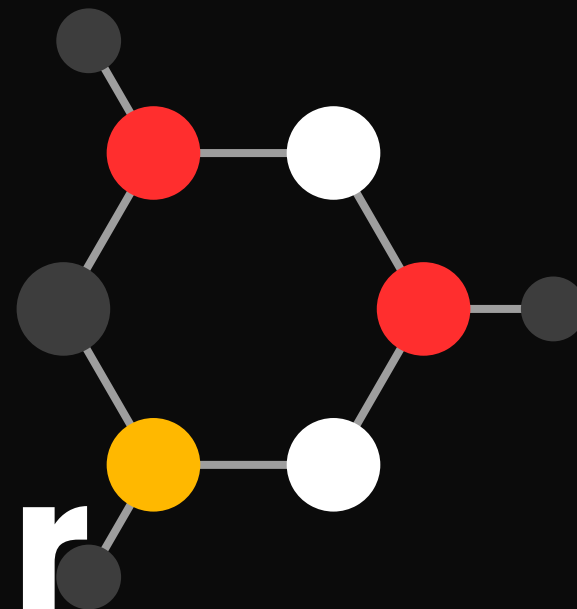


SEMINAR SERIES

07 Technical Seminar Compendium

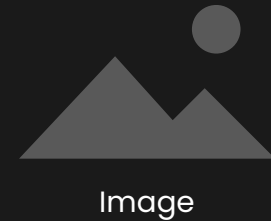
Talks, case studies and discussion slides

Presenter Name · 7 · 2026



Course map

- 01** Machine Learning in Healthcare
- 02** Cloud-Native Applications
- 03** Quantum Computing
- 04** Augmented Reality
- 05** Edge Computing
- 06** 5G Technology



MACHINE LEARNING IN HEALTHCARE

01

KEY IDEA

How data is changing diagnosis and care

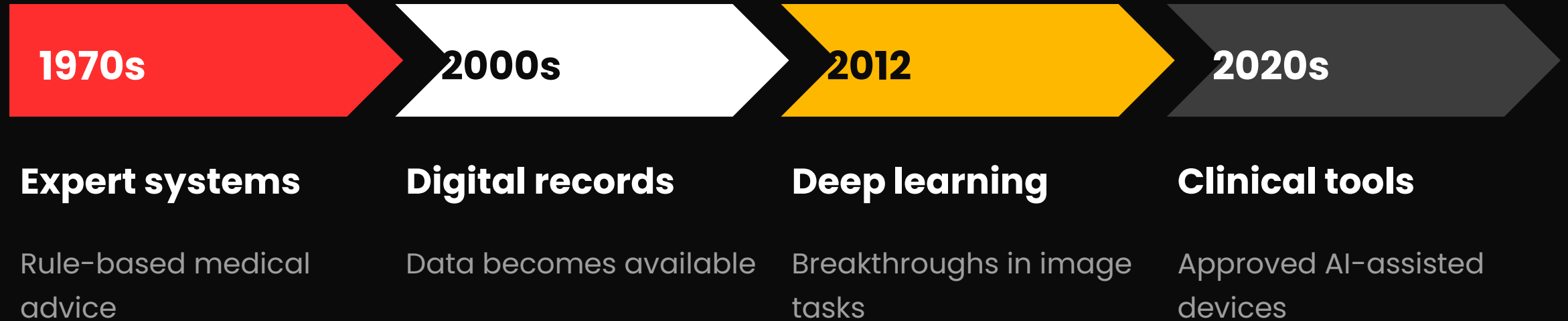
Talk 1 · Machine Learning in Healthcare

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



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



Collect

Anonymised clinical
data



Train

Models learn patterns



Validate

Test on new hospitals



Assist

Support doctors'
decisions

Architecture

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.



Architecture diagram

Applications



Image 1

Radiology

Flagging suspicious scans.



Image 2

Triage

Prioritising urgent cases.

