Digital Education Infrastructure in Practice

And what my life has become…

Exploring the transformative role of NRENs in shaping Europe's educational digital future through innovation, collaboration, and strategic infrastructure development.

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Developing Countries Will Outpace the West in Adopting AI & Technology in Education

Leapfrogging Barriers

Developing nations are bypassing traditional educational infrastructure by implementing AI-powered tools that solve teacher shortages and resource gaps more rapidly than Western systems.

Critical Need Drives Innovation

Sub-Saharan Africa needs 15 million more teachers by 2030. AI tutoring systems are already filling these gaps with personalized learning solutions.

Proven Adoption Velocity

Mobile phone adoption took just 16 years in emerging markets versus 75 years for landlines, signaling unprecedented speed for AI integration.

Government Leadership In Action

Countries like **India, Uganda, Sri Lanka and Moldova** are actively implementing comprehensive AI education strategies, accelerating teacher training and digital literacy programs at the national level.

Unlike many Western institutions that remain cautious about AI due to academic integrity concerns, developing countries embrace these technologies as **vital equalizers** to close educational gaps.

AI's ability to provide personalized, scalable, and low-cost education solutions uniquely positions developing countries to transform learning faster than the West.

What are NRENs?

National Research and Education Networks form the digital backbone of European academic collaboration. These specialized networks connect universities, research institutions, and schools across 38 European countries.

NRENs deliver high-speed connectivity, advanced services, and foster international cooperation in education and research through dedicated infrastructure.

Connectivity

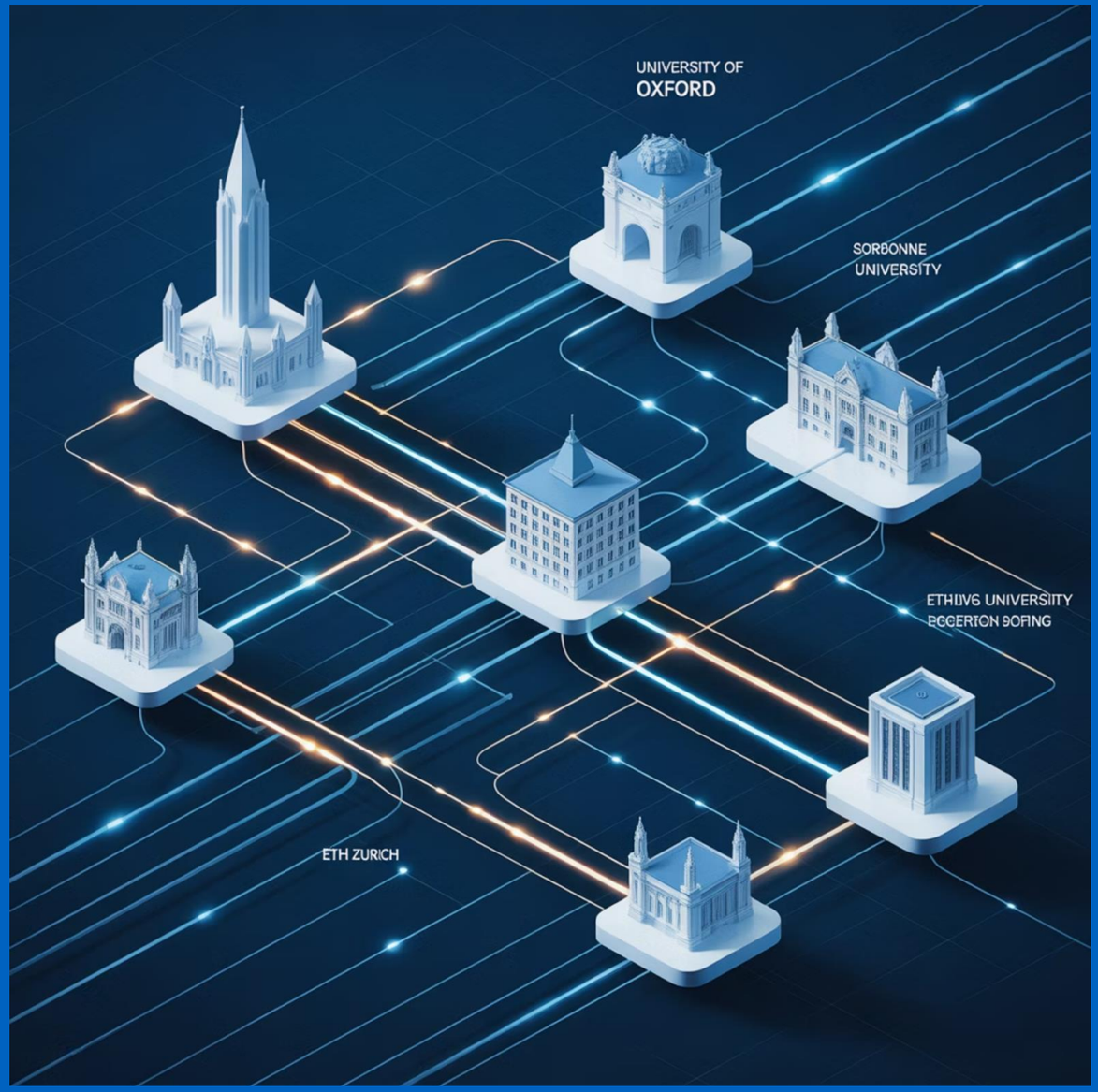
High-speed networks linking 50+ million users across educational institutions

