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# Can ISPs become CSPs?

## A vision of Computing Service Providers

**Dr Noa Zilberman**

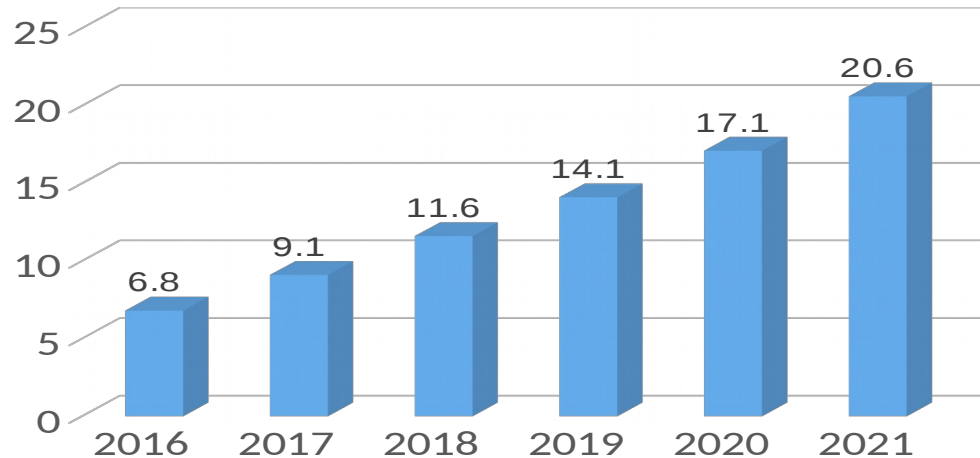
University of Cambridge

March 2019

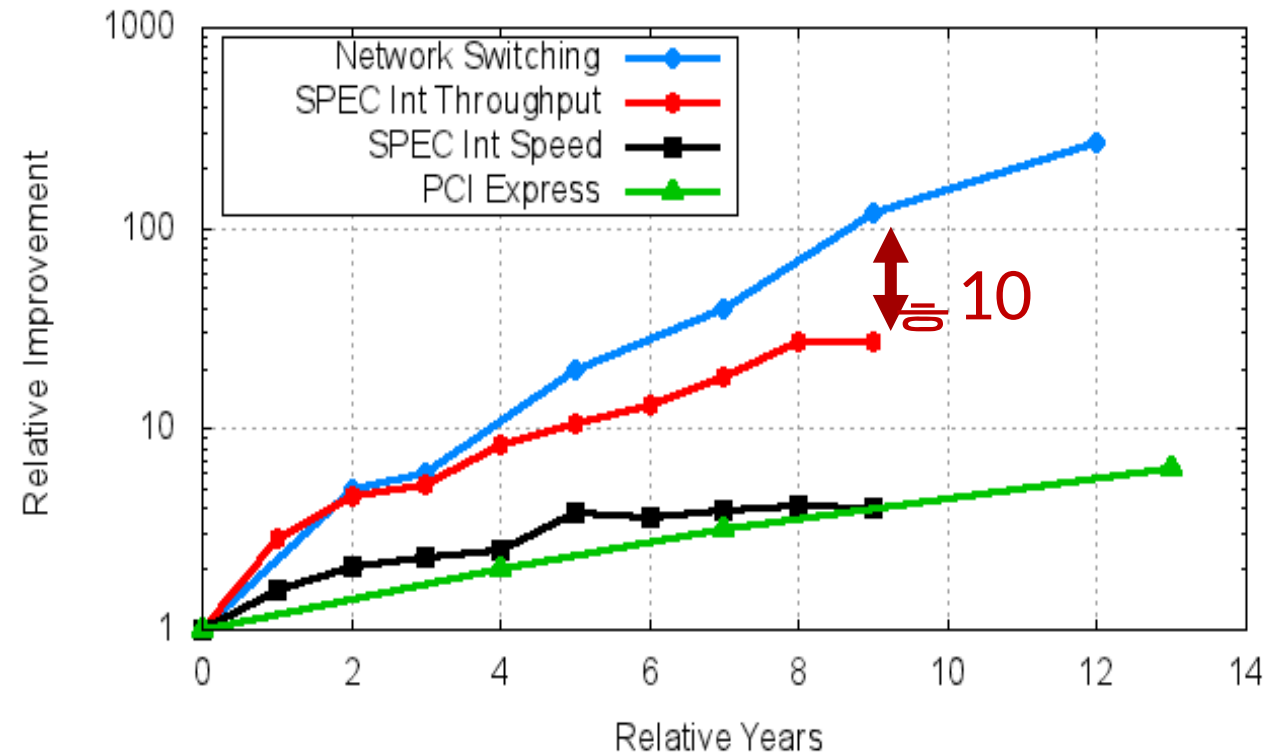
# The performance gap between networking and computing grows

Zetabytes per year

### Global data center IP traffic



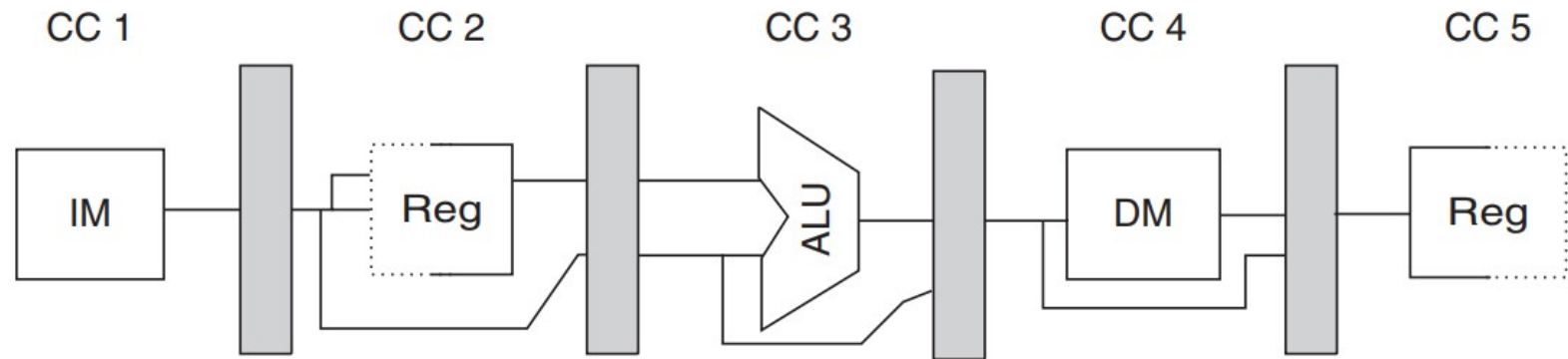
Source: Cisco global cloud index, 2016-2021



