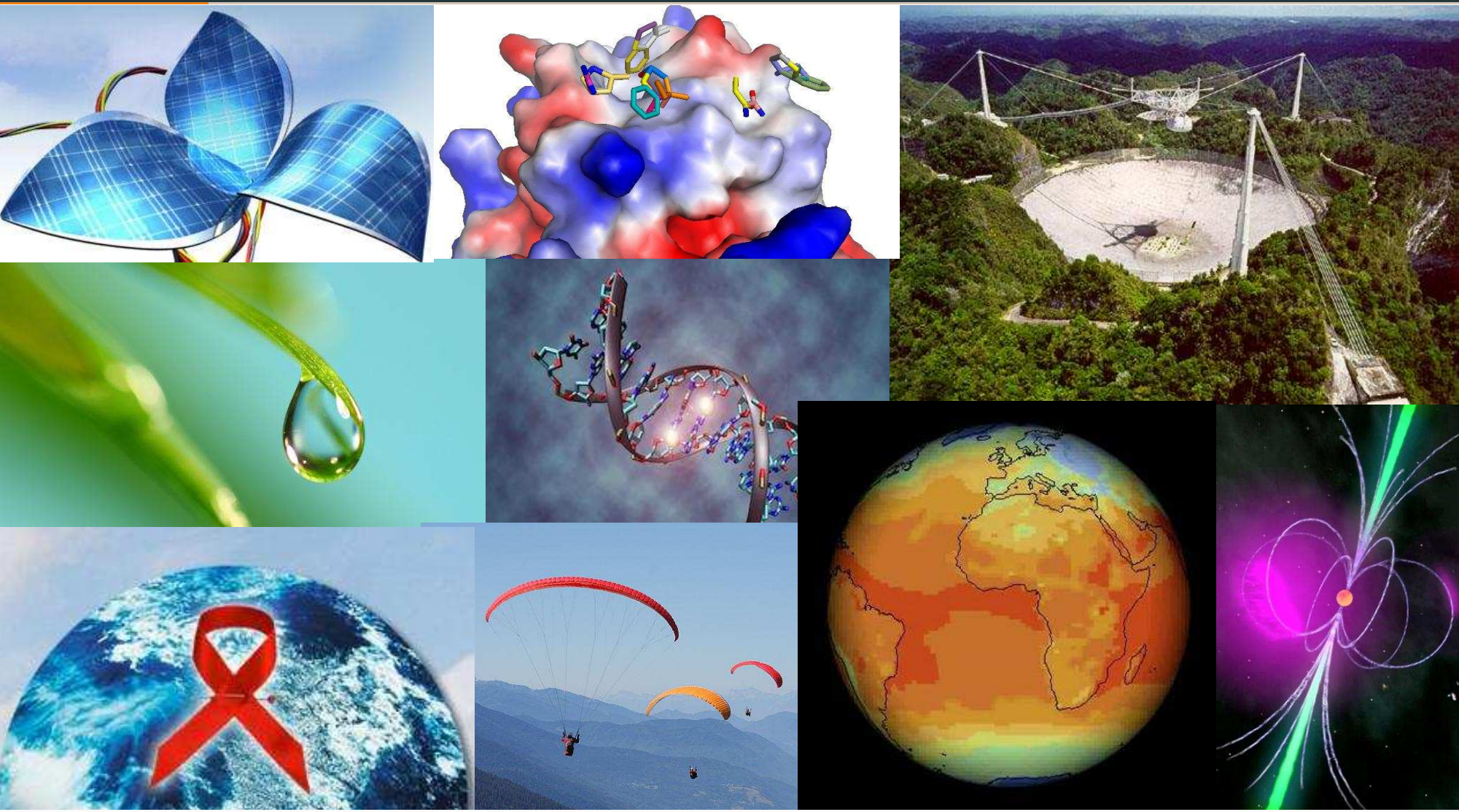
Digital intrastructure challenges

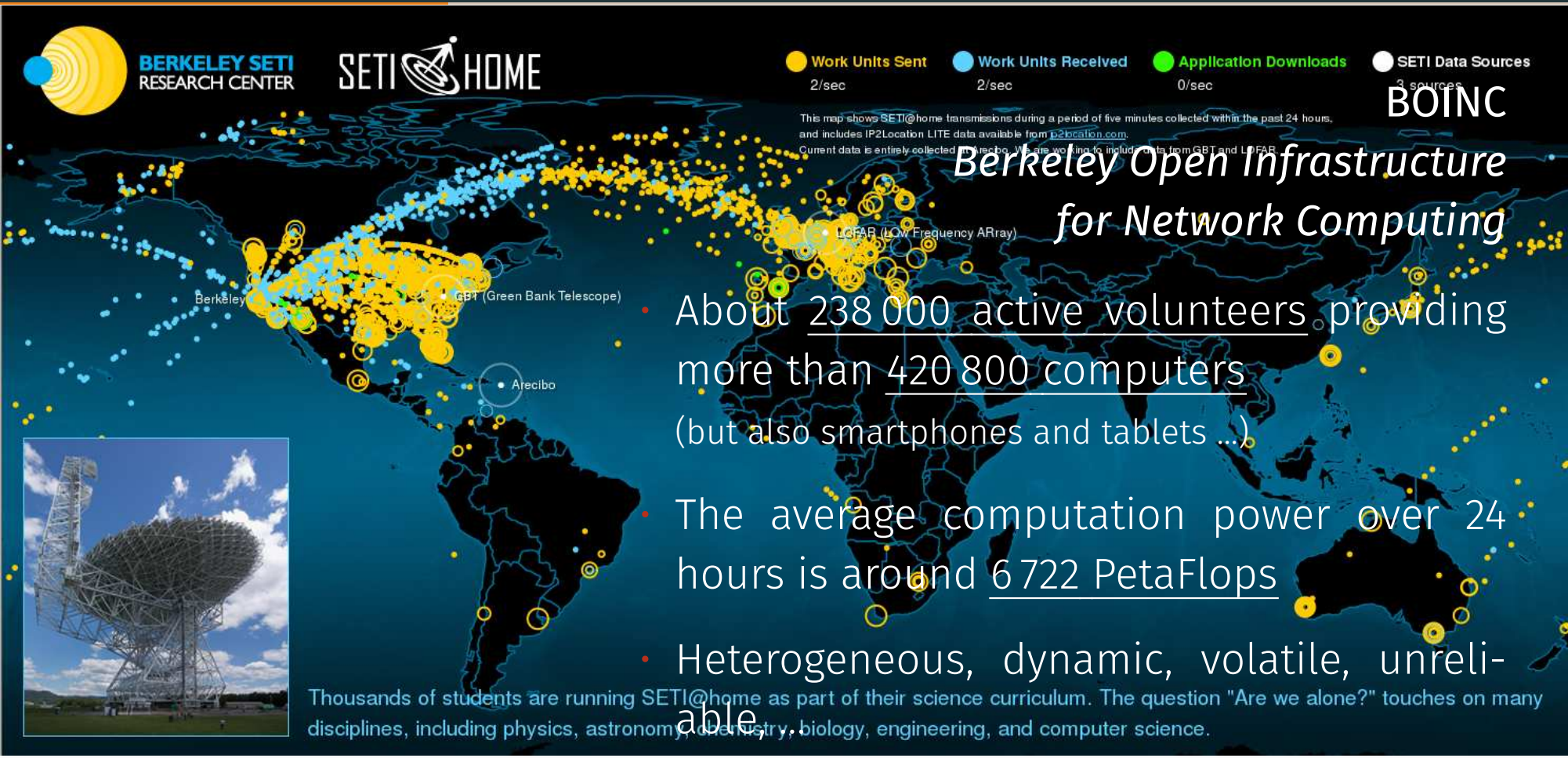
Arnaud Legrand

What do ... have in common ?



Clean water, solar cells, new drugs against Ebola/AIDS/Cancer, climate evolution, weather forecast for paragliding, searching for Extra-Terrestrial Intelligence, pulsars, ...