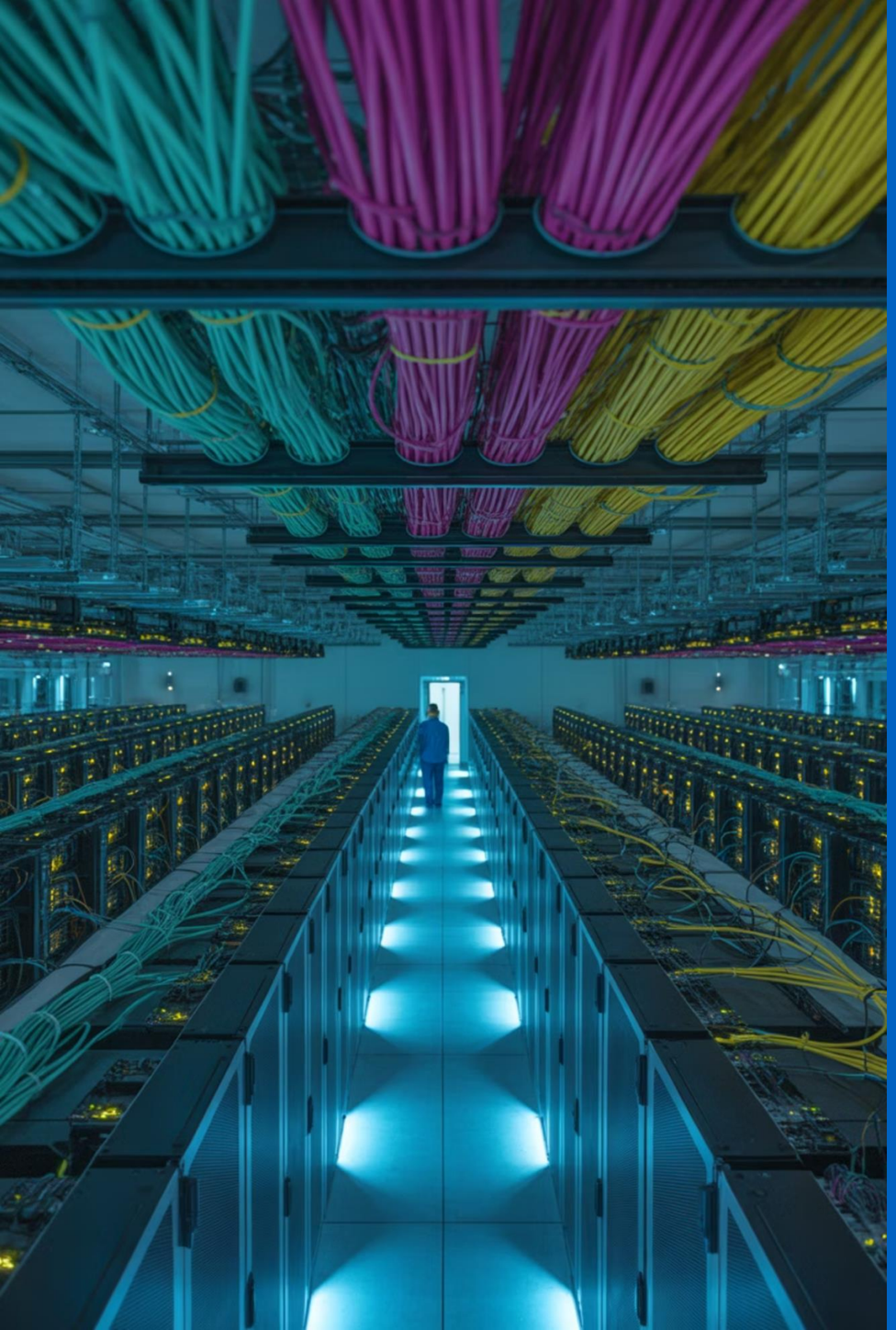
Services

Advanced digital tools including cloud computing, identity management, and collaboration platforms

Innovation

Testbeds for emerging technologies and digital transformation initiatives





Digital Infrastructure Landscape

98%

Network Coverage

European higher education institutions connected to high-speed networks

<100Gb

Backbone Speed

Average connection capacity across major NREN infrastructure

€2.1B

Annual Investment

Combined NREN spending on digital infrastructure and services

450K

Institutions

Schools, universities, and research centers currently served

Significant progress achieved in connecting educational institutions, yet disparities remain between regions in bandwidth availability and advanced service adoption.

Cross-Border Collaboration

Shared Resources

Federated digital libraries and research databases accessible across NREN-connected institutions, eliminating geographical barriers.

Virtual Mobility

Digital student exchange programs enabling course participation at partner universities without physical relocation.

Collaborative Research

Joint research projects leveraging distributed computing resources and shared datasets across European institutions.

Success Story: The European Open Science Cloud now connects over 300 research organizations, sharing 15 petabytes of scientific data through NREN infrastructure.

Implications for NREN/Higher Education Planning

Convergence on Key Priorities

All European countries are focusing on:

- **AI literacy development**
- **Assessment integrity**
- **GDPR-compliant tools**
- **AI ACT**