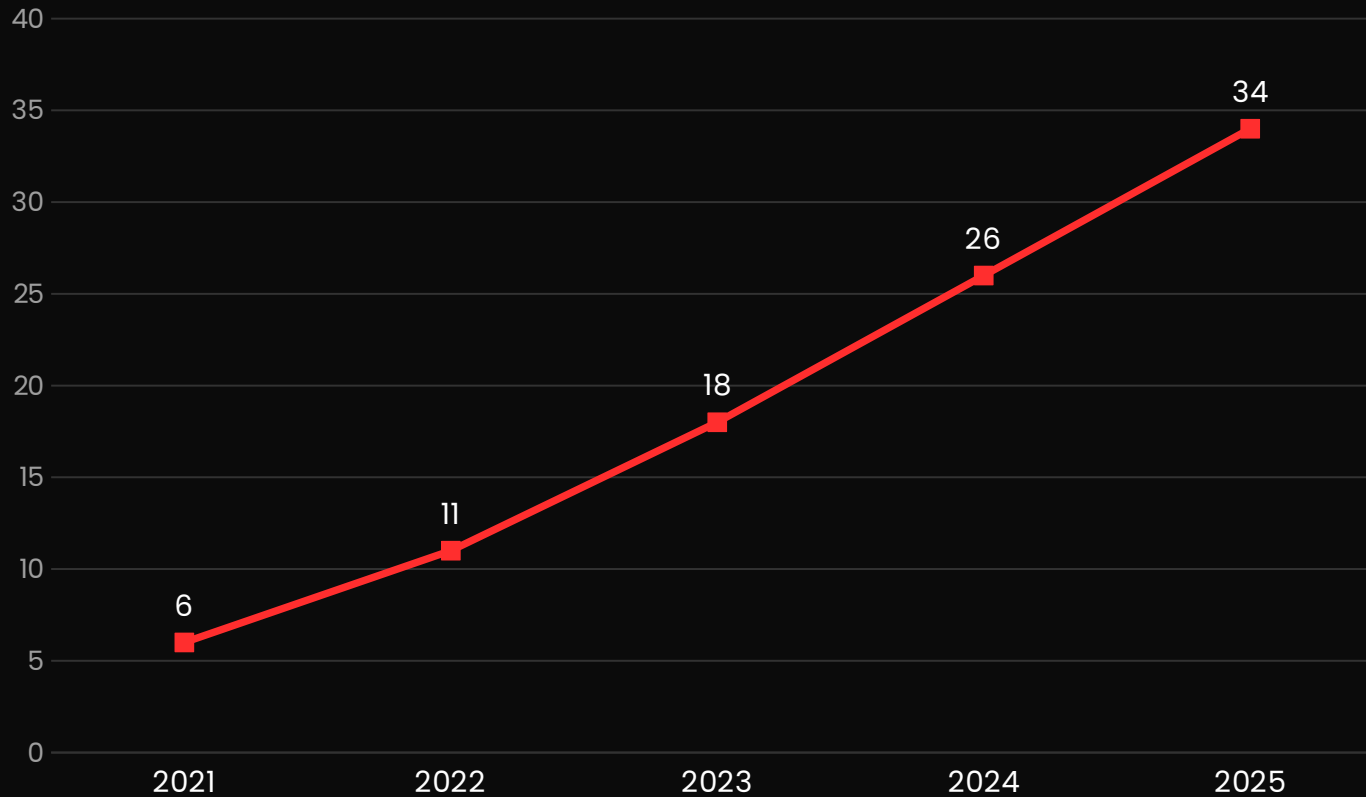


Image 3

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

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.
- [2] Textbook chapter covering fundamentals, 2023.
- [3] Recent conference paper on applications, 2025.
- [4] Industry white paper (generic reference).

CLOUD-NATIVE APPLICATIONS

02

KEY IDEA

Microservices, containers and DevOps

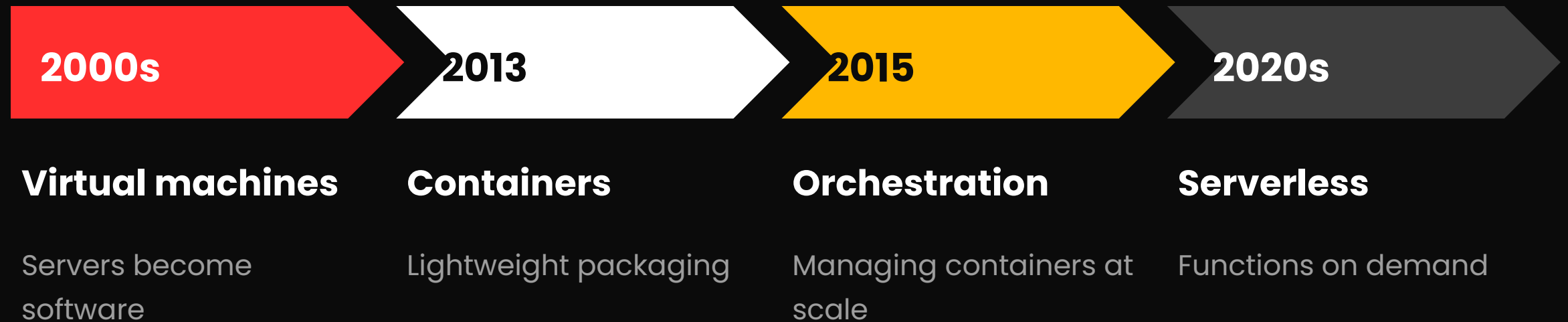
Talk 2 · Cloud-Native Applications

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



Evolution



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



Code

Small, independent
services



Package

Build container images



Deploy

Orchestrator runs them



Observe

Logs, metrics, traces

Architecture



Architecture diagram

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.

Applications



Image 1

E-commerce

Scale during big sales.



Image 2

Banking apps

Release features weekly.