Volunteer Computing



BOINC

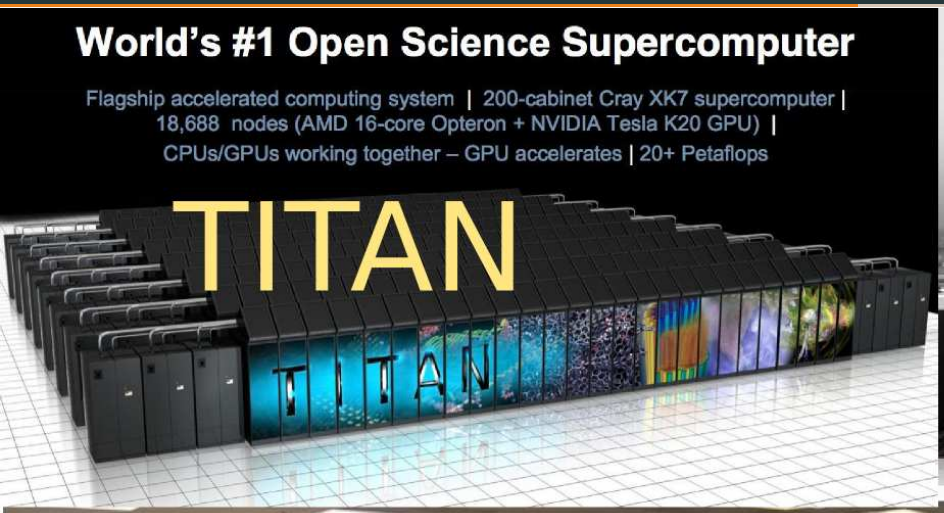
Berkeley Open Infrastructure for Network Computing

- About 238 000 active volunteers providing more than 420 800 computers
  (but also smartphones and tablets ...)
- The average computation power over 24 hours is around 6 722 PetaFlops
- Heterogeneous, dynamic, volatile, unreliable, ...

Today the computer is just as important a tool for chemists as the test tube. Simulations are so realistic that they predict the outcome of traditional experiments

– Nobel committee (chemistry), 2013

Supercomputers

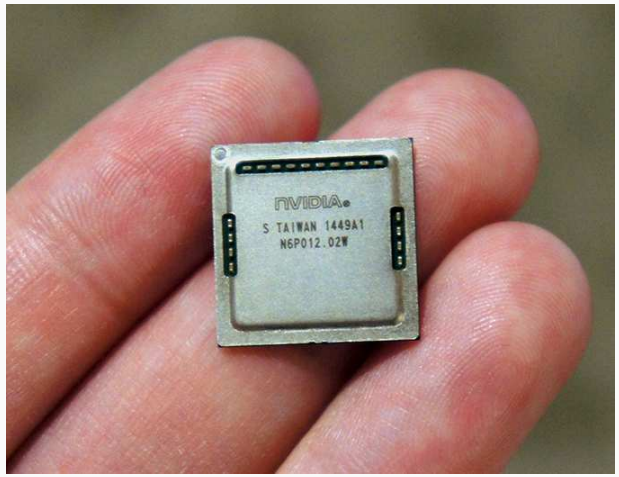


- 100,000 to 10,000,000 of cores, accelerators (GPU, KNL), a high throughput/low latency interconnection network
- A race between countries (Top500)

Cloud computing

A Breathtaking Evolution

Hybrid and very large scale parallel architectures to answer computation needs in restricted power envelopes.

1996	2009	2015
		
ASCI Red	ATI Radeon	Nvidia Tegra X1
1 Teraflop	2.4 Teraflop	1 Teraflop
9298 Pentium II	1600 Stream Processors	8-core ARM CPU
1 000 Flops/W	1 600 000 Flops/W	667 000 000 Flops/W

My smartphone is as powerful as a 20 years old supercomputer

Wait! **Millions of threads** exchanging data!?!

Embedded Systems, Sensor Networks, Internet of Things...