# CPU vs switch architecture

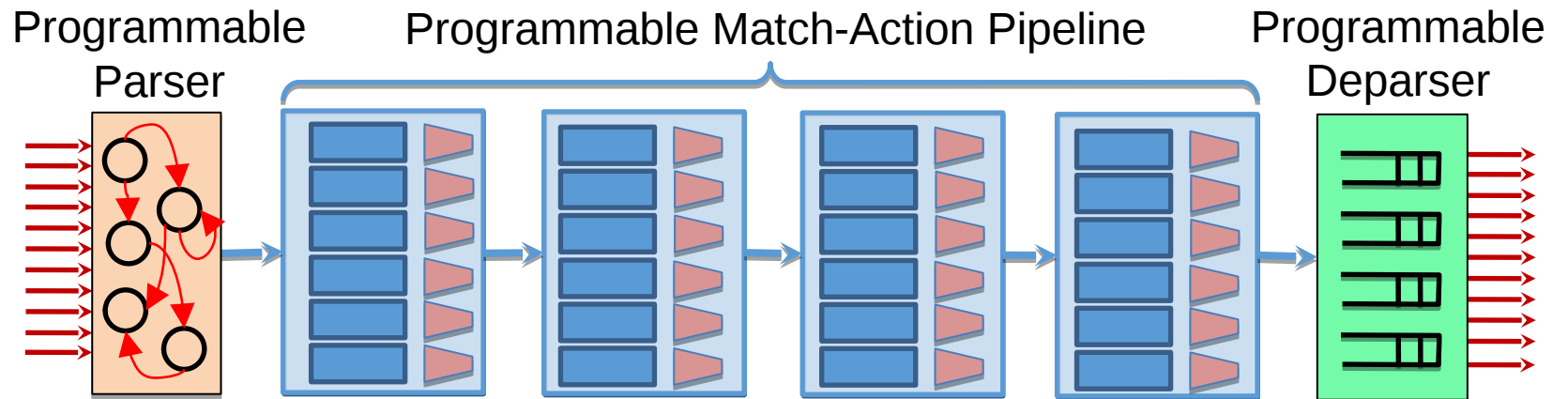
## CPU

Moving **instructions**  
Bus width 64bit



## Switch

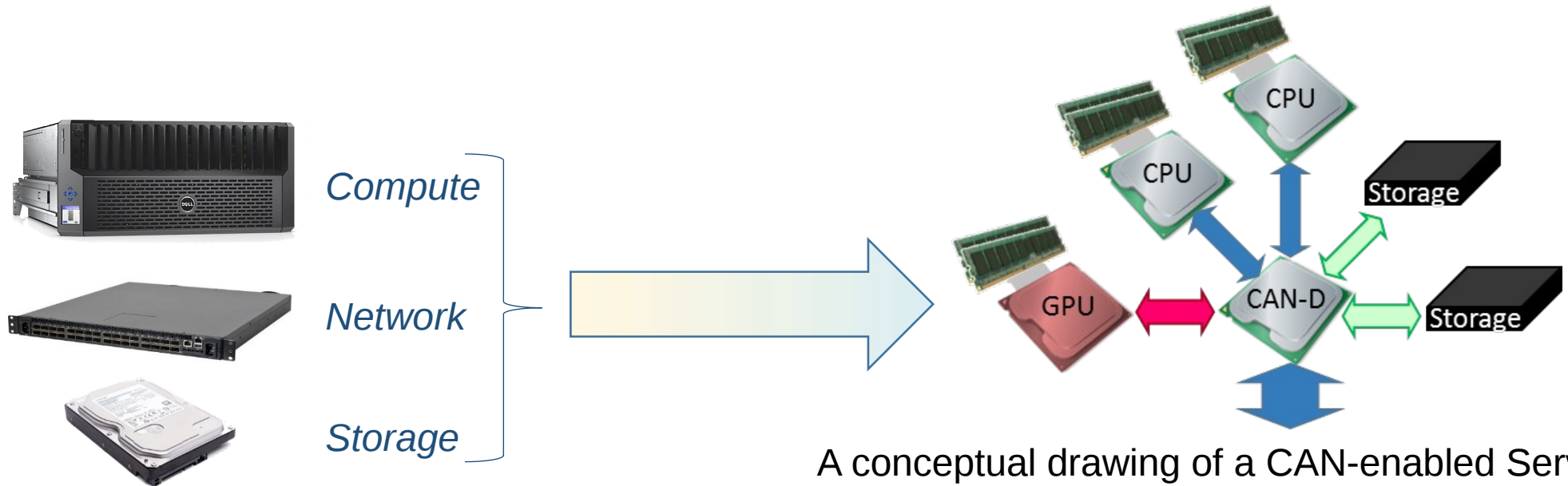
Moving **data**  
Bus width  $\approx$  256Byte



# CAN: Computing As Network

## 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

# 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!

We are not there yet

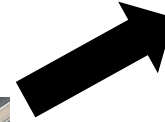
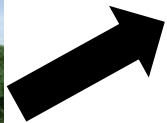


# Computing as an Infrastructure

# Infrastructure

Infrastructure is deployed:

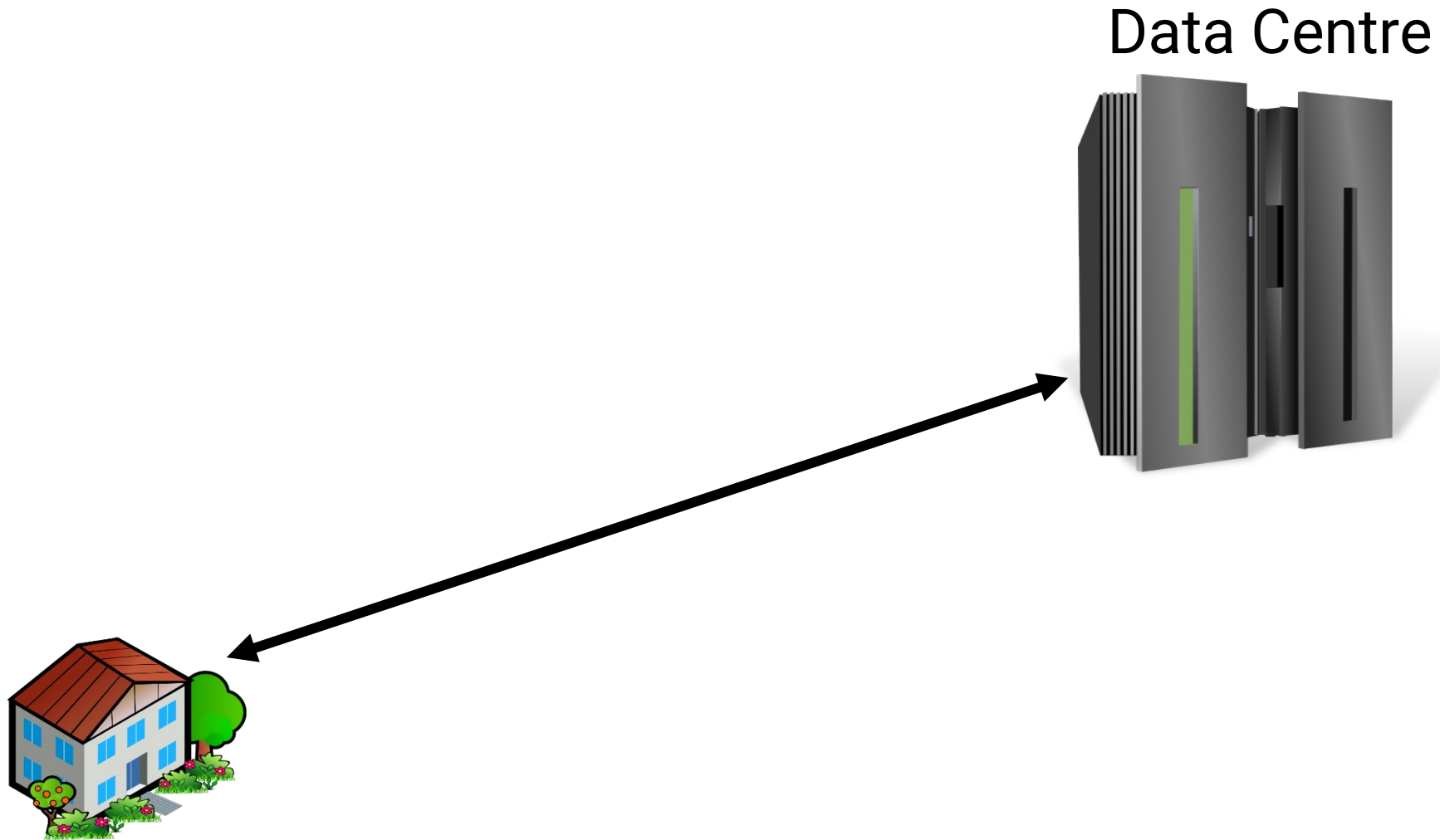
- At varying scales
- For varying needs



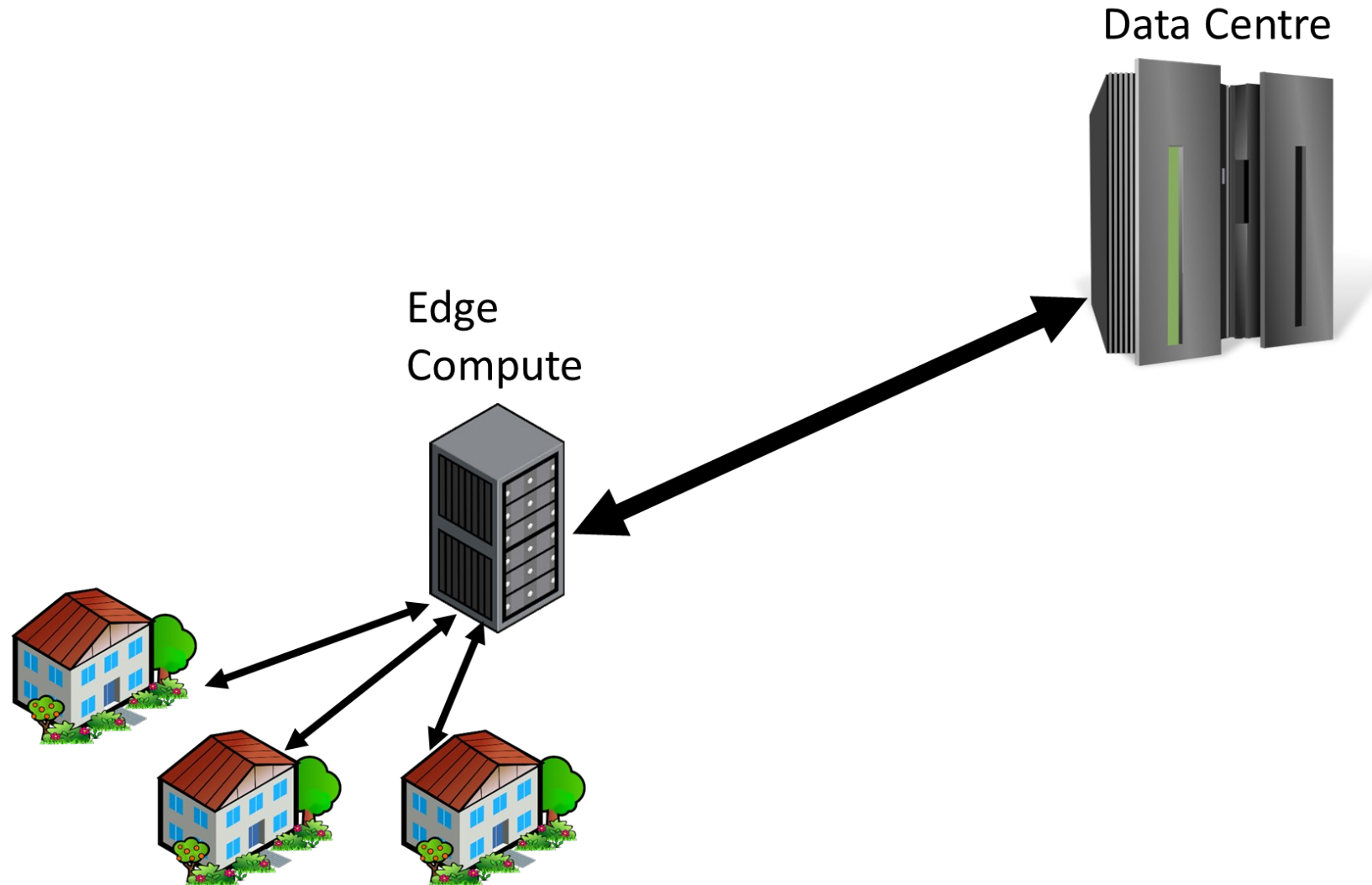
***Computing becomes akin to Infrastructure***



