Can Cloud Computing and Optical Networking Save the Planet?

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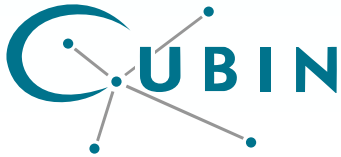
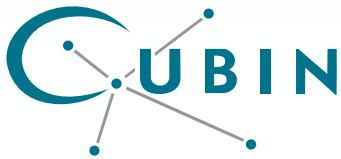


Cloud Computing

What do the following have in common?

- Happiness
- Love
- Marketing Hype
- Recession
- Cloud Computing

They all mean different things to different people



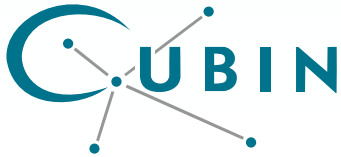
Summary

Cloud Computing as a Logistics Problem

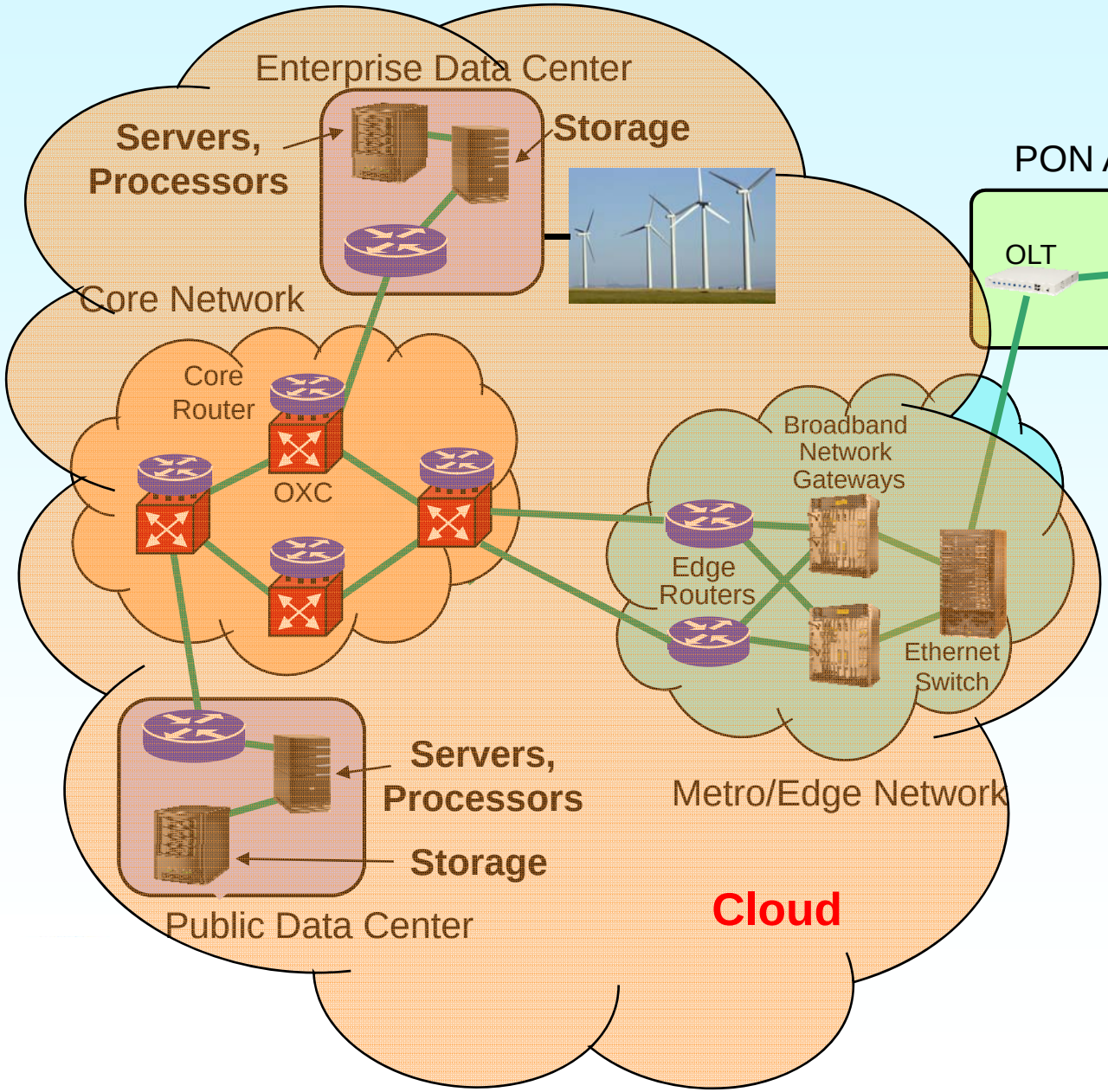
Key elements of logistics

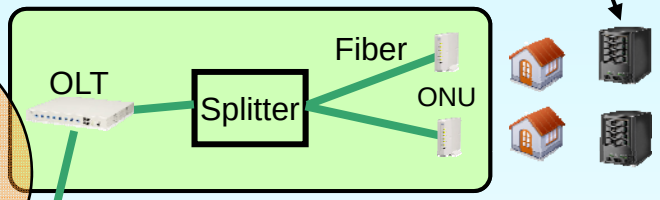
- Processing
- Storage
- Transport

} Energy costs



Cloud Computing Energy Model





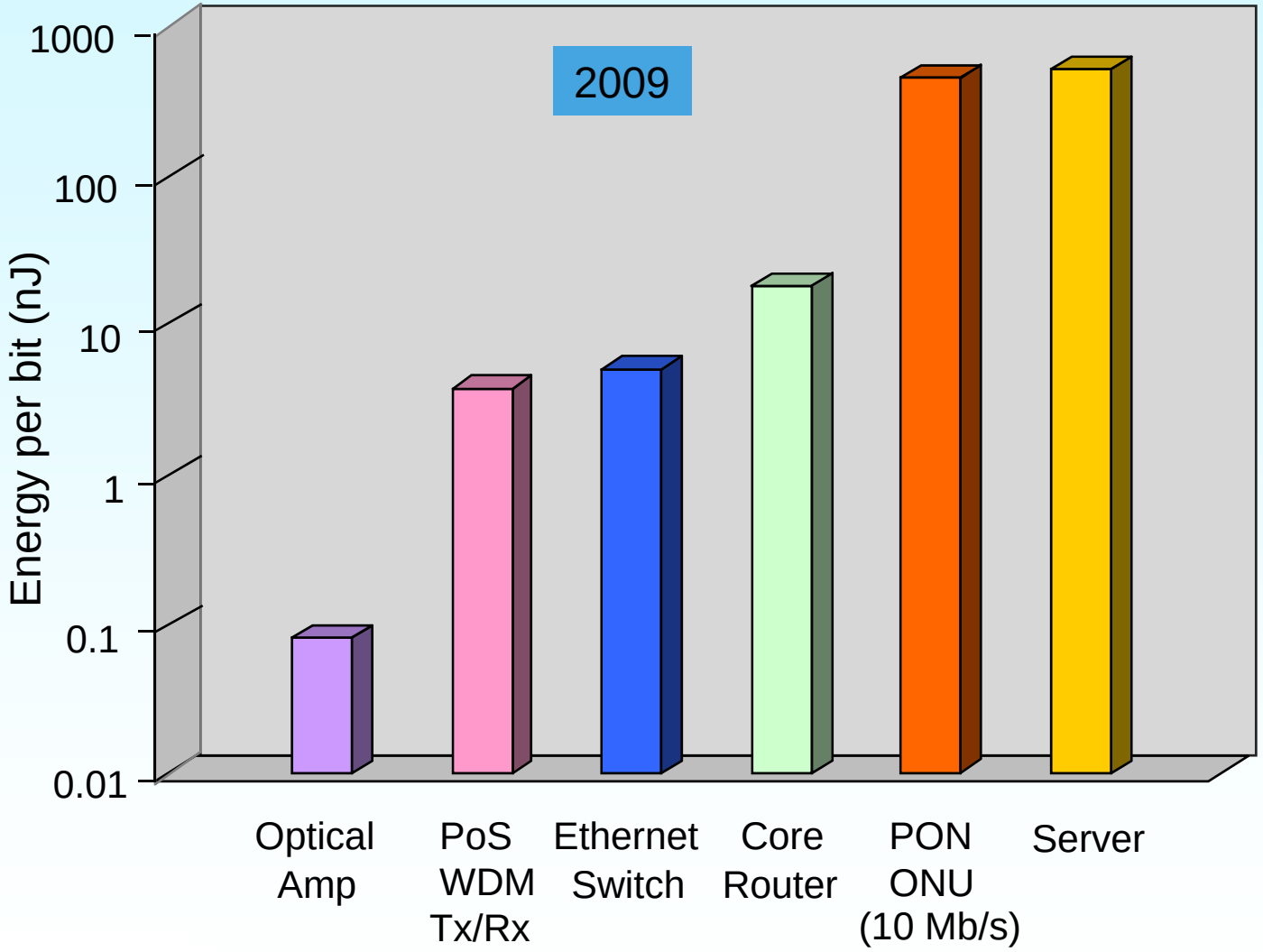
Total Energy Consumption =

Energy/bit used in
- Storage
- Transport
- Processing