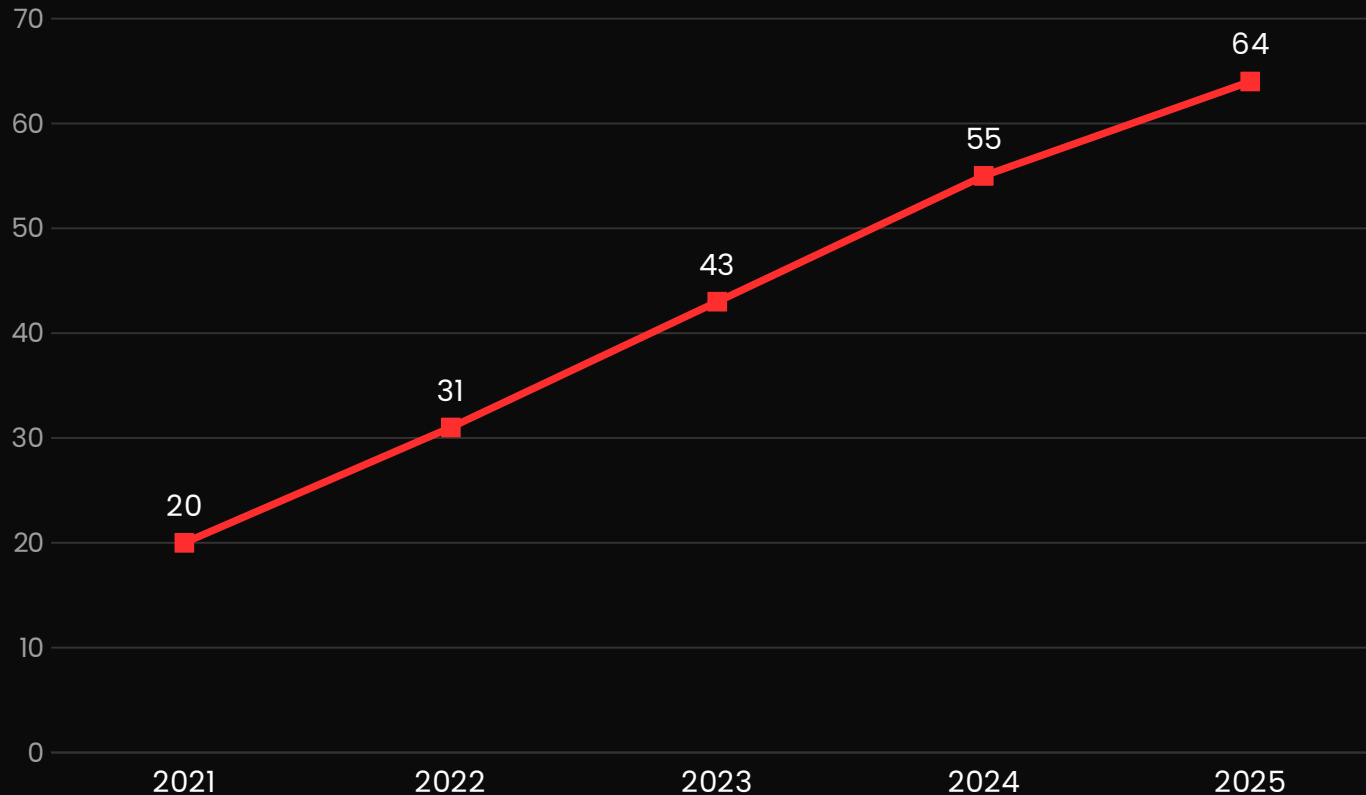


Image 3

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

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).

QUANTUM COMPUTING

03

KEY IDEA

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

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



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

01

Initialise

Qubits prepared in a known state

02

Gates

Quantum gates create superposition

03

Entangle

Qubits linked into a circuit

04

Measure

Result read out as classical bits

Architecture

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.



