Can ISPs become CSPs?

A vision of Computing Service Providers

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The performance gap between networking and computing grows

Global data center IP traffic

Source: Cisco global cloud index, 2016-2021

Zilberman et al., “From photons to big data applications: Terminating terabits”, RSTA 2016
CPU vs switch architecture

**CPU**

Moving **instructions**
Bus width 64bit

**Switch**

Moving **data**
Bus width ≥ 256Byte

Create a "Tiny Terabit Data Centre"

- "Pull" all data centre components into a single computer
- A network-fabric device at the core
- Other components are "peripherals"
- Optimise for high data rates

A conceptual drawing of a CAN-enabled Server

Zilberman et al., "From photons to big data applications: Terminating terabits", RSTA 2016
In-network computing

In the context of this talk:

In-network computing:
The execution of native host applications within the network using standard network devices: network interface cards (NIC), switches
In-network computing: potential benefits

• Every op done in the network frees CPU cycles
• Superior application throughput
• Significant latency reduction.
• A single network switch can “replace” multiple server-racks
  • saving ~1GWh/year.
• The cost is almost zero:
  • The devices are already within the network!

Tokusahi et al., “The case for in-network computing on demand”, Eurosys 2019
Computing as an Infrastructure
Infrastructure

Infrastructure is deployed:
• At varying scales
• For varying needs

Computing becomes akin to Infrastructure
Computing infrastructure today

Data Centre
Computing infrastructure - emerging
Communication infrastructure
Scaling computing infrastructure
Unified communication and computing infrastructure

Aggregate compute

Edge compute

Local compute

Switch-based computers (CAN)
Unified communication and computing infrastructure

• Terminate data at the edge  
  • Before it gets to the data centre

• Reduce the complexity of every stage

• Increase scalability and longevity

• Reduce power consumption

• Improve privacy and data control
Scaling Computing Infrastructure – Cloud Providers

- Cloud providers have incentives to move computing closer to users:
  - Reduce the load on data centre infrastructure
  - Many applications require quick reactions:
    - Online gaming
    - Face recognition
    - Hand-writing recognition
    - Better smart-assistant experience
Rethinking application deployment model

Current Model

- Compute
- Applications
- User

Proposed Model

- Applications
- Compute
- User

Zilberman, “Revolutionising Computing Infrastructure For Citizen Empowerment”, Data for policy 2017
Give us the right to choose our provider!
Give us the right to choose our apps pack!
Taking back control of data

• **You** choose your compute service provider
  • Like choosing a television service provider
• Privacy and data control as a service
• Competitive market
• Improved resilience
Thinking Ahead

• Can new types of computing entities emerge?
  • E.g. neighbourhood clouds
  • Can be led by community or non-profit organisations
Questions?

All papers are available at: www.cl.cam.ac.uk/~nz247