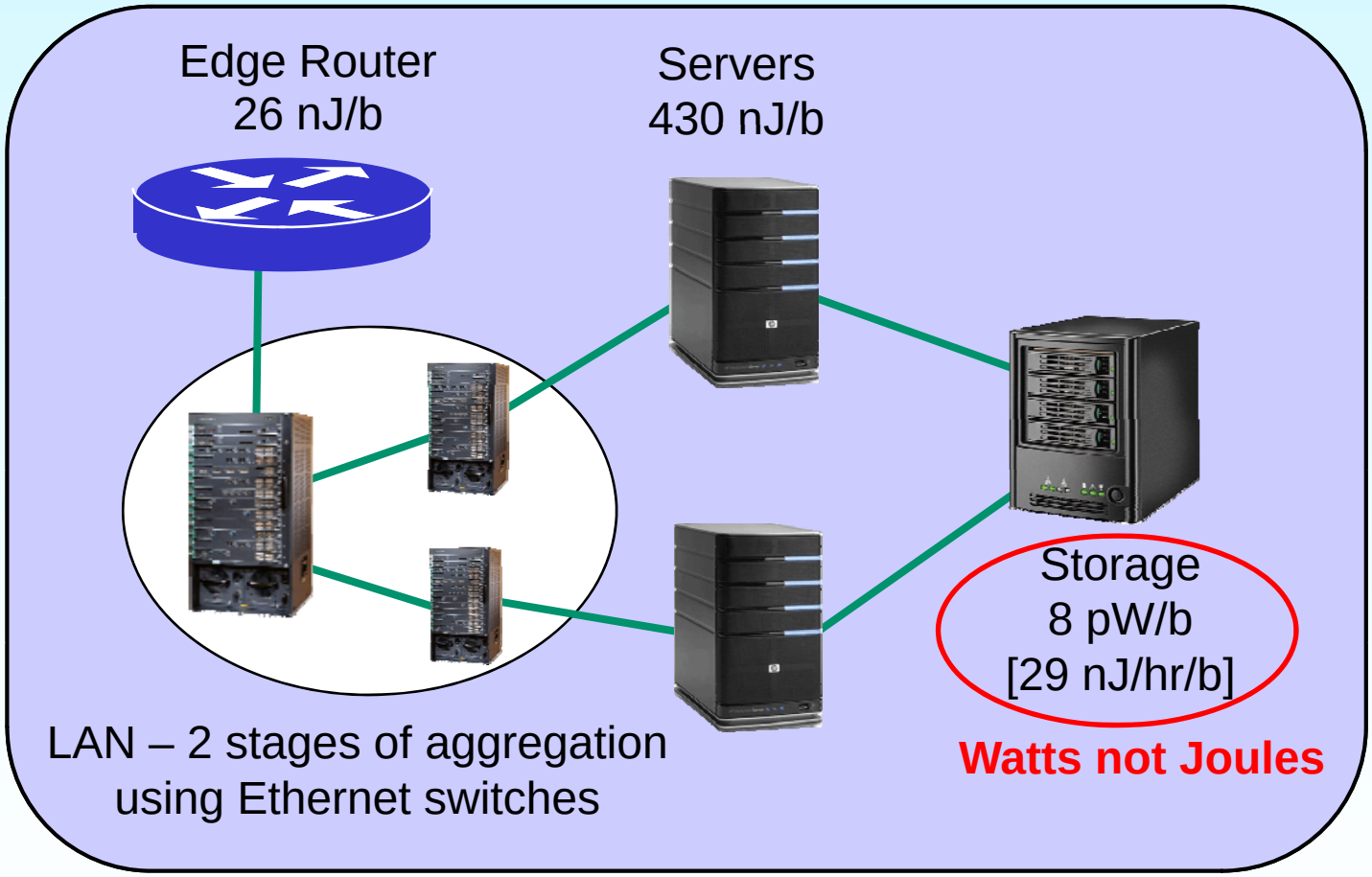
X

Total number of bits

Network Energy Model

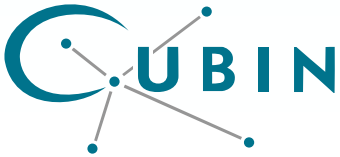


Data Centre Energy Model



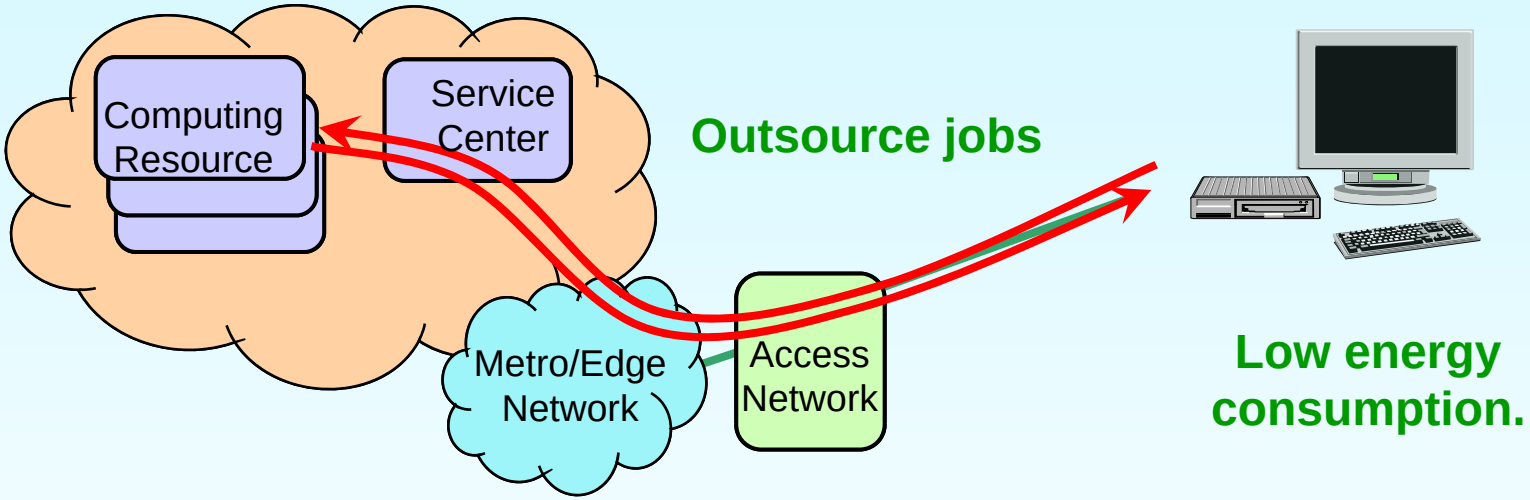
User Hardware Energy Model

- **End user computer:**
  - **High Energy Use Desktop 140 Watts**
    - Eg. Intel Quad-core, or older P4, mid-range graphics
  - **Modern mid-range Desktop 70 Watts**
    - Eg. Intel Core Duo 2.5 GHz, 2 GB RAM, mid-range graphics
  - **Low-end Desktop/Thin Client 18 Watts**
    - Eg. Intel Atom 1.6 GHz, 2 GB RAM, chipset-based graphics
  - **Ignore monitor (LCD/CRT) energy consumption**
    - This will be similar in all our comparisons



Outsource to Cloud or Oversize Computer?

Should I use a low-end Computer & Outsource Jobs



- OR -

Use a high-end computer that can handle any of my jobs