Architecture diagram

Applications



Image 1

Drug discovery

Simulating molecules more accurately



Image 2

Optimisation

Logistics and scheduling problems

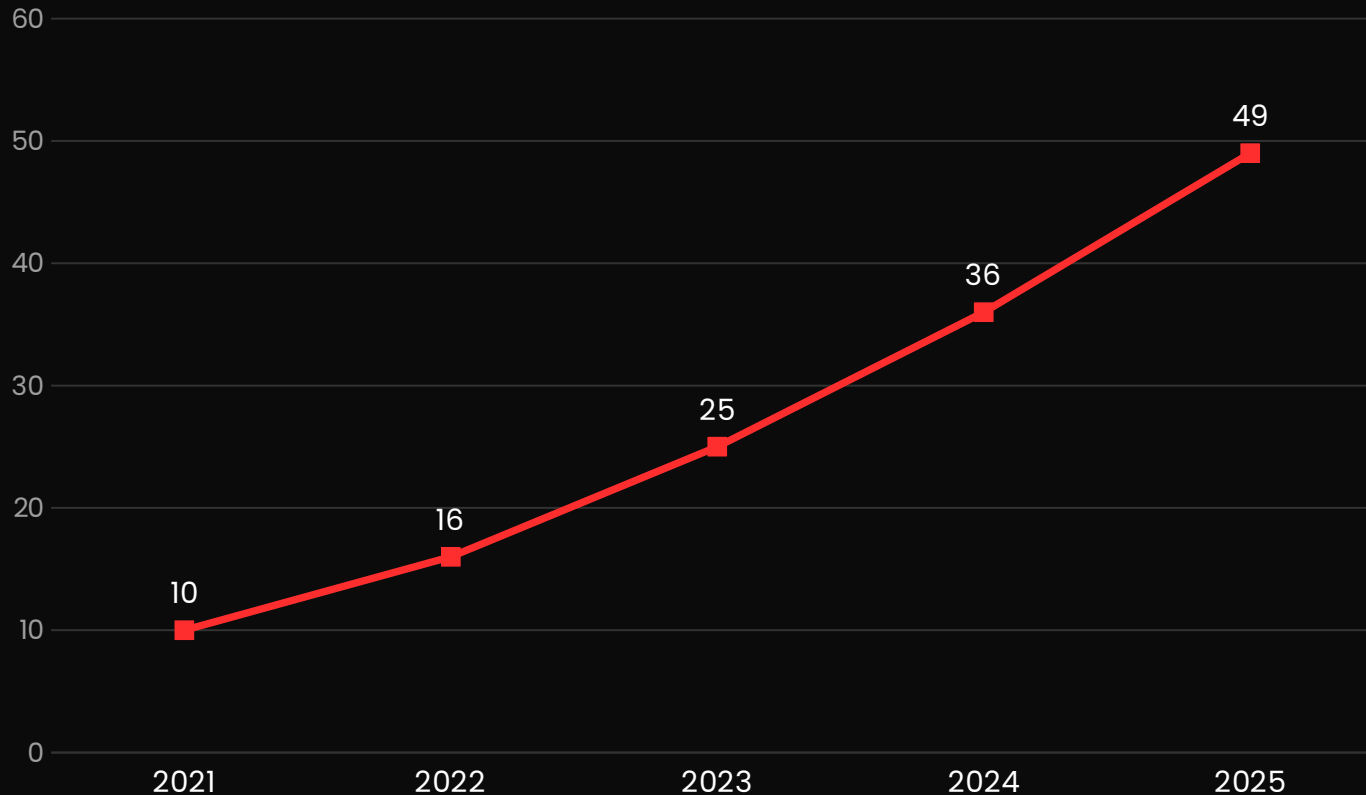


Image 3

Cryptography

New, quantum-safe security methods

Adoption trend



Sample data for illustration — replace with your own figures.

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

Advantages and limitations

Advantages

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

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.
- [3] Recent conference paper on applications, 2025.
- [4] Industry white paper (generic reference).

AUGMENTED REALITY

04

KEY IDEA

Blending digital content with the real world

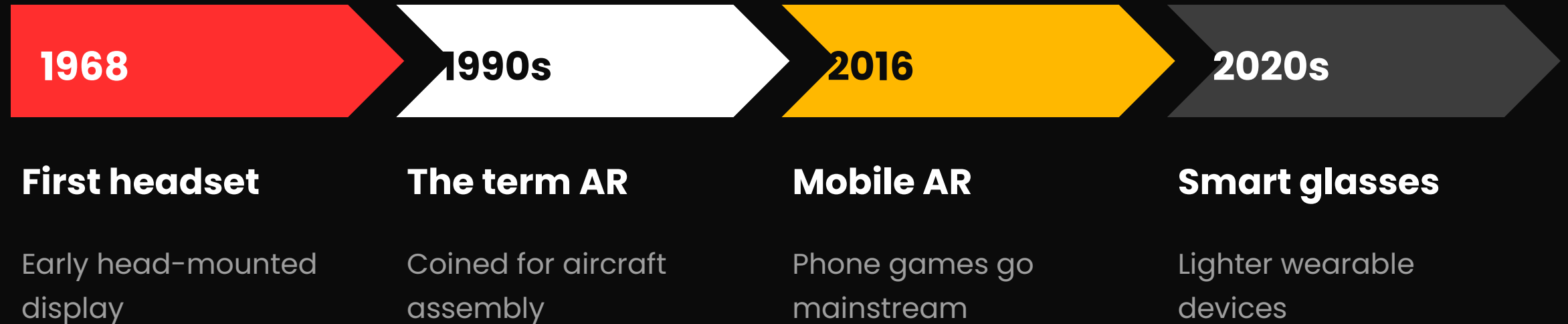
Talk 4 · Augmented Reality

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



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



Capture

Camera sees the scene



Understand

Detect surfaces and
objects



Anchor

Place digital content



Render

Show it in real time

Architecture



Architecture diagram

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.

Applications



Image 1

Retail

Try furniture or glasses at home.



Image 2

Education

3D models of the heart or planets.