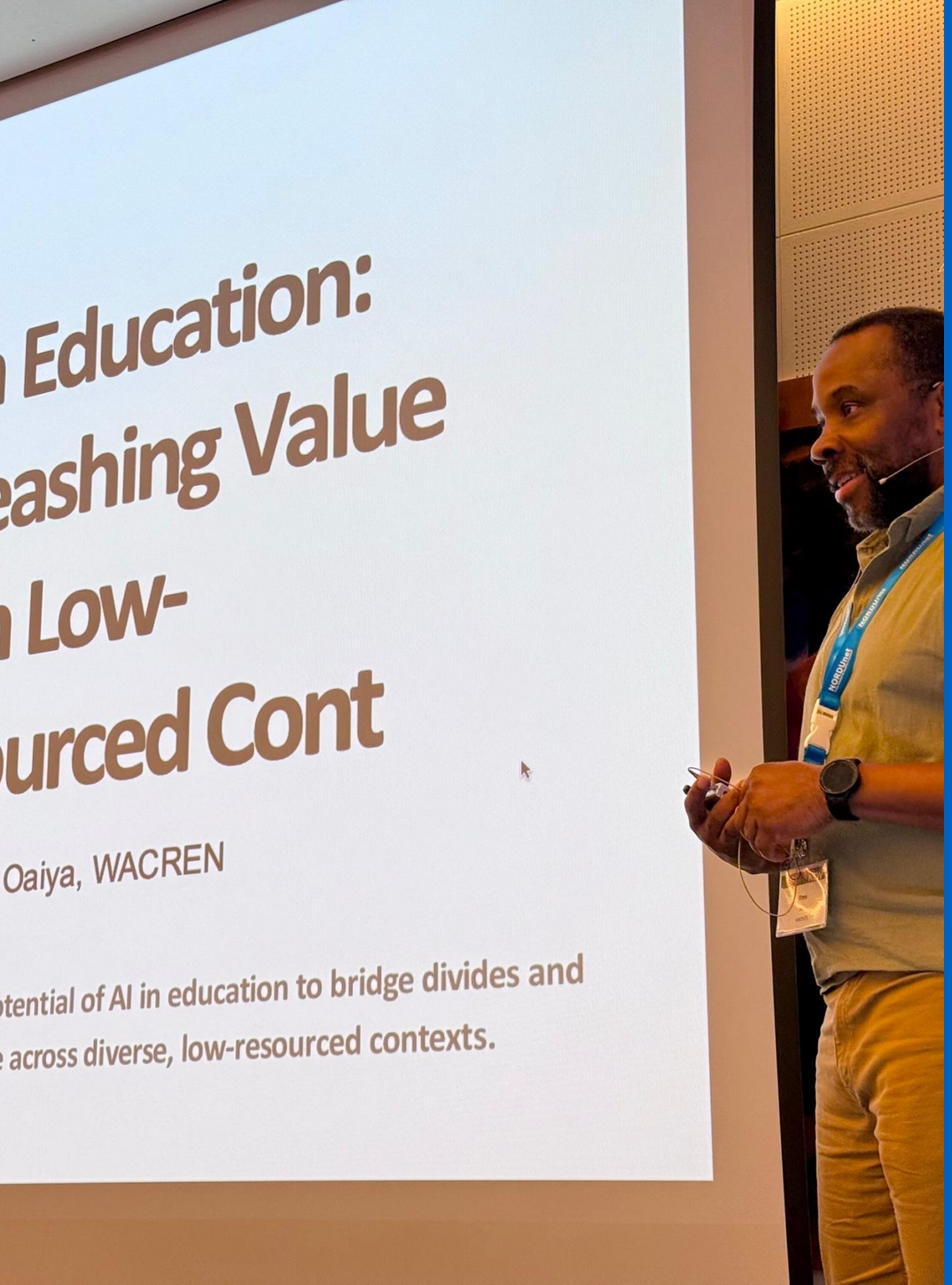
European guidance provide the most "implementation-ready" templates for schools.

Higher Education Direction

National-level nudges are evident:

- **Sweden:** Mandatory HE reports
- **Greece:** Grnet Socrates AI
- **Netherlands: SURF Npuls**

These provide good levers for cross-European alignment in higher education.



AI Initiatives: Collaborative AI Environments

Federated AI Platforms

Infrastructure enabling researchers to train AI models across distributed datasets without moving sensitive data across borders, preserving privacy while enhancing collaboration.

Secure Cross-Border Data Access

Technical and governance frameworks that maintain compliance with EU data protection regulations while facilitating legitimate research access to valuable datasets.

FAIR Principles Implementation

Systems ensuring data is Findable, Accessible, Interoperable, and Reusable, with practical metadata standards tailored for AI research requirements.

Example: Climate data modeling projects linking HPC centers with university researchers across multiple countries, processing petabytes of data while maintaining local sovereignty.

AI Initiatives: AI for Cybersecurity

AI-based Security Operations

Other NRENs has implemented sophisticated machine learning systems that enhance their security capabilities:

- Advanced pattern recognition algorithms that detect DDoS attacks and network intrusions with greater accuracy than traditional signature-based systems
- Automated incident triage systems that prioritize alerts based on threat intelligence and network context
- Predictive security measures that identify potential vulnerabilities before they can be exploited

Real-world impact: The ML-enhanced Security Operations Center now identifies and mitigates threats up to 73% faster than human-only operations, dramatically reducing potential exposure time.