But high energy consumption even for light jobs

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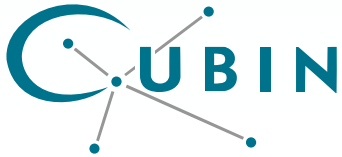
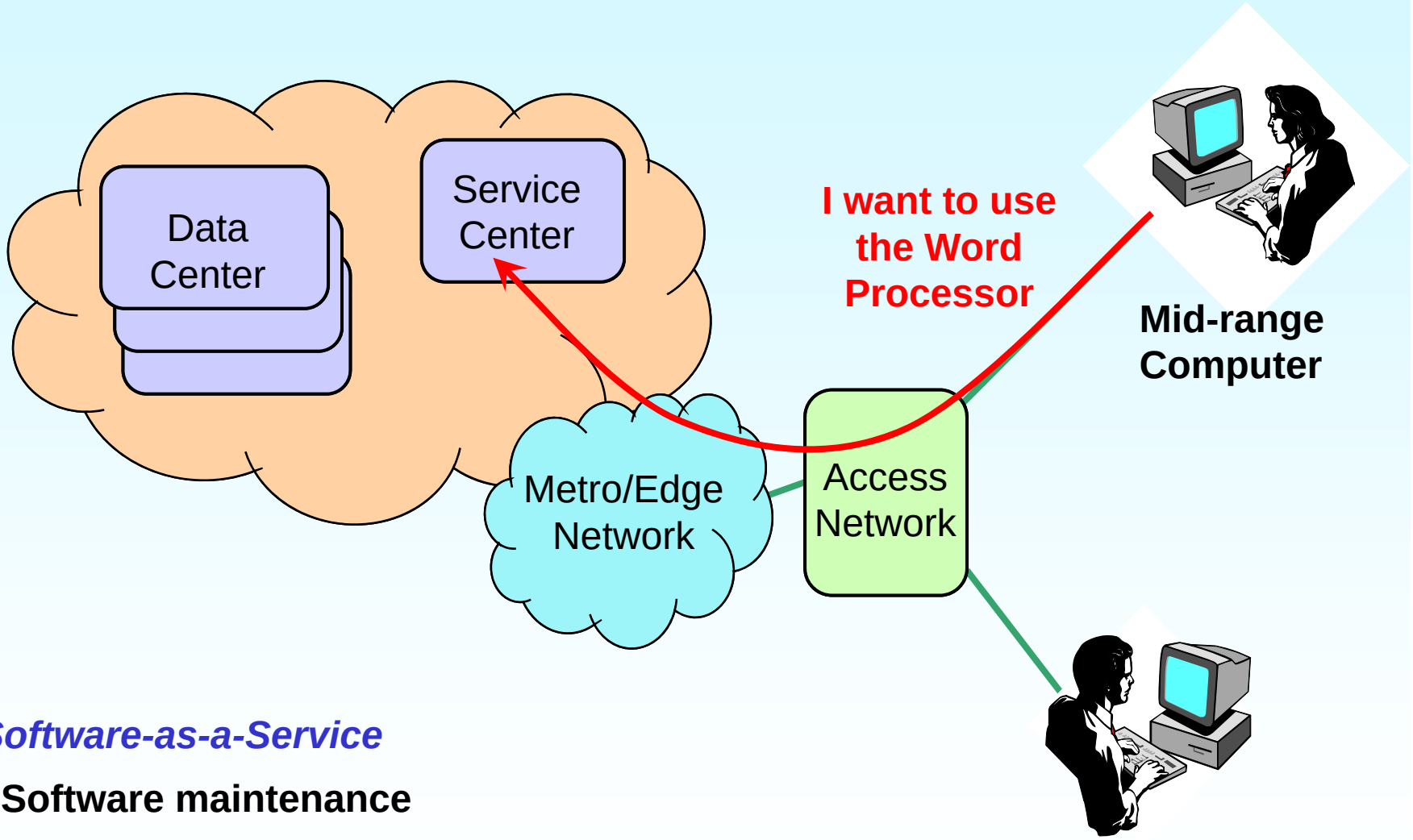
Consider Three Scenarios

1. **Software-as-a-Service**
   - **Stored on user's computer with updates downloaded regularly**
     - Eg current anti-virus software model extended to mainstream applications, MS Update (weekly patch) model
2. **Service Bureau**
   - **Most tasks done on lower end user machine, outsource the "big" jobs**
3. **Computing-as-a-Service**
   - **Hosted and run on provider's computer "farm" with data initially uploaded from user**
     - User data may be hosted or locally stored
     - Like enterprise "Thin Client" model

Can cloud computing save energy ?