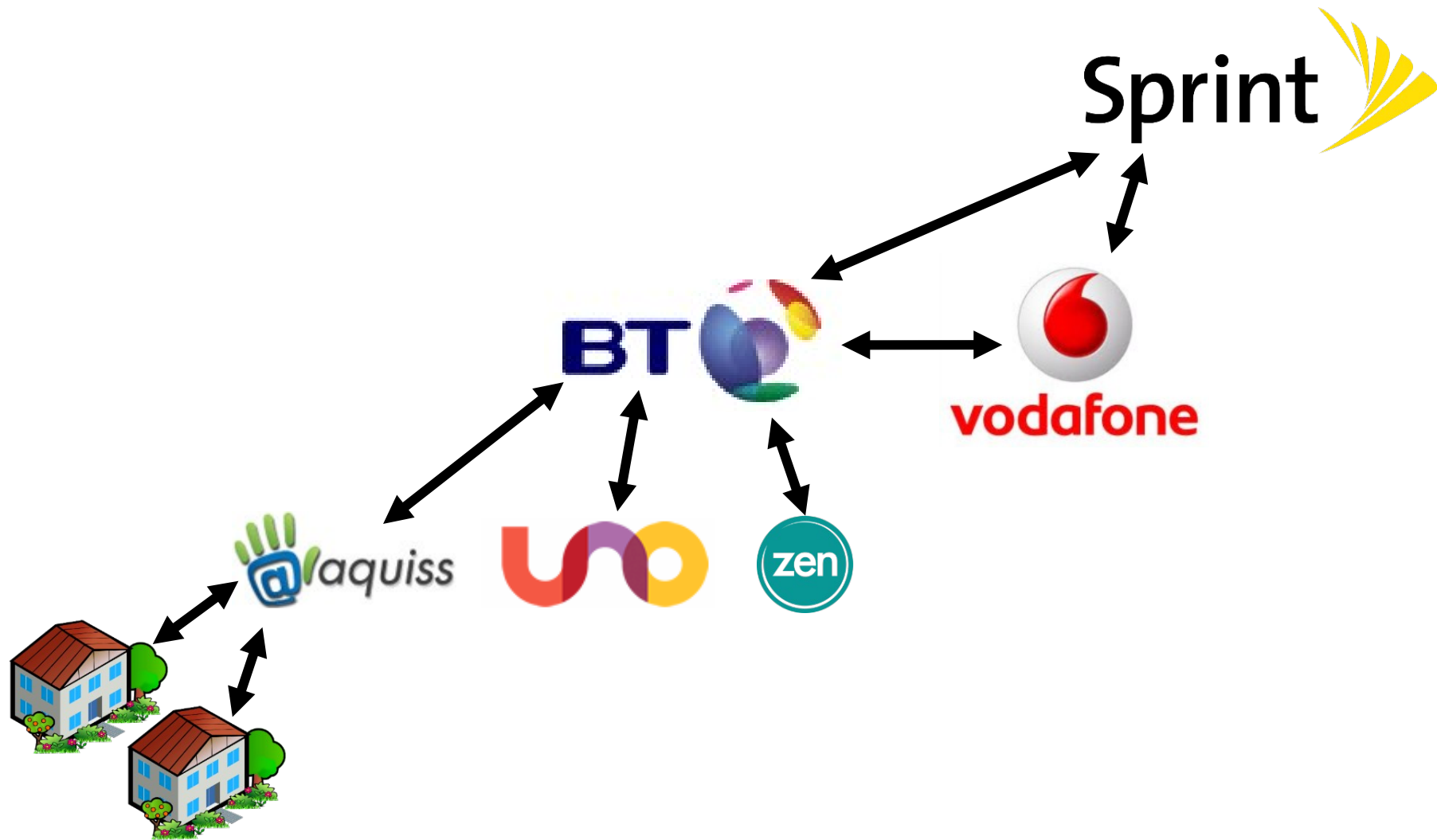
# Computing infrastructure today



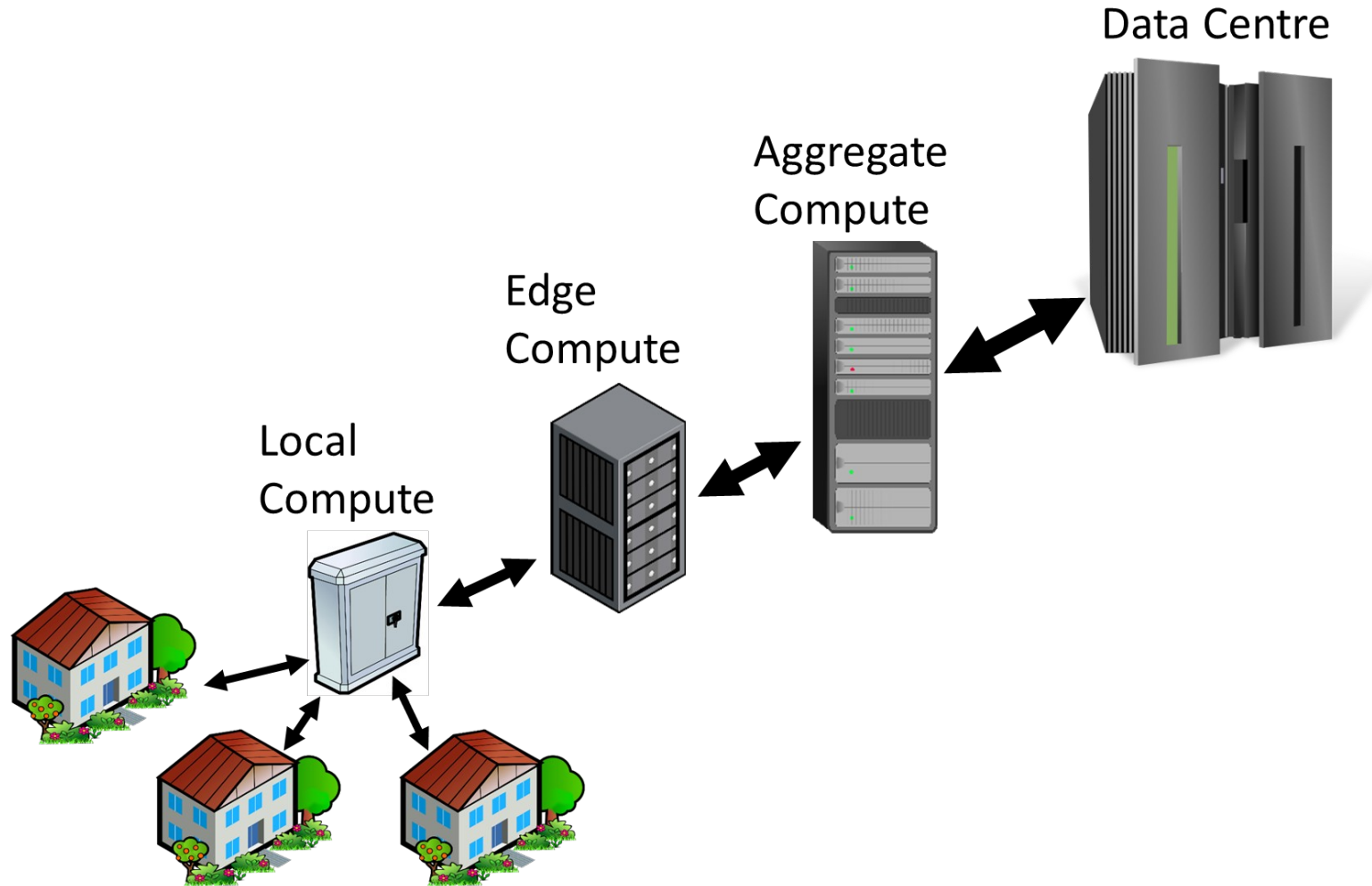
# Computing infrastructure - emerging