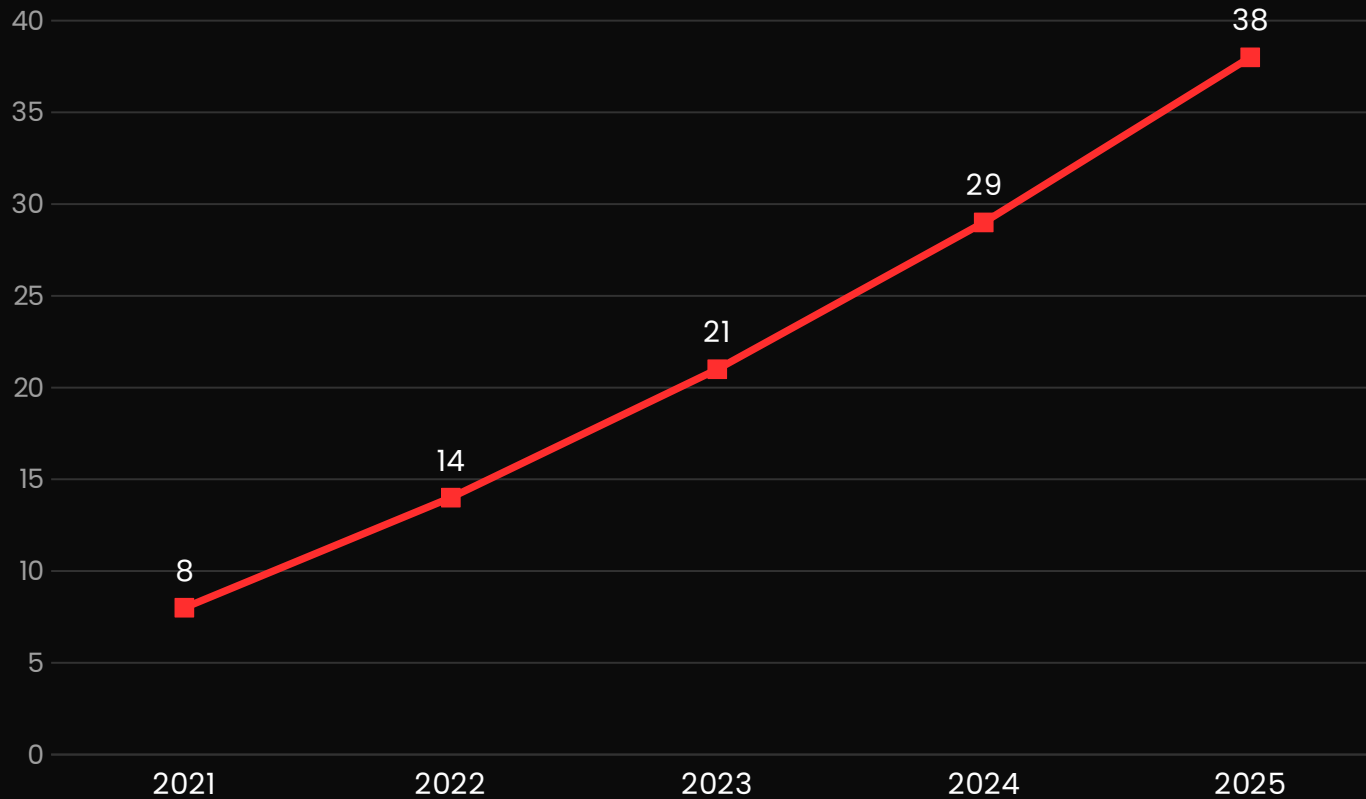


Image 3

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

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.
- [2] Textbook chapter covering fundamentals, 2023.
- [3] Recent conference paper on applications, 2025.
- [4] Industry white paper (generic reference).



EDGE COMPUTING

05

KEY IDEA

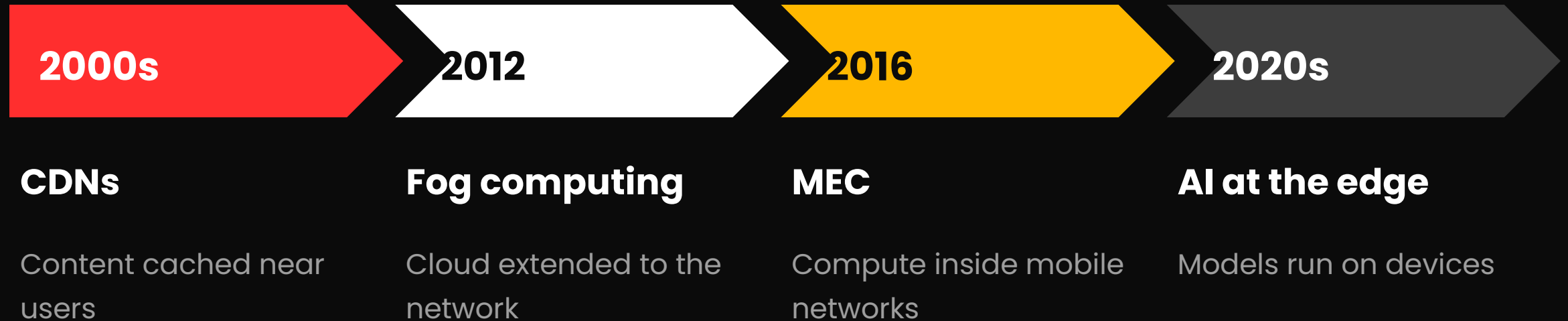
**Bringing computation
closer to where data is
created**

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



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

01

Sense

Devices collect data

02

Filter

Edge node cleans and
aggregates

03

Decide

Local model acts
instantly

04

Sync

Summaries go to the
cloud

Architecture

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.