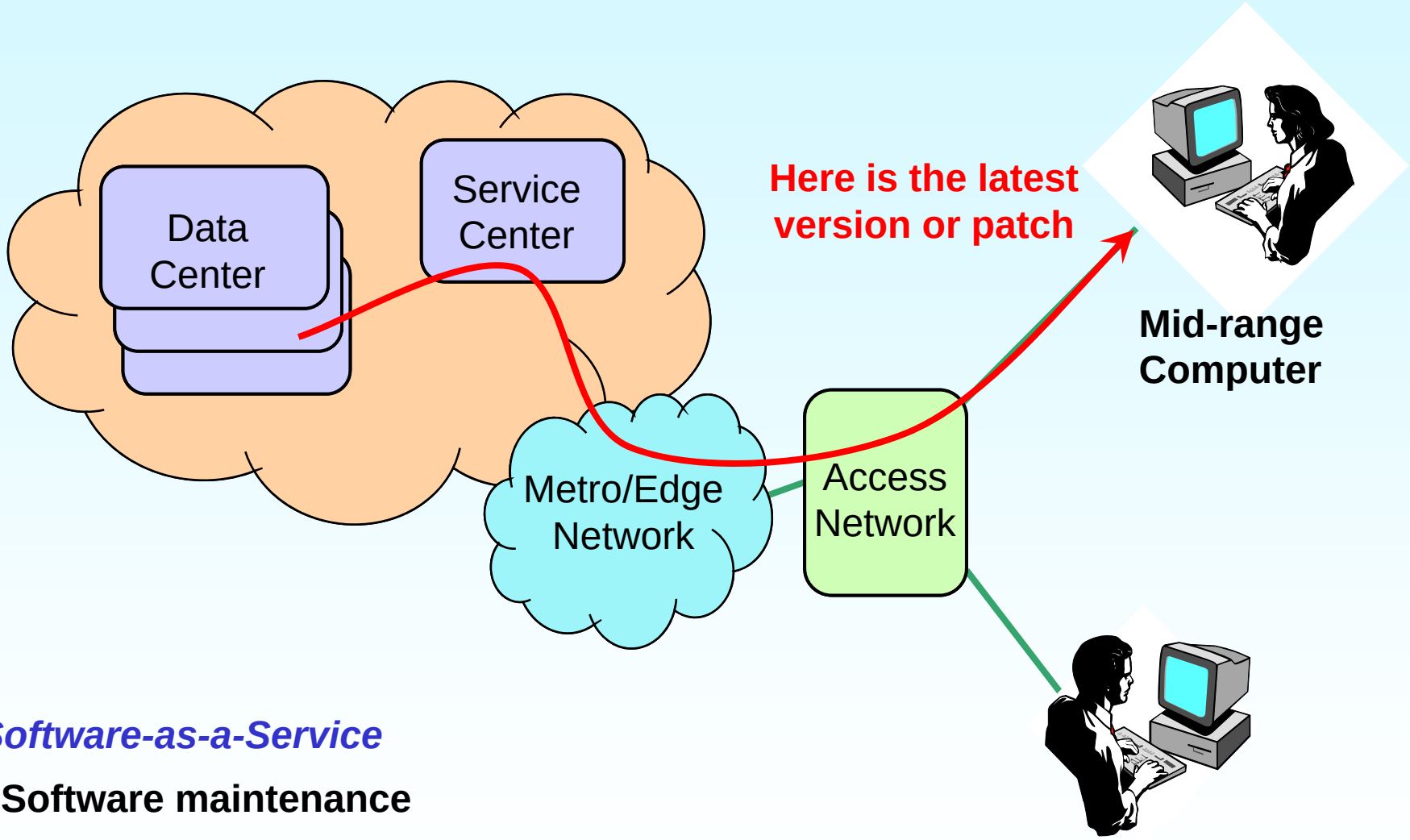
1. Software-as-a-Service



Software-as-a-Service

- **Software maintenance**

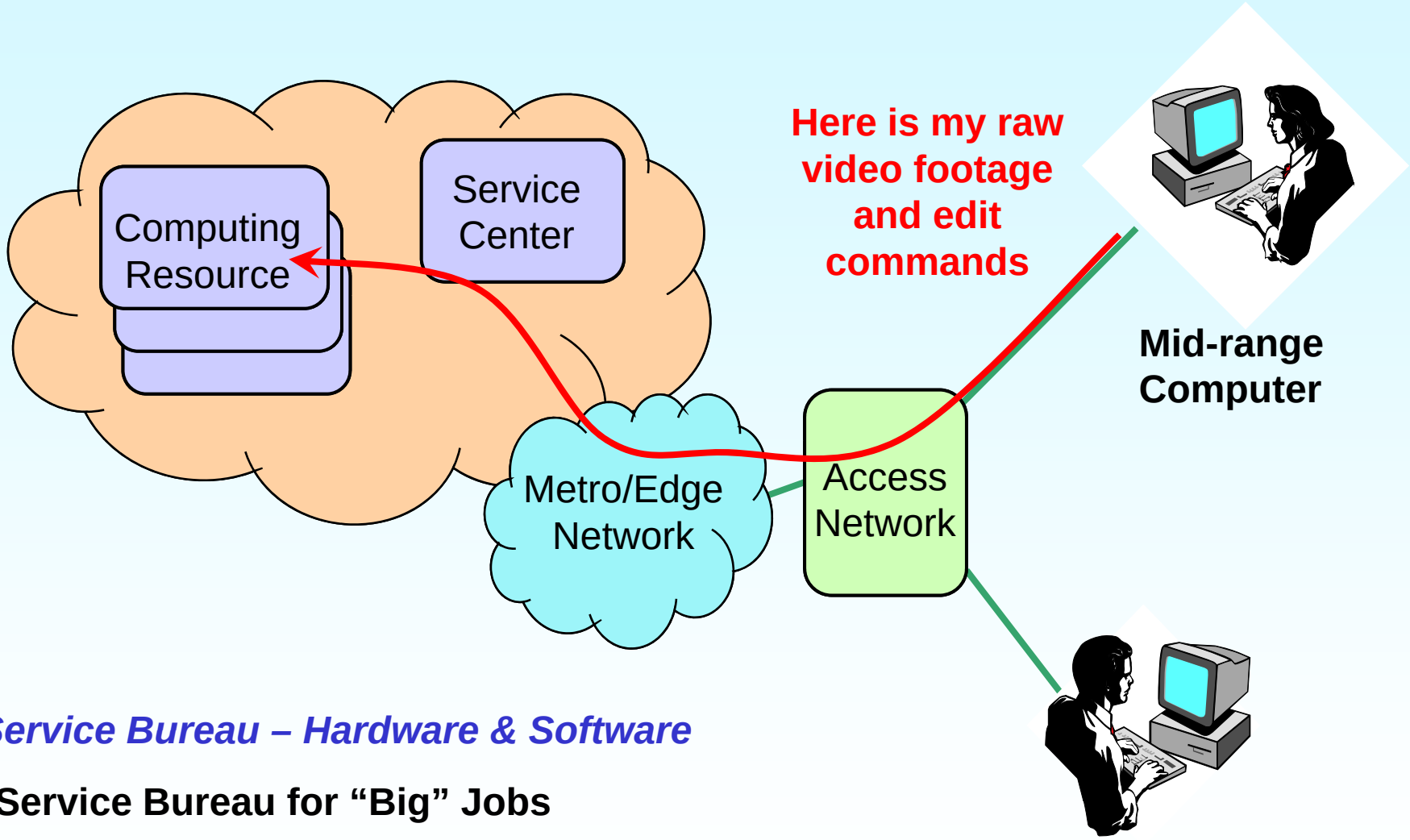
1. Software-as-a-Service



Software-as-a-Service

- **Software maintenance**

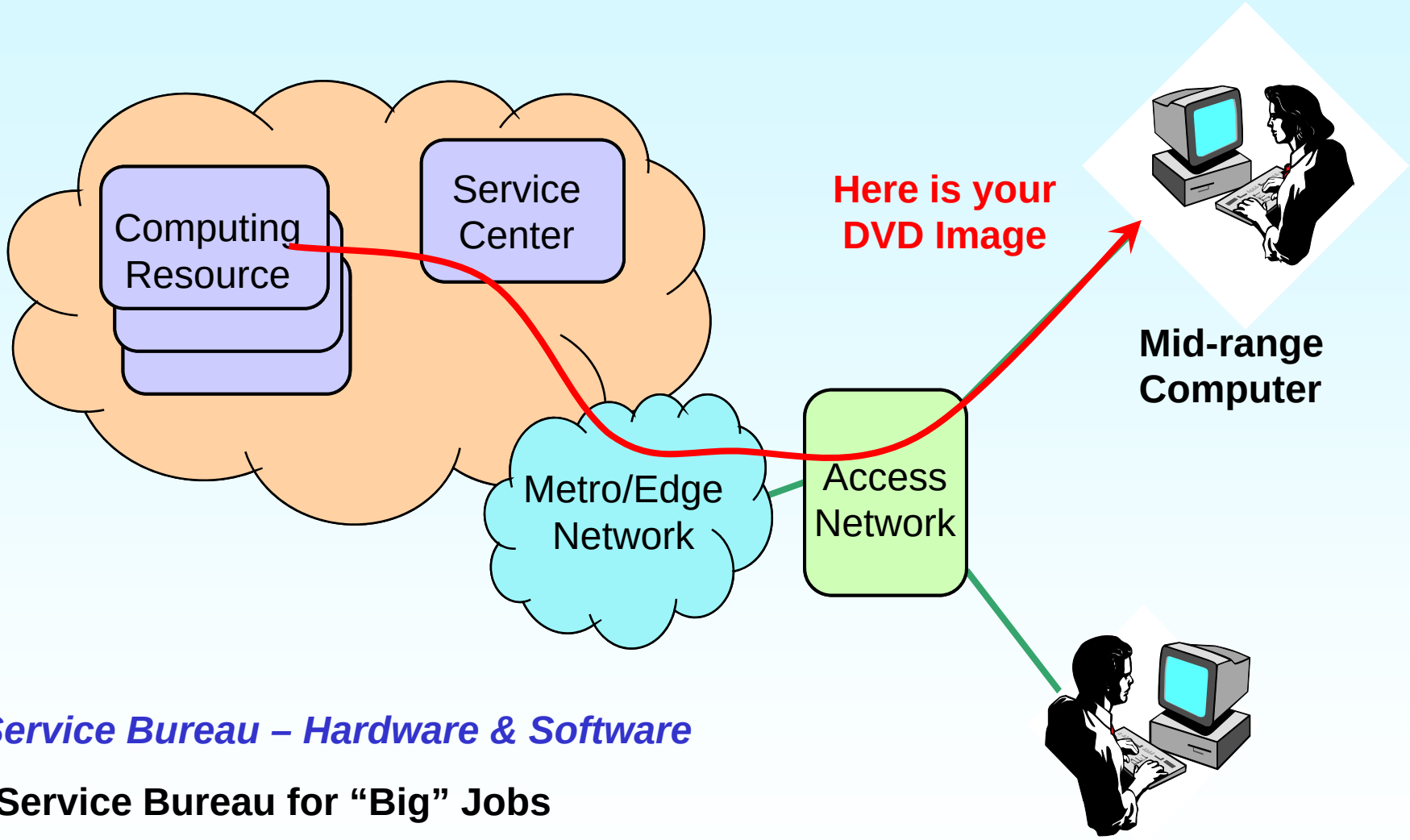
2. Service Bureau