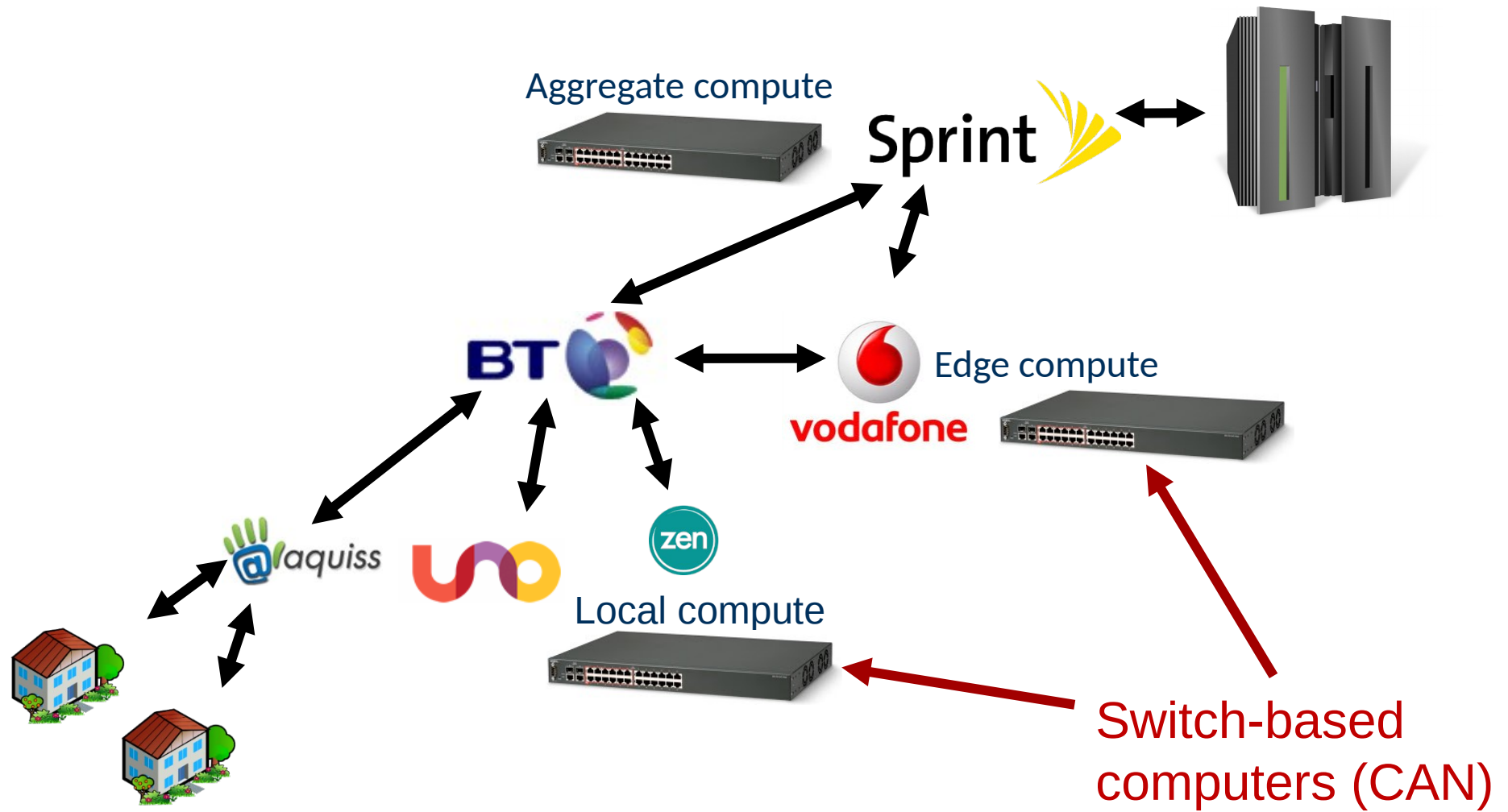
# Communication infrastructure



# Scaling computing infrastructure

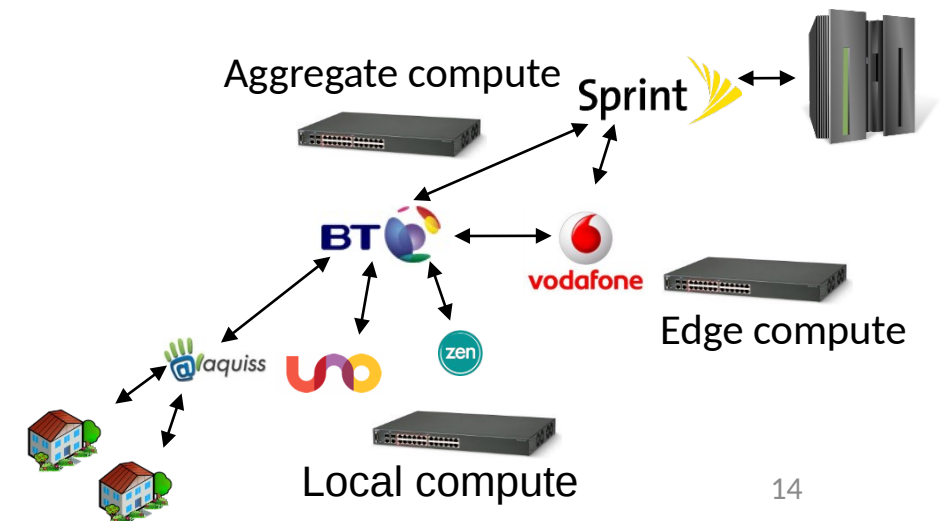


