



# The Internet ecosystem & NRENs

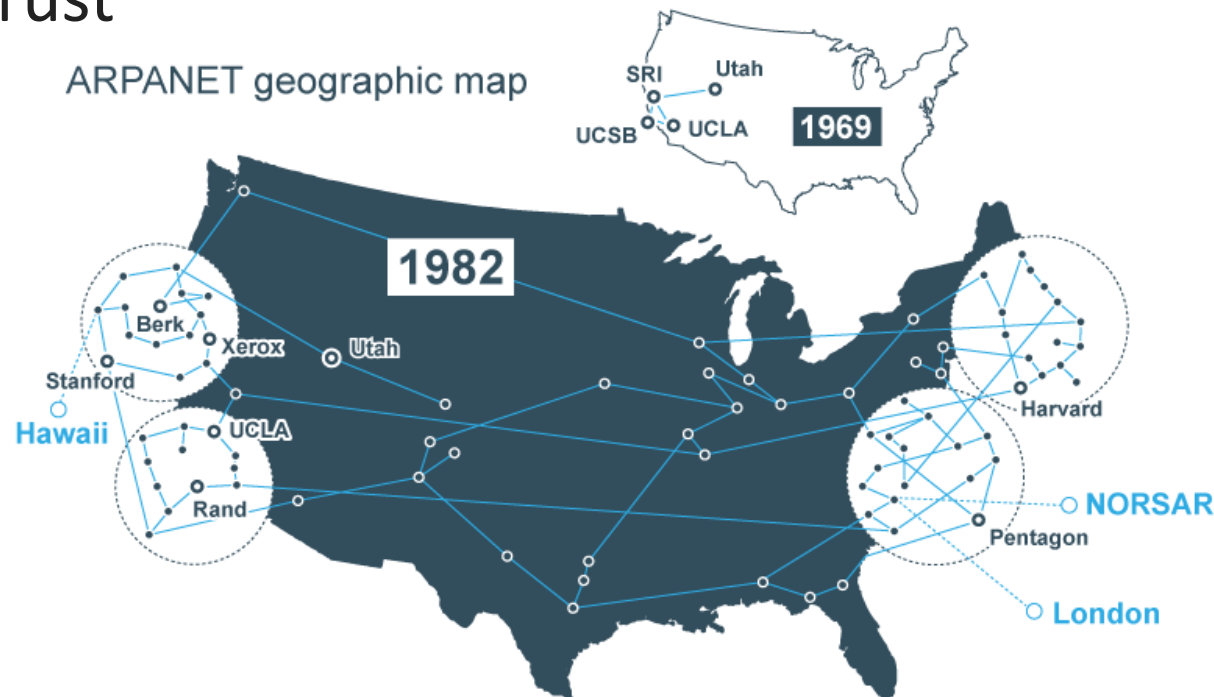
Brief Internet history / NREN services / Power of federation