Service Bureau – Hardware & Software

- **Service Bureau for "Big" Jobs**

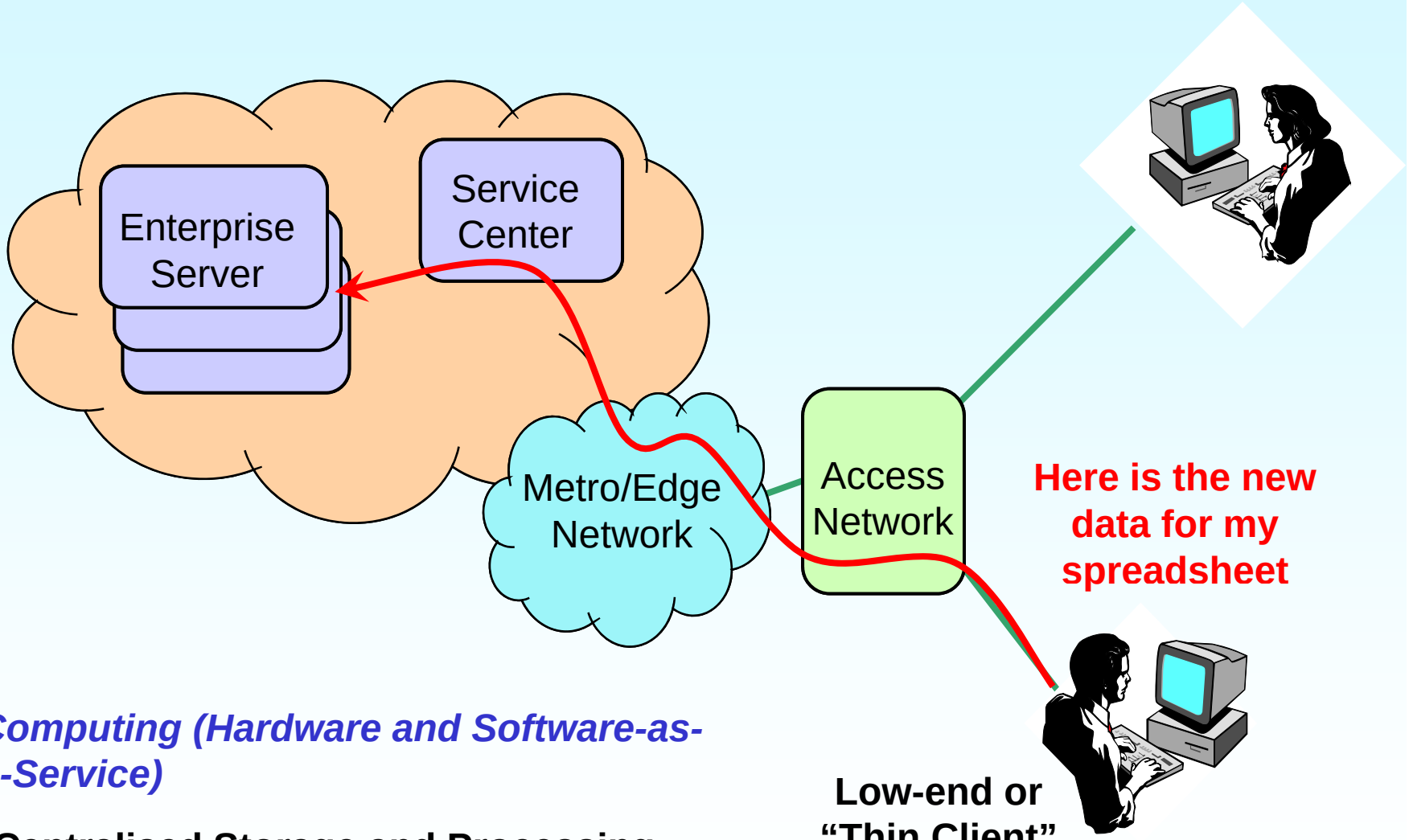
2. Service Bureau



Service Bureau – Hardware & Software

•Service Bureau for "Big" Jobs

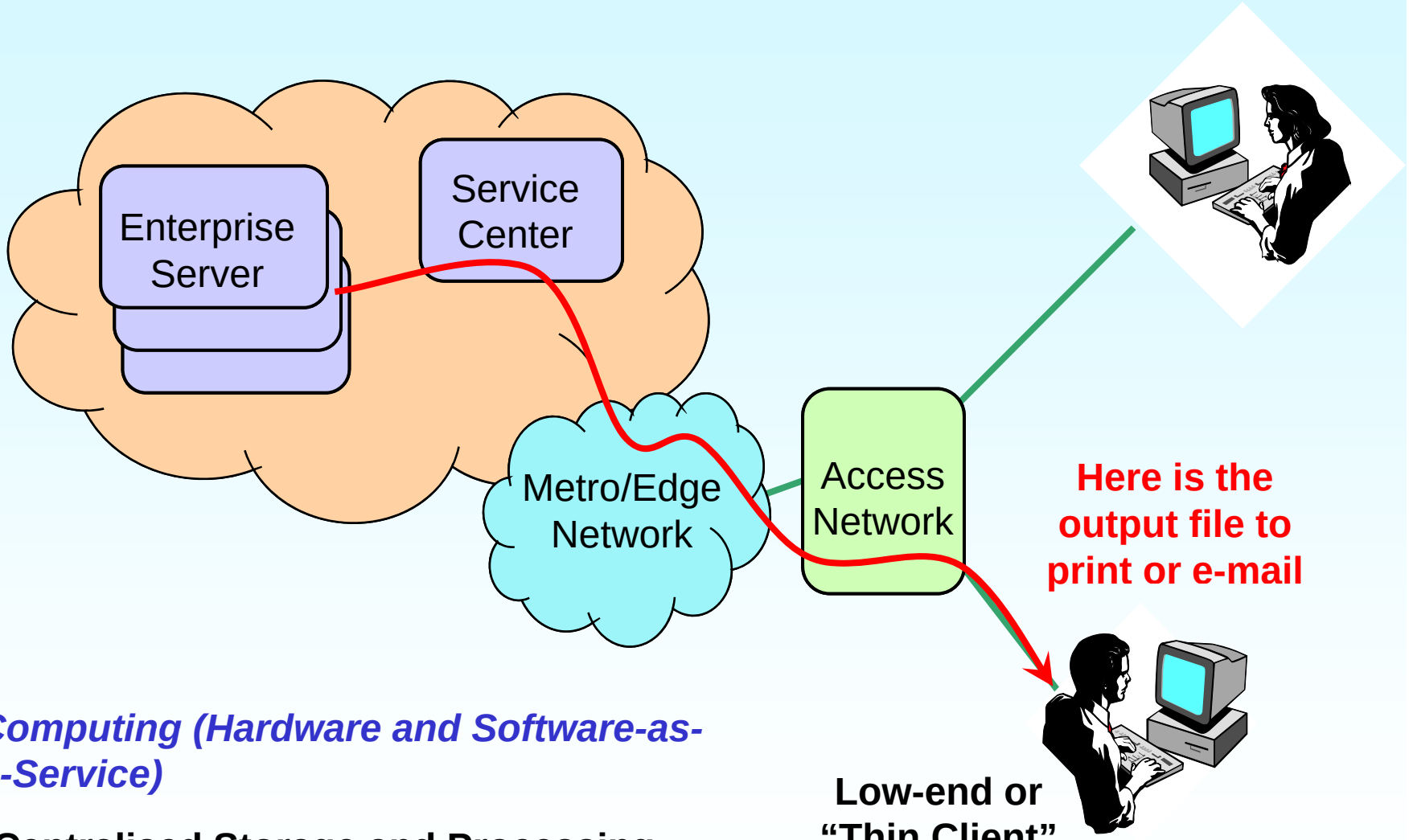
3. Computing-as-a-Service