Architecture diagram

Applications



Image 1

Smart factories

Machine faults detected in milliseconds



Image 2

Connected vehicles

Local processing for safety features

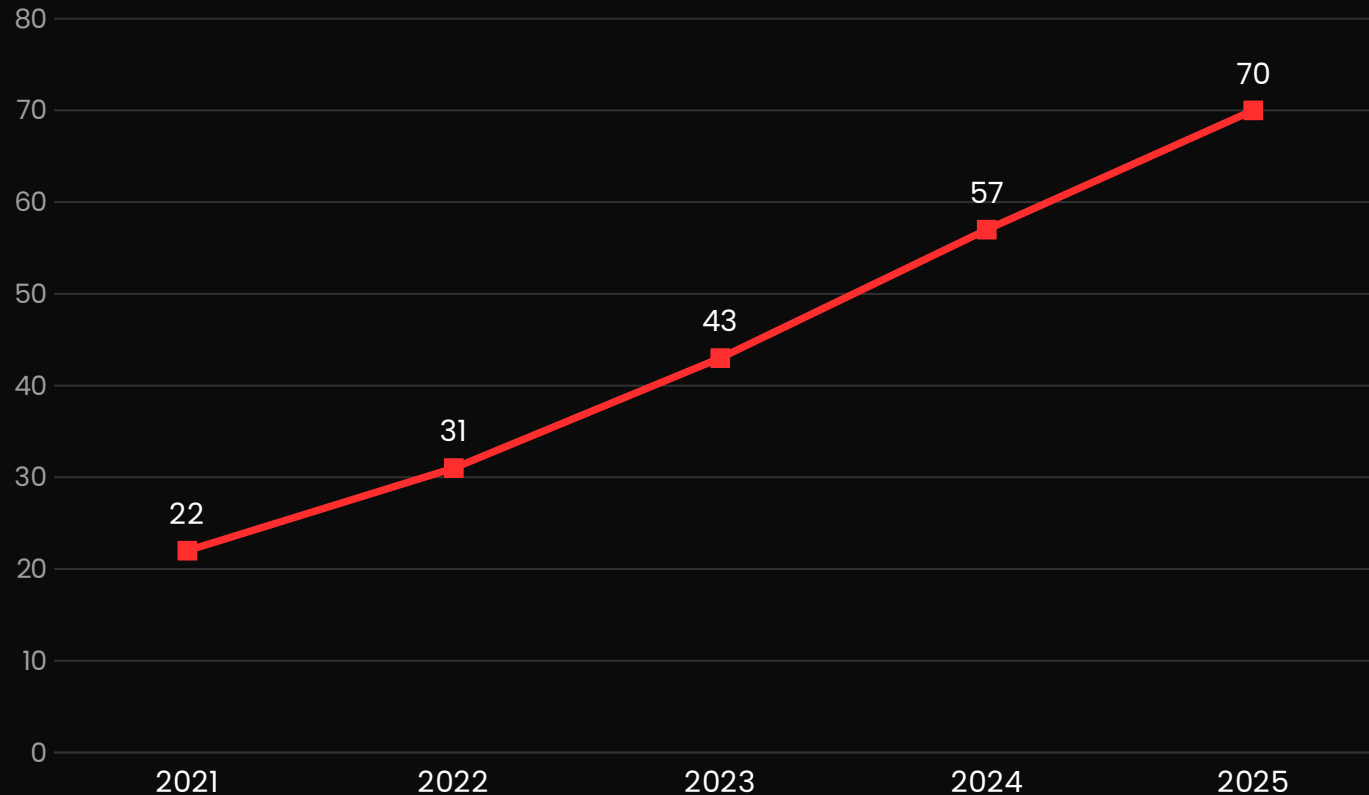


Image 3

Retail

In-store analytics without uploading video

Adoption trend



Sample data for illustration — replace with your own figures.

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

Advantages and limitations

Advantages

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

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.
- [3] Recent conference paper on applications, 2025.
- [4] Industry white paper (generic reference).



5G TECHNOLOGY

06

KEY IDEA

The next generation of mobile networks

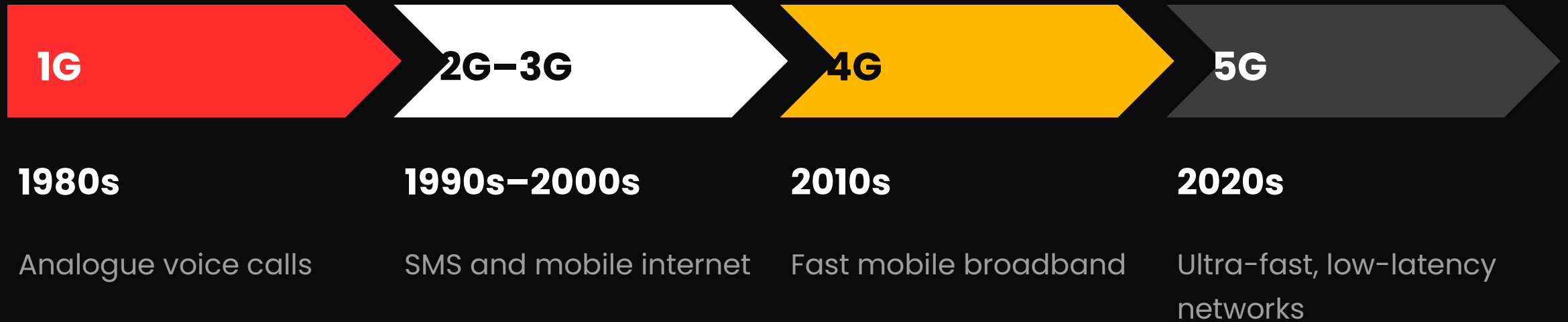
Talk 6 · 5G Technology

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



Evolution



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



Device

Phone or sensor
connects



Small cell

Dense radio nodes
nearby



Core

Cloud-native 5G core



Service

Apps with low latency

Architecture



Architecture diagram

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.

Applications



Image 1

Smart factories

Wireless robots and sensors.



Image 2

Telemedicine

Remote consultations and monitoring.

