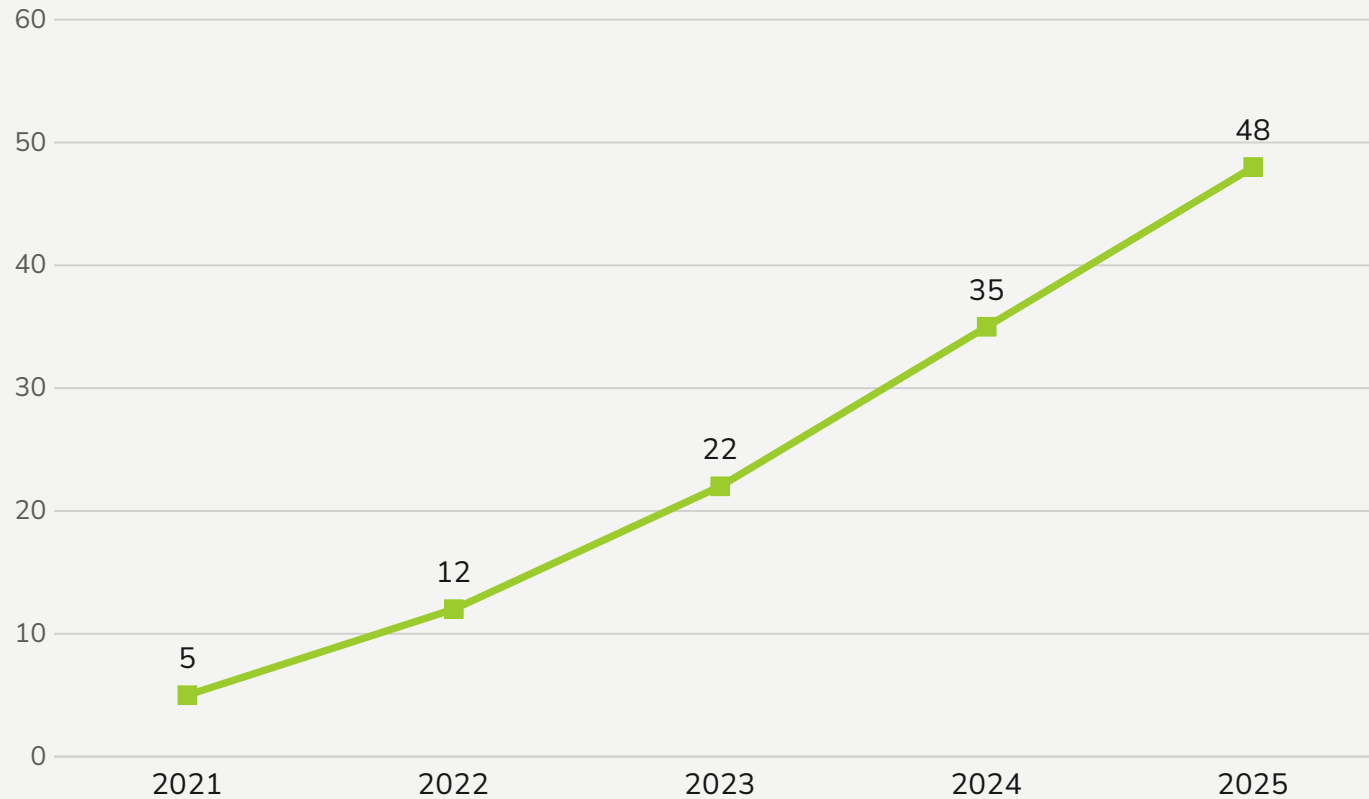


Image 3

Connected vehicles

Real-time traffic data.

Adoption trend



Share of mobile connections on 5G (sample data).

Sample data for illustration — replace with your own figures.

Advantages and limitations

Advantages

- Very high speeds
- Latency of a few milliseconds
- Huge device capacity
- Flexible network slices

vs

Limitations

- Expensive rollout
- Short range at high bands
- Device costs
- Energy use of dense networks

Open challenges

01

Coverage

Dense cells needed in cities.

02

Cost

Spectrum and equipment investment.

03

Security

More connected devices to protect.

Conclusion

- 5G is more than faster phones
- It unlocks industrial and civic use cases
- Coverage and cost remain the key challenges

References

- [1] Survey paper on the topic, IEEE Access, 2024.
- [2] Textbook chapter covering fundamentals, 2023.
- [3] Recent conference paper on applications, 2025.
- [4] Industry white paper (generic reference).

MACHINE LEARNING IN HEALTHCARE





How data is changing diagnosis and care

Talk 6 · Machine Learning in Healthcare

Introduction

- Machine learning finds patterns in medical data
- It supports doctors in diagnosis and planning
- Used with scans, records and wearable data
- Needs careful validation and privacy safeguards



Evolution

1970s

Expert systems

Rule-based medical advice

2012

Deep learning

Breakthroughs in image tasks

2000s

Digital records

Data becomes available

2020s

Clinical tools

Approved AI-assisted devices

Key concepts

01

Supervised learning

Learning from labelled examples.