Computing (Hardware and Software-as-a-Service)

- **Centralised Storage and Processing**

3. Computing-as-a-Service



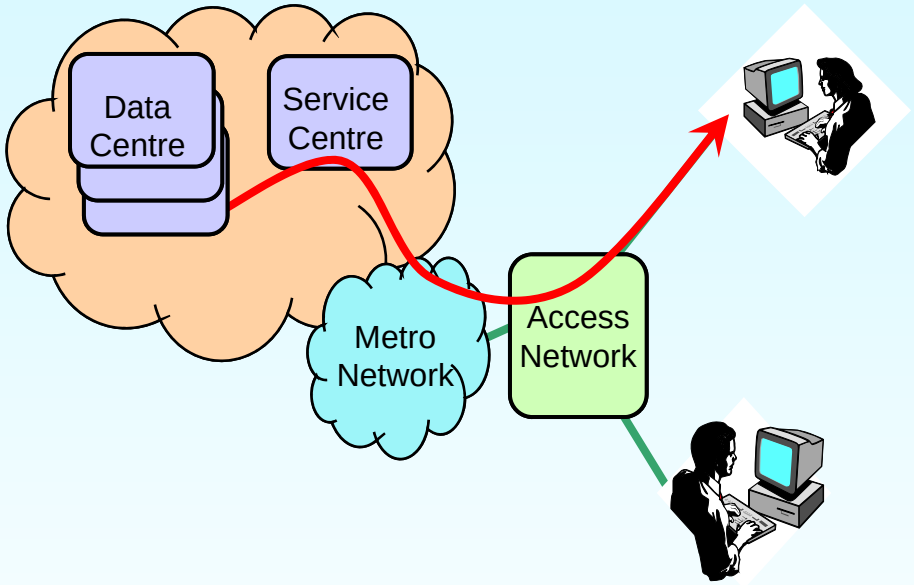
Computing (Hardware and Software-as-a-Service)

- **Centralised Storage and Processing**

1. Software-as-a-Service Example

Store on Local Disk or in the Cloud?