# Unified communication and computing infrastructure



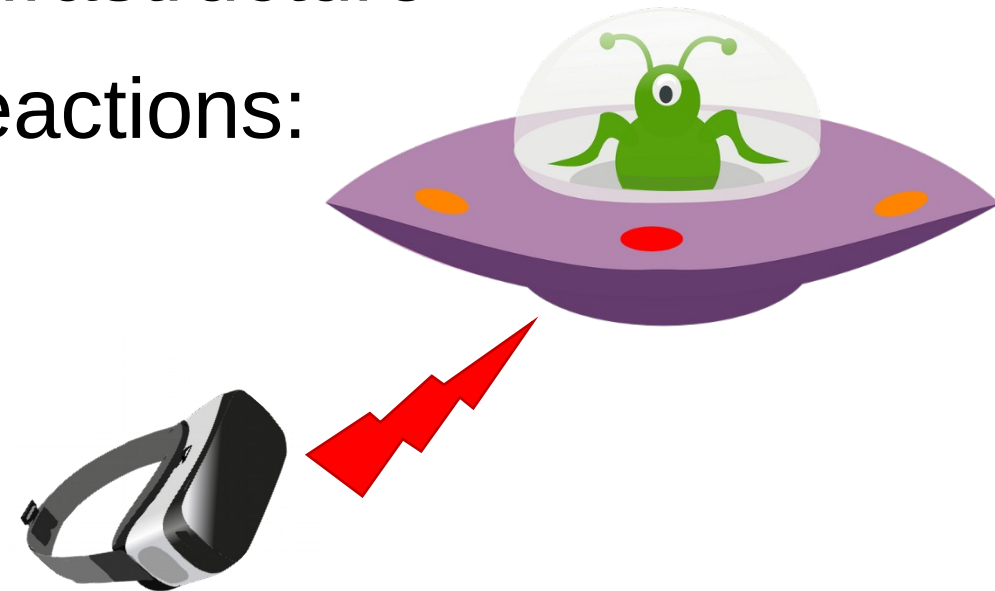
# Unified communication and computing infrastructure