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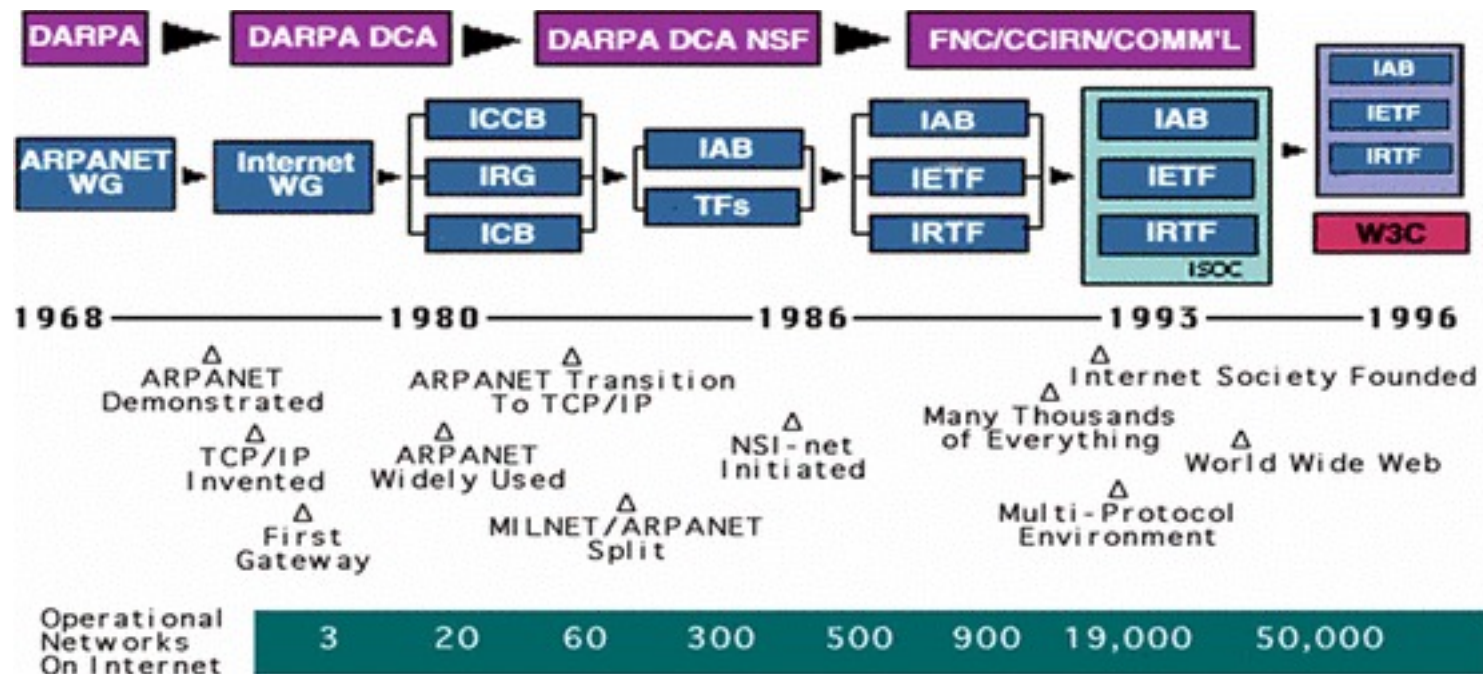
# Beginnings of the Internet

- ARPANET connecting universities and laboratories in late 60s
- Universities as natural testing grounds: technical expertise - culture that welcomed experimentation and innovation - shared sense of purpose and trust



# Evolution into commercial networks

- Commercial interests began to shape the general-purpose Internet in the 1980s and 1990s
- Institutionalization of standards and governance bodies



# Internet governance

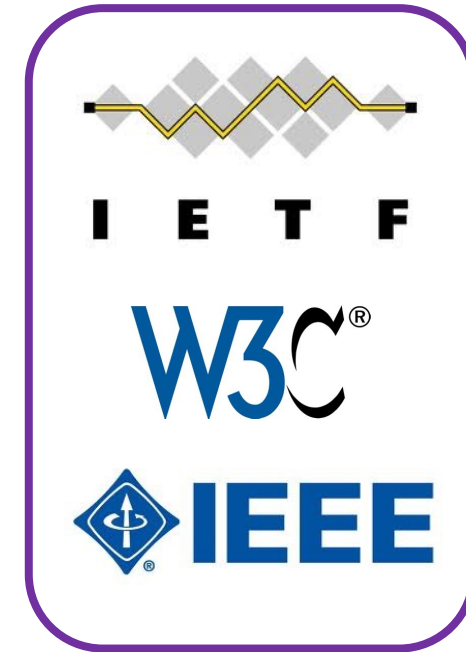
Bodies assuring uniqueness  
of internet numbers and  
domain names



Regional Internet Registries  
(RIRs)



Standards bodies



The community - NOGs - ISPs - government/regulators

# Re-emergence of NRENs

- Increasing data demands: Genomics, climate science, particle physics generate vast amounts of data requiring high-speed reliable networks
- Innovation and trust: NRENs bring back two important aspects that were lost in commercial networks. Provide platforms for innovating and experimenting with new networking technologies
- Not just ISPs, provide value added services
- Contribution to sustainable development

# NRENs contribution to UN SDGs



# NRENs contribution to UN SDGs



## **SDG 4: Quality Education**

NRENs provide high-speed internet connectivity and advanced network services to educational institutions, enabling them to deliver high-quality online education and research programs.