- **Energy impact of the "Software as a Service" & "Storage as a Service" models**
- **Compare the energy cost to store & transport 50 MB blocks to the user, cf. store on local drive**

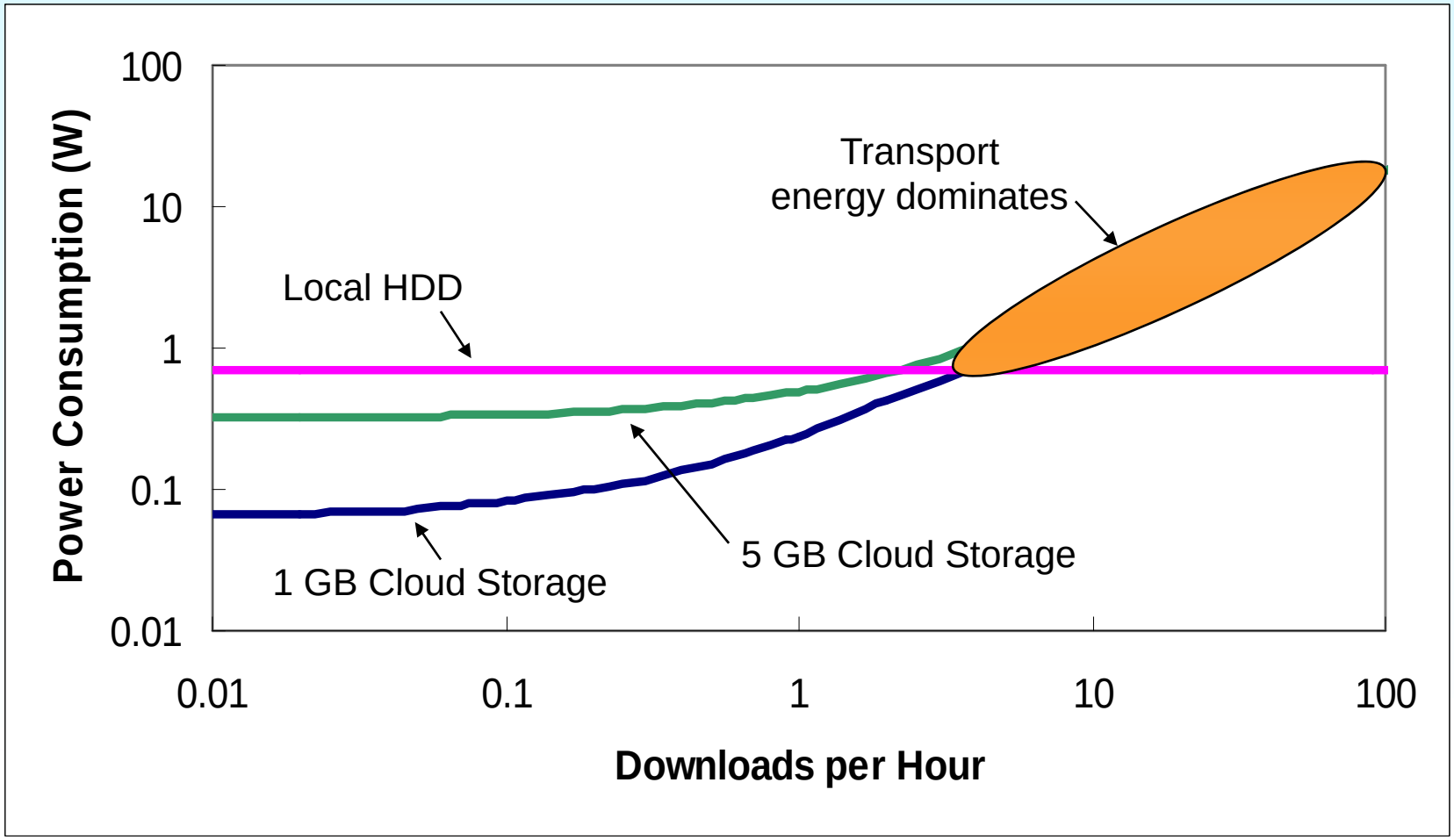


- **Users require 1GB and 5GB "cloud" storage**

1. Software-as-a-Service Example

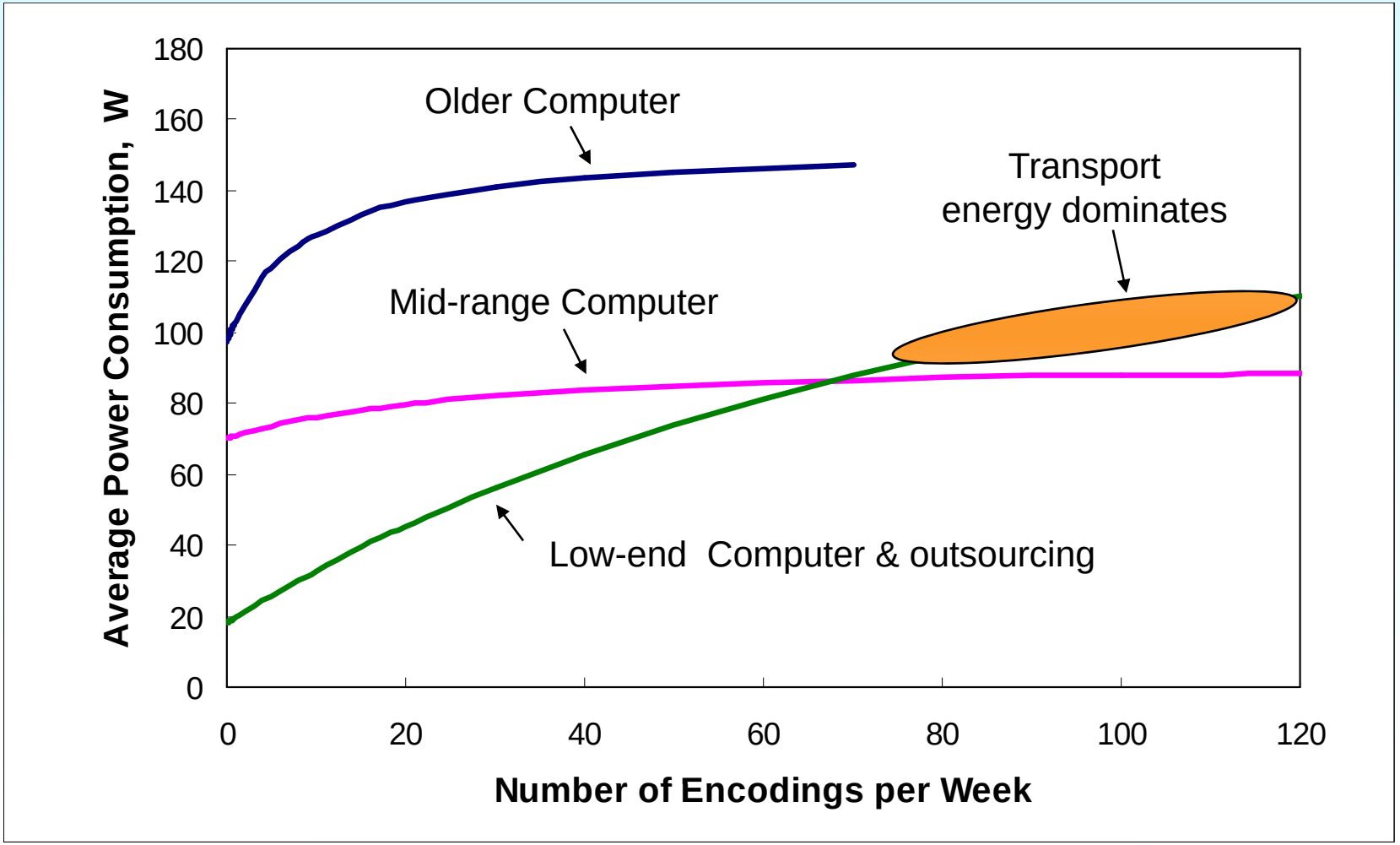
Store on Local Disk or in the Cloud?