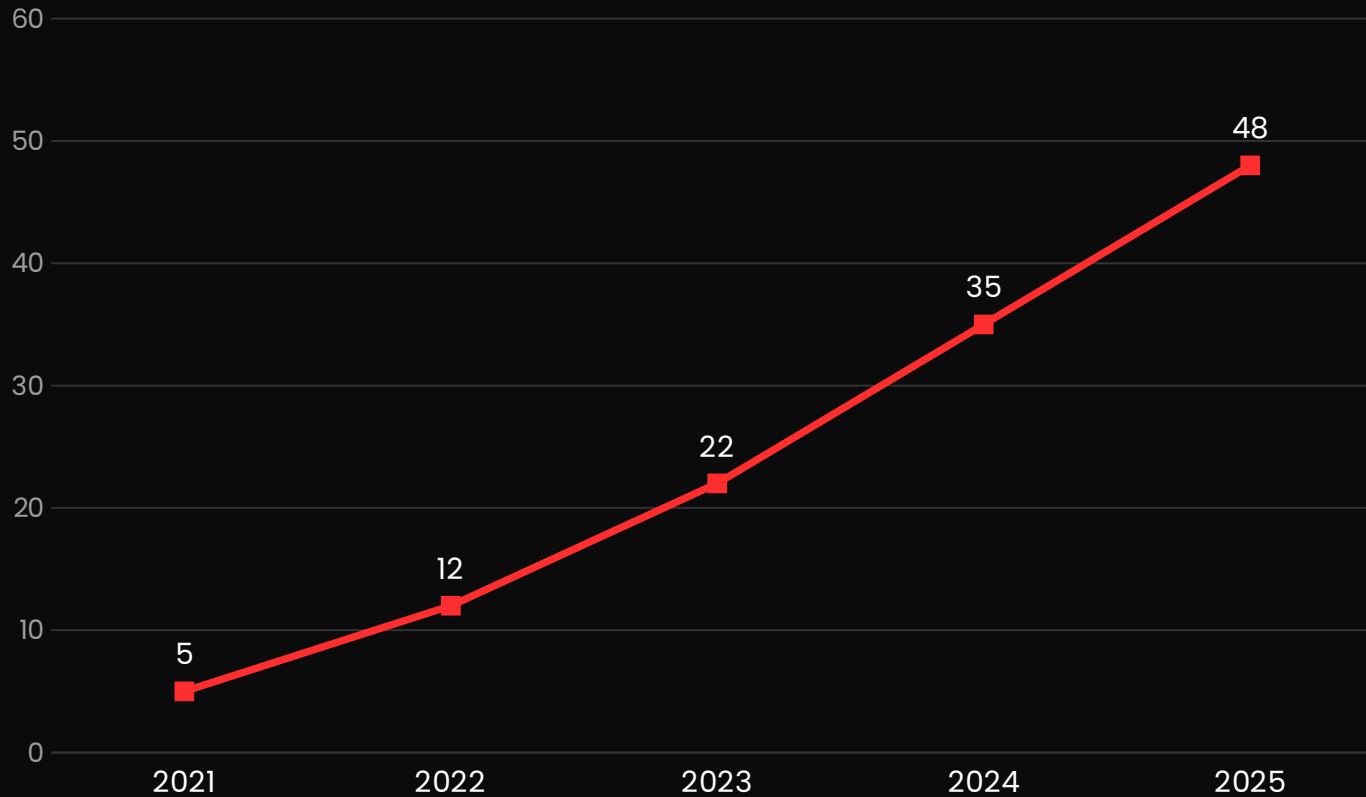


Image 3

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

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).

RENEWABLE ENERGY SYSTEMS

07

KEY IDEA

Solar, wind and the path to clean power

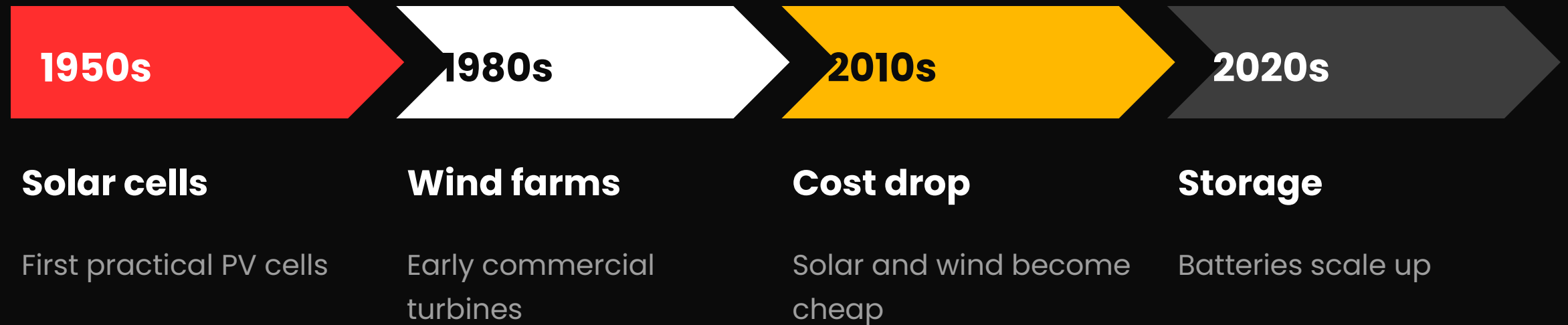
Talk 7 · Renewable Energy Systems

Introduction

- Renewable energy comes from sources that refill naturally
- Solar and wind are now among the cheapest power sources
- Storage and smart grids handle their variability
- Clean energy is central to climate goals



Evolution



Key concepts

01

Photovoltaics

Solar cells turn light directly into electricity.