## **SDG 9: Industry, Innovation, and Infrastructure**

NRENs support research and innovation by providing advanced network services, computing resources, and collaboration tools to researchers, industries, and startups.



## **SDG 11: Sustainable Cities and Communities**

NRENs can support smart city initiatives through research and collaboration on sustainable urban development, leveraging technology to improve urban living conditions.

# NRENs contribution to UN SDGs



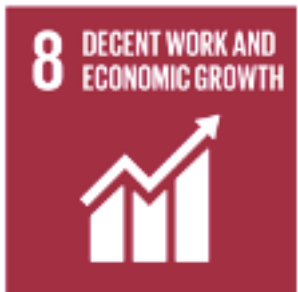
## **SDG 10: Reduced Inequalities**

NRENs help bridge the digital divide by providing access to high-speed internet and digital resources in underserved areas, promoting equitable access to education and research opportunities.



## **SDG 13: Climate Action**

NRENs support climate research and monitoring by providing high-speed data transfer, computing resources and necessary infrastructure to climate scientists and researchers.



## **SDG 8: Decent Work and Economic Growth**

By supporting research and innovation, NRENs contribute to economic growth and the creation of decent jobs in the knowledge economy.



# NRENs contribution to UN SDGs



## **SDG 17: Partnerships for the Goals**

NRENs often collaborate with various stakeholders, including governments, educational institutions, and international organizations, to promote research and education initiatives. These partnerships can enhance resource sharing and capacity building.

NREN services

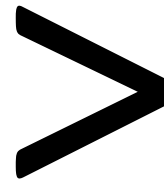
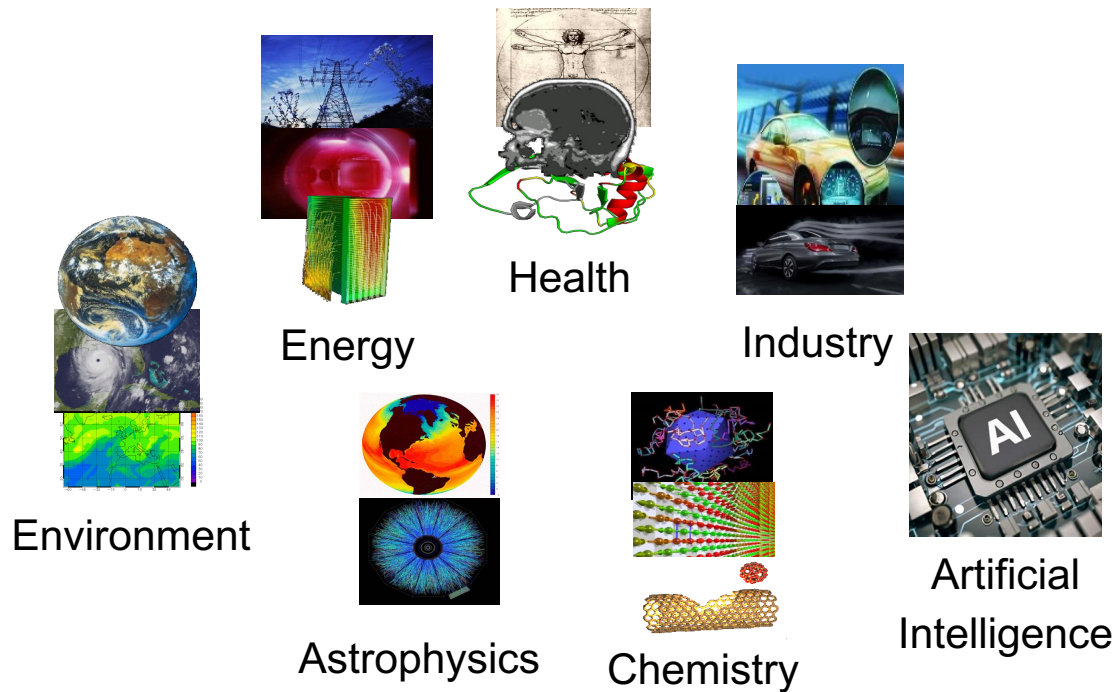
# The Network