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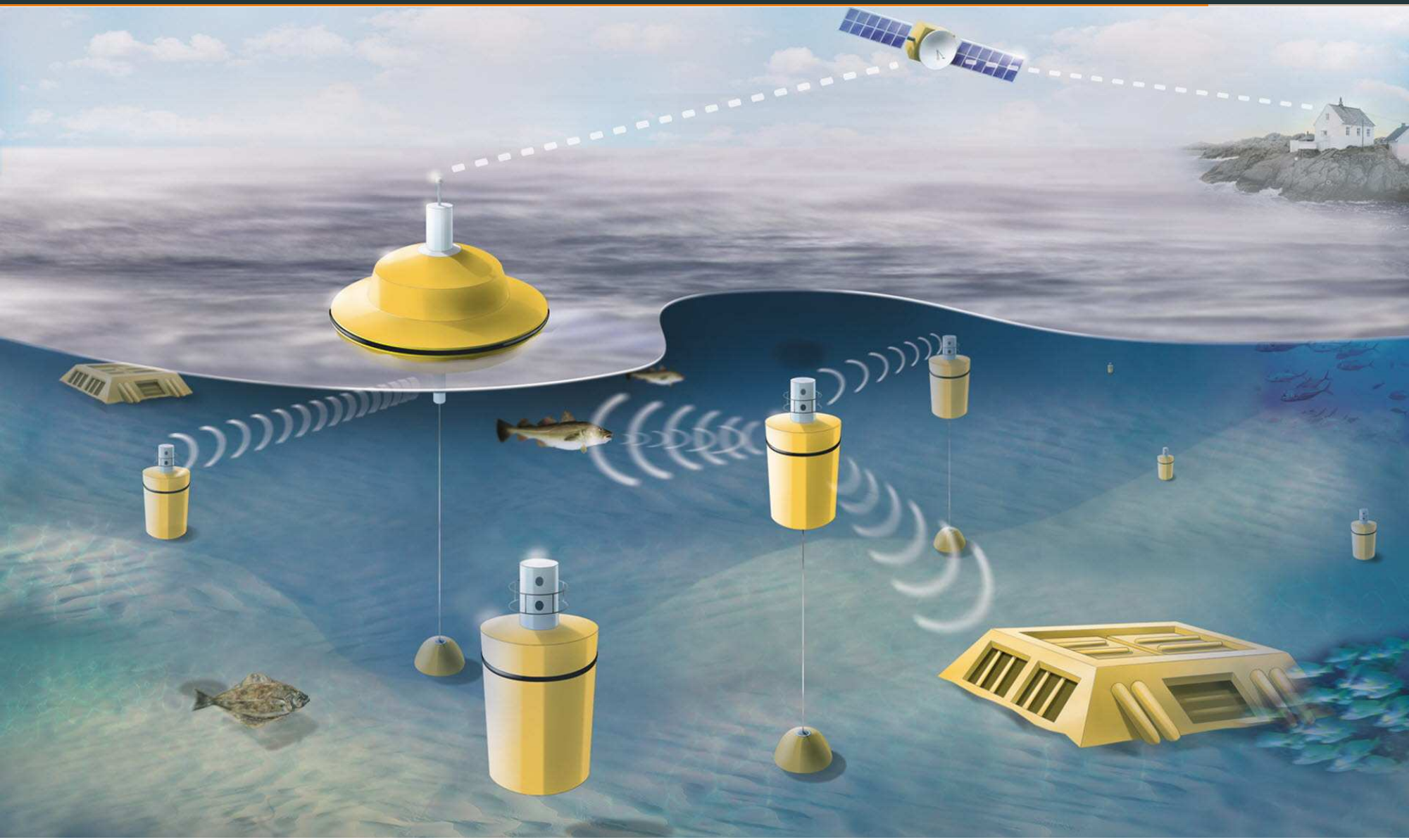

Digital infrastructures

Our society (citizens, companies, science, ...) relies (often obliviously) on gigantic digital infrastructures

How to design/use/optimize/understand such infrastructures?

- Scalability
- Fair sharing
- Fault tolerance
- Capacity planning
- Energy consumption
- Modeling/performance evaluation

Similar issues with any large distributed infrastructure

- HPC/cloud/...
- Wireless networks
- Smart grids
- Transportation systems