- 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

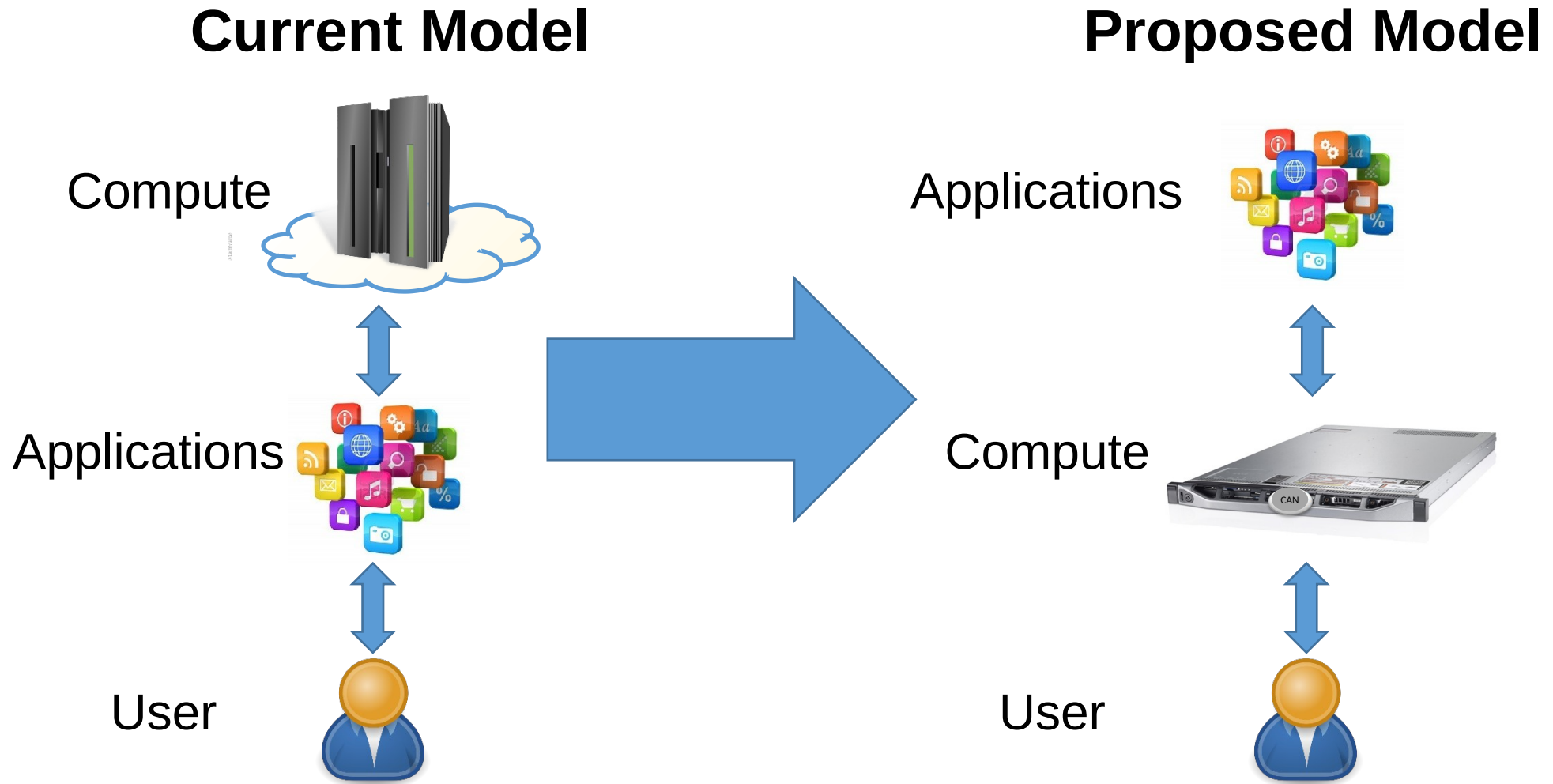


# Scaling Computing Infrastructure – Cloud Providers

- 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





# Give us the right to choose our provider!

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Provider	Service	Speed	Price per month	Setup costs	Contract	More
NOW Broadband	Fibre Unlimited	Up to* 38Mb	£29.99 p/m for 12 months	£9.99	12 month contract	Visit now
TalkTalk	Fibre Unlimited	Up to* 38Mb	£29.50 p/m for 18 months	£25.00	18 month contract	Visit now
TalkTalk	Fibre Unlimited	Up to* 38Mb	£29.50 p/m for 18 months	£50.00	18 month contract	Visit now
BT	Fibre Unlimited	Up to* 52Mb	£29.99 p/m for 6 months, £33.49 p/m for months 7-18	£59.99	18 month contract	Visit now

**Broadband options**

Broadband type Standard  Fibre

Monthly usage allowance Limited  Unlimited

Minimum speed 17Mb

**TV options**

Include TV

Channels

- BT Sport
- sky sports
- sky cinema
- sky atlantic
- sky one

# Give us the right to choose our apps pack!

**108 Channels**

Entertainment (56) Factual (2) Lifestyle (3) News (6) Music (4) Movies (3) Shopping (9) Radio (20) Childrens (4) Interactive (1)

The grid displays 108 channel logos arranged in 12 rows and 9 columns. The channels include:

- Row 1: Sky One, Sky Living, Sky Arts, Sky Two, Fox, Comedy Central, MTV, Real Lives, National Geographic
- Row 2: History, Crime + Investigation, 4Seven, BBC Alba, RTE One, RTE 2, BBC Four, BBC Four HD, BBC One
- Row 3: BBC Two, BBC Two HD, Challenge, Channel 4, Channel 4 HD, Channel 4+1, Channel 5, Channel 5+1, My5
- Row 4: Dave, E4, E4+1, Five USA, ITV, ITV+1, ITV 1 HD, ITV2, ITV2+1
- Row 5: ITV3+1, ITV4, More4, Pick TV, Quest, Quest+1, S4C, Dave ja vu, Drama
- Row 6: TruTV+1, True Entertainment, CBS Reality, CBS Action, Blaze, TG4

The grid displays 60 channel logos arranged in 10 rows and 6 columns. The channels include:

- Row 1: One, Two, ITV, Four, S4C, Five
- Row 2: ITV2, ALBA, Local TV, Four, ITV3, Pick
- Row 3: Dave, +1, 4, Film, Q, Really
- Row 4: +1, Y, Drama, 5USA, Ideal World, Creative Crafty
- Row 5: ITV4, Home, ITV Be., ITV2+, 4, 4+
- Row 6: 5Star, 5Spike, S, ITV, ITV3+, Q Beauty
- Row 7: Q Style, Quest, Quest Red, Casaction, R&C, Food
- Row 8: Travel, GEMS, 5+, Film, Challenge, 4
- Row 9: Movies Men, TJC, TG4, RTE One, RTE 2, Select
- Row 10: 5Star+, 5USA+, 5Spike+, S, True, True
- Row 11: Blaze, Casaction+, TBN UK, Casreality, Casreality+, tru+
- Row 12: S, Horror Channel, CBS Drama, Your, Chat Show TV, Jewellery Maker
- Row 13: TCC, Sewing Quarter, Dave ja vu, Talking Pictures, Vantage, Quest+1