- A network as a collaboration tool and an innovation enabler
- Supporting research through high speed data transfers
- Reaching isolated and underserved areas otherwise non covered by commercial networks



# High Performance Computing

- HPC infrastructure as an enabler for research
- High demand for GPU computing (parallel computing, AI training)



# Tools for access & mobility

- Provide mobility for students/researchers/staff to foster collaboration
- eduroam: international Wi-Fi roaming
- Identity federation: ease of access , single academic identity
- eduVPN: remote access or secure Internet access



# Online education

- Online education or Massive Open Online Course (MOOC) platforms
- Ensure continuity of courses in challenging times (COVID19 as an example)
- Democratize education

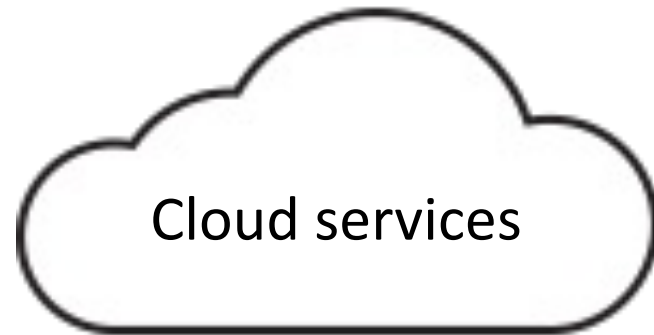


# Collaboration tools

- Video conferencing solutions
- National platform for ongoing research thesis
- Platform for event/conference organizing
- Tools for online surveys, mailing lists, wikis



# Hosting services



Data storage / File sharing







The power of federation

# Bringing the community together

- One of the main roles of NRENs is to bring together the research and education community
- More collaboration, joint research projects, events, and initiatives
- Resource sharing: computing, instrumentation, laboratories

# Bargaining power

- Greater bargaining (negotiation) power
- The bigger the coalition, the better the deals/contracts/prices
- Examples in next slides:

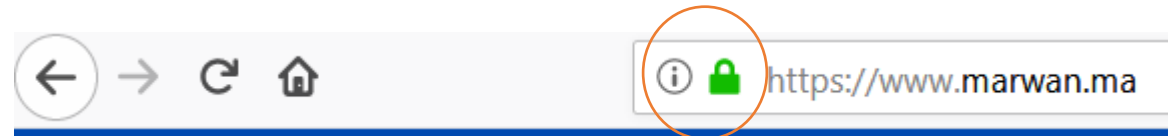
# MARWAN VPLS connectivity

<b>Bandwidth (Mbps)</b>	<b>MARWAN pricing per month (MAD excl. tax)</b>	<b>Approximate operator pricing per month (MAD excl. tax) (*)</b>
200	7 300	10 000 - 20 000
1000	19 200	30 000 - 50 000
2000	23 500	50 000 - 70 000
4000	36 400	80 000 - 100 000
5000	45 000	100 000 - 130 000
10000	75 000	150 000 - 200 000

(\*) Conservative approximate prices in Morocco, sometimes higher in real life

# MARWAN Trusted Certificate Service

<https://www.marwan.ma>



Standard SSL	\$198
Multi-Domain SSL	\$358
WildCard	\$658
Document Signing - Organization (5000)	\$895

- Current contract with HARICA (through GEANT): \$14 000 per year
- Available for all 20 universities

# Further things to negotiate as a federation

- Commercial Video conferencing solutions
- Commercial Cloud procurement
- Equipement procurement

Questions ?