02

Wind turbines

Blades turn a generator using wind energy.

03

Energy storage

Batteries and pumped hydro balance supply.

How it works



Generate

Solar panels and
turbines



Convert

Inverters to grid power



Store

Batteries for later use



Distribute

Smart grid delivers
power

Architecture

Generation, storage and a smart grid.

Variable renewable output is smoothed by forecasting, battery storage and flexible demand, while a digital grid balances supply and demand every second.



Architecture diagram

Applications



Image 1

Rooftop solar

Homes and offices cut bills.



Image 2

Solar parks

Large plants for utilities.

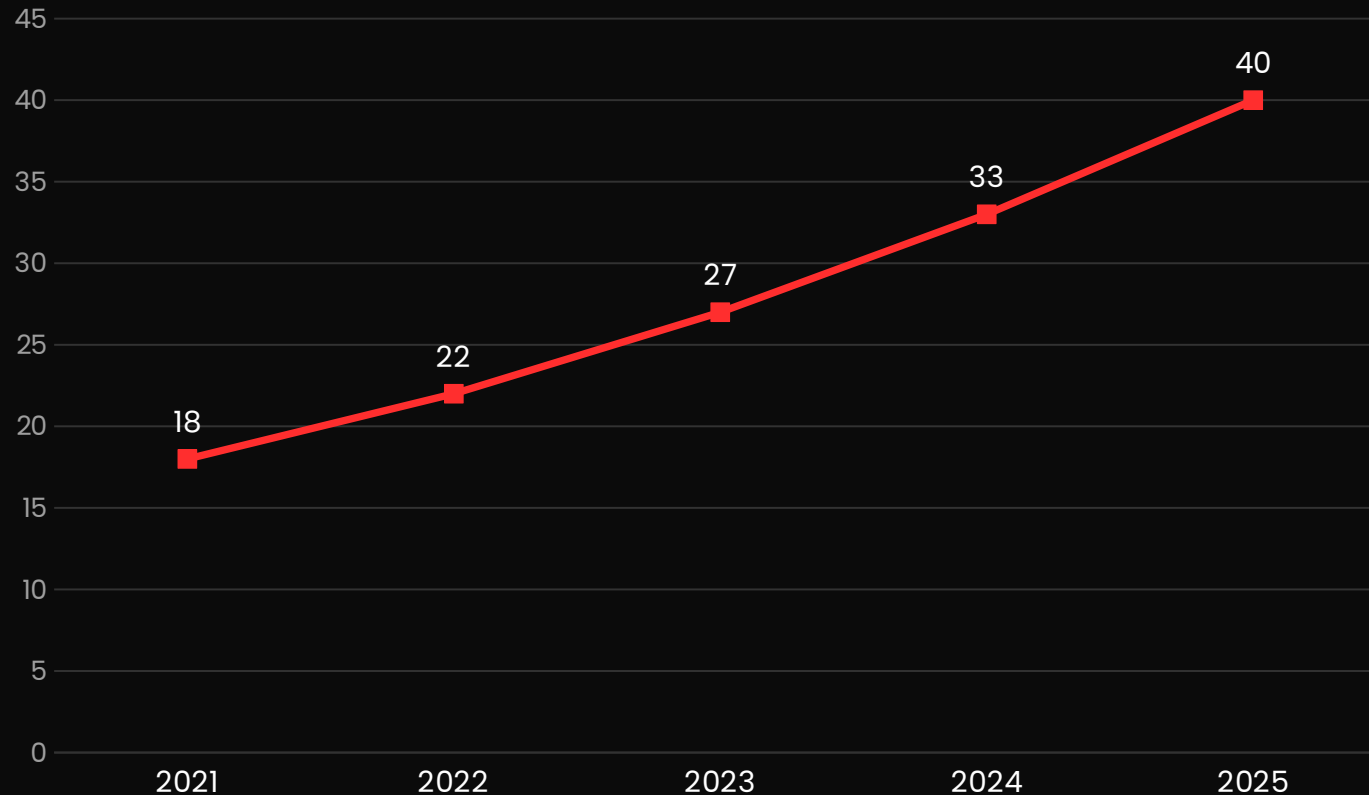


Image 3

Microgrids

Power for remote villages.

Adoption trend



Share of renewables in new capacity (sample data).

Sample data for illustration — replace with your own figures.

Advantages and limitations

Advantages

- ✓ No fuel cost
- ✓ Low emissions
- ✓ Energy independence
- ✓ Creates local jobs

Limitations

- Weather dependent
- Needs storage
- Land use
- Grid upgrades required

Open challenges

01

Variability

Sun and wind change.

02

Storage cost

Batteries still costly.

03

Grid

Transmission must expand.

Conclusion

- Renewables are now mainstream
- Storage and grids are the key enablers
- Policy and finance will set the pace

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).

Thank you

Questions and discussion.

Presenter Name

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