# 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

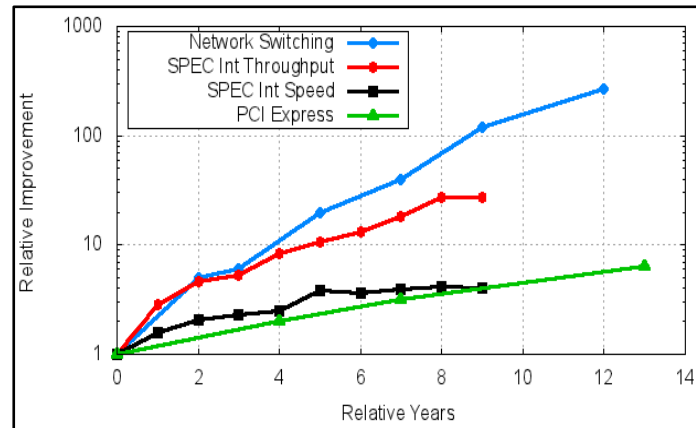
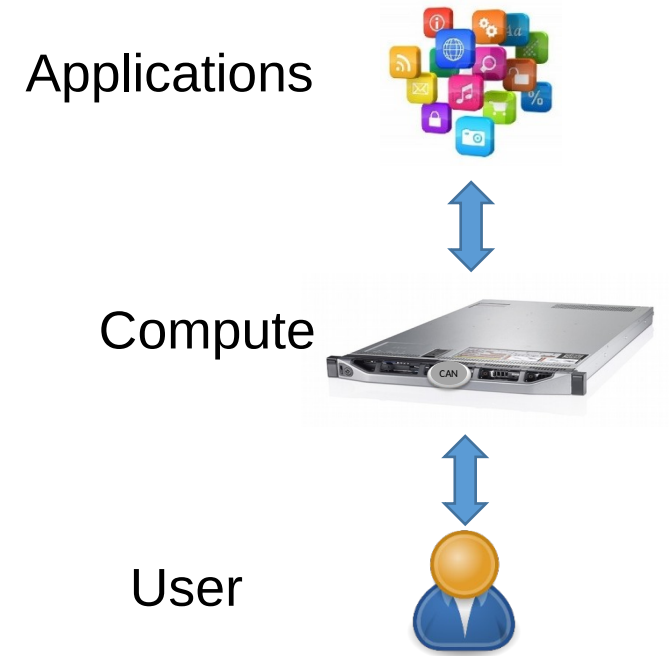
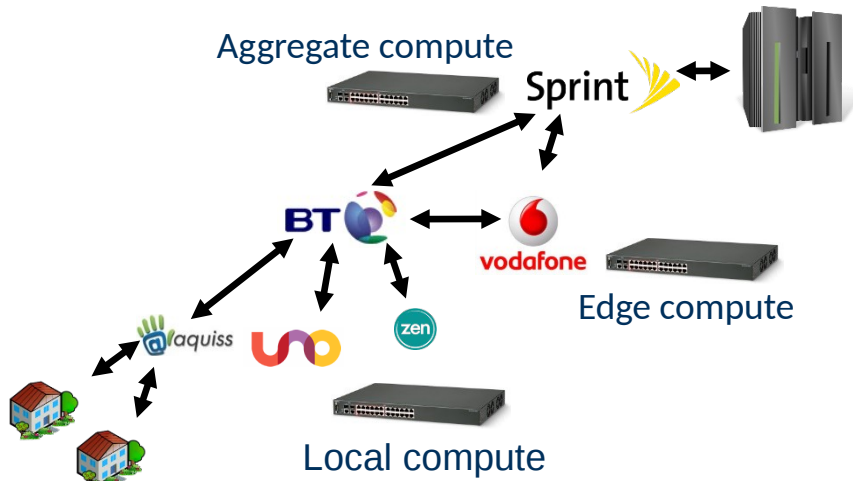
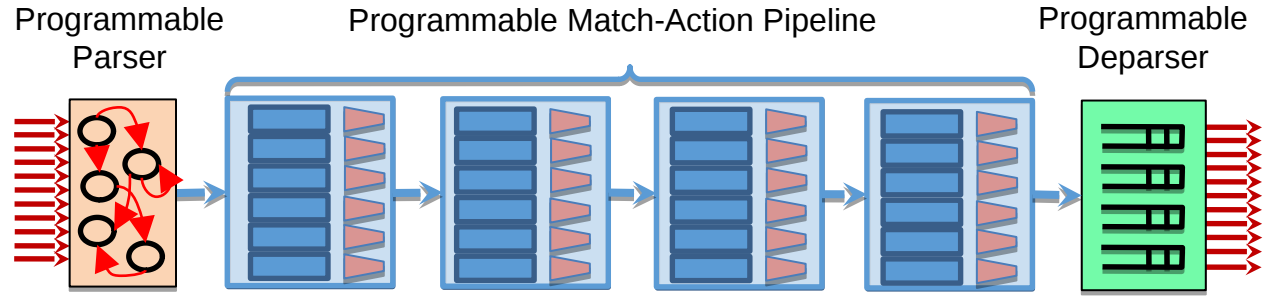
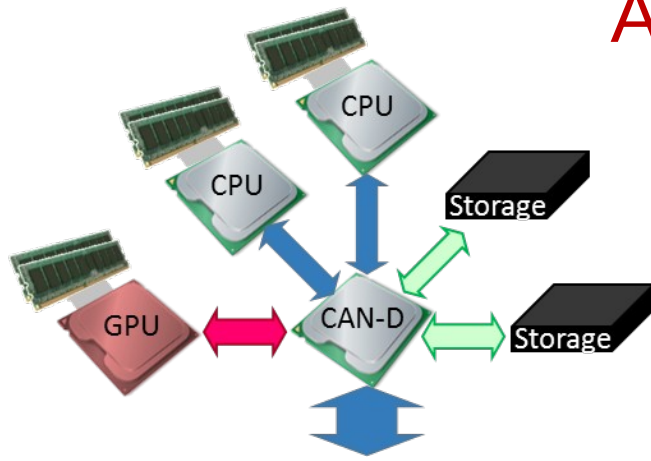


# Thinking Ahead

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



All papers are available at: [www.cl.cam.ac.uk/~nz247](http://www.cl.cam.ac.uk/~nz247)



Questions?