AI Initiatives: AI in Scientific Workflows

Data Acquisition

Automated capture from scientific instruments with AI-optimized compression and routing

Compute Processing

Seamless integration with HPC resources and specialized GPU clusters for real-time analysis

Visualization & Analysis

AI-generated insights delivered to interactive dashboards for researcher interpretation

The scientific workflow automation demonstrates how AI can transform research efficiency by eliminating manual steps between data collection and analysis. Their genomics pipeline has reduced processing time from weeks to hours while increasing reproducibility across institutions.

AI Initiatives: Shared AI Labs

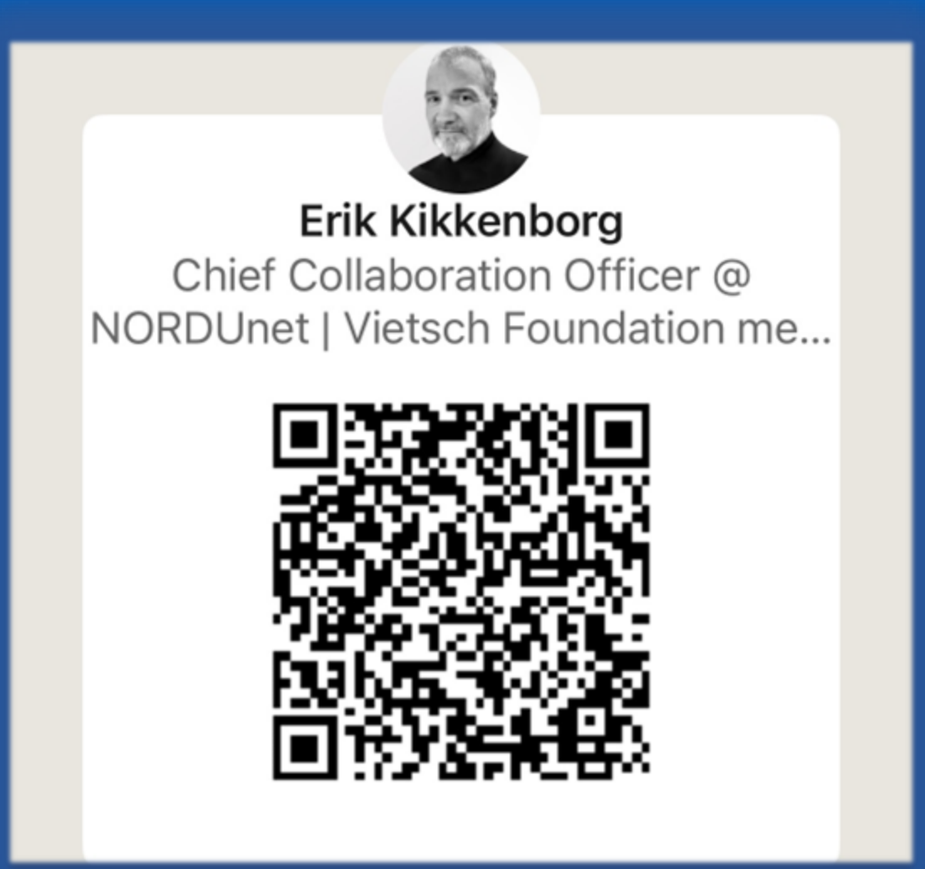
AI Resource Federation

NREN has pioneered a collaborative approach to AI infrastructure that maximizes resource utilization while minimizing institutional investment:

- Federated GPU clusters that allow researchers to access specialized computing when needed without maintaining dedicated hardware
- Secure data sharing frameworks that enable cross-institutional collaboration on sensitive datasets
- Standardized APIs and tools that reduce the technical barriers to AI adoption

This model has proven particularly valuable for smaller institutions that could not independently justify large-scale AI infrastructure investments.

Example: The National US AI Testbed connects 17 institutions, allowing researchers to experiment with large-scale models without duplicating expensive infrastructure at each location.



Thank You!

Erik Kikkenborg

Chief Collaboration Officer

Thank you for your time and engagement.
I look forward to continuing our
collaboration and building meaningful
connections together.

Let's Connect

Connect with me on LinkedIn for ongoing insights, industry updates, and collaboration opportunities: linkedin.com/in/kikkenborg