Storage of application & data “in the cloud” compared with storing on a local disk.
50 MBytes per download. Modern laptop-style HDD 20% read/write and 80% idle.



2. Service Bureau Example

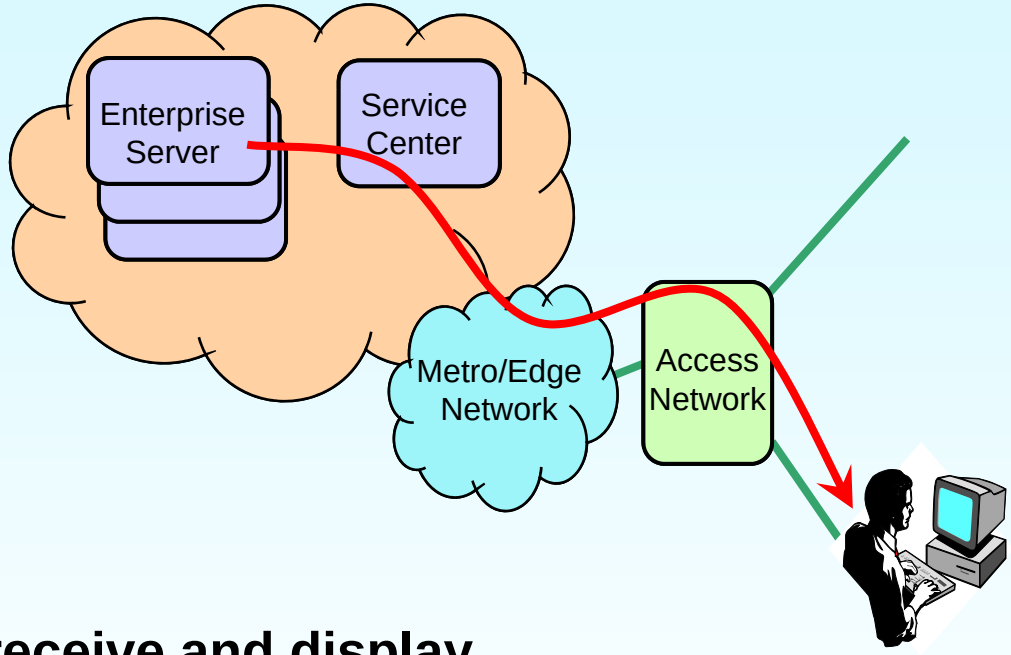
Computer used for 20 hrs/week, plus some video encoding of ½ hour videos



3. Computing-as-a-Service Example

Thin Client or Small PC in Office?

- **Office situation**
  - **non-intensive tasks,**
- **Should this office deploy:**
  - **a low-end machine per user OR “dumb, thin clients”?**



- **Commonly, thin client would receive and display HTML formatted data from the server**
- **Thin client capability may be limited to displaying bitmaps developed from its server**

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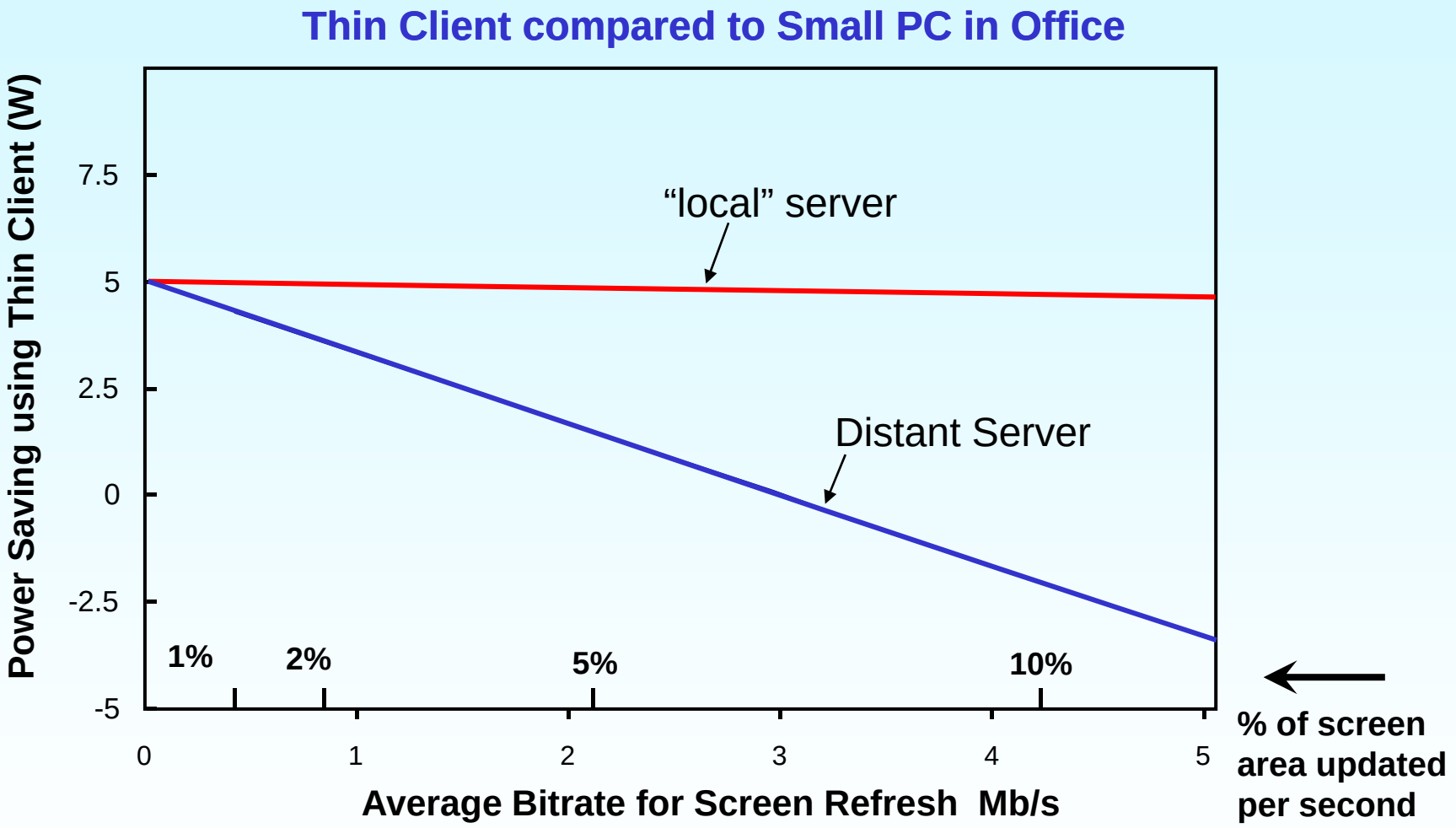
3. Computing-as-a-Service Example



Thin client solution "green" only when the server is local

Summary

- **Cloud Storage and Cloud Computing can provide energy savings**
  - **More so for less-demanding users**
  - **For handling the occasional intensive task**
- **But...**
  - **Advantages may be lost when data transfer is large**
  - **This is where optical networking needs to come to the rescue**
- **Cloud Computing may not save the planet….**
  - **But if used appropriately, it could help to mitigate the growth in energy consumption in our industry**
  - **A classical Logistics problem**

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