02

Computer vision

Reading X-rays and scans.

03

Predictive models

Estimating risk from records.

How it works

1

Collect

Anonymised clinical data

2

Train

Models learn patterns

3

Validate

Test on new hospitals

4

Assist

Support doctors' decisions

Architecture



Architecture diagram

Data pipelines, models and clinician review.

Models are trained on de-identified data, validated on separate populations and deployed as decision support, with clinicians always making the final call.

Applications



Image 1

Radiology

Flagging suspicious scans.



Image 2

Triage

Prioritising urgent cases.

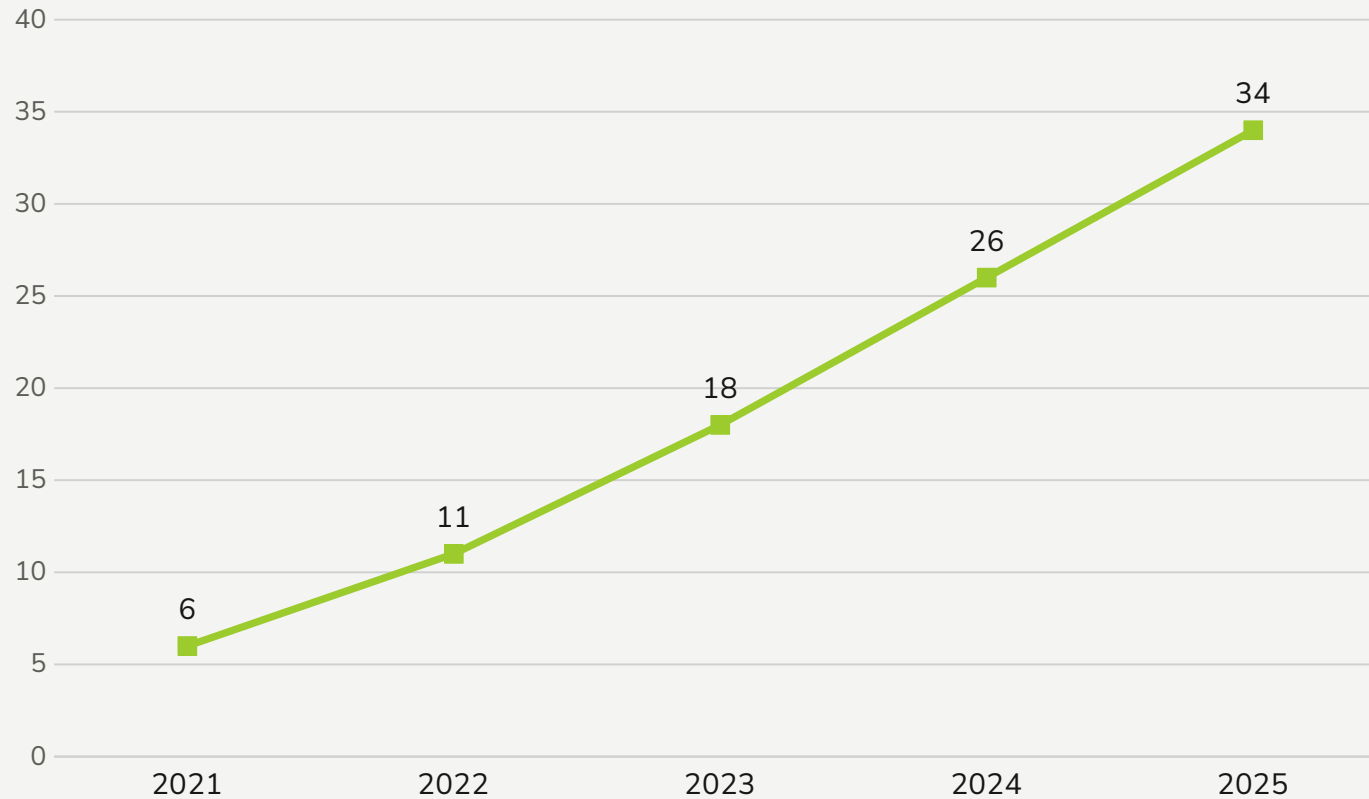


Image 3

Chronic care

Predicting complications early.

Adoption trend



Hospitals piloting AI tools
(sample data).

Sample data for illustration — replace with your own figures.

Advantages and limitations

Advantages

- Earlier detection
- Faster reporting
- Support where specialists are scarce
- Personalised care

vs

Limitations

- Bias in data
- Privacy risks
- Hard to explain decisions
- Regulatory hurdles

Open challenges

01

Data quality

Diverse, labelled data needed.

02

Trust

Explainability for clinicians.

03

Regulation

Approval and monitoring.

Conclusion

- ML can extend specialist expertise
- Validation and fairness are essential
- Humans stay in charge of care

References

- [1] Survey paper on the topic, IEEE Access, 2024.
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- [3] Recent conference paper on applications, 2025.
- [4] Industry white paper (generic reference).

Thank you

Questions and discussion.

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