Advanced Grid Applications

ITU-T/OGF Workshop on Next Generation Networks and Grids

Geneva, 23-24 October 2006

Piet Demeester, IBBT-UGent
piet.demeester@intec.ugent.be
www.ibbt.be; www.intec.ugent.be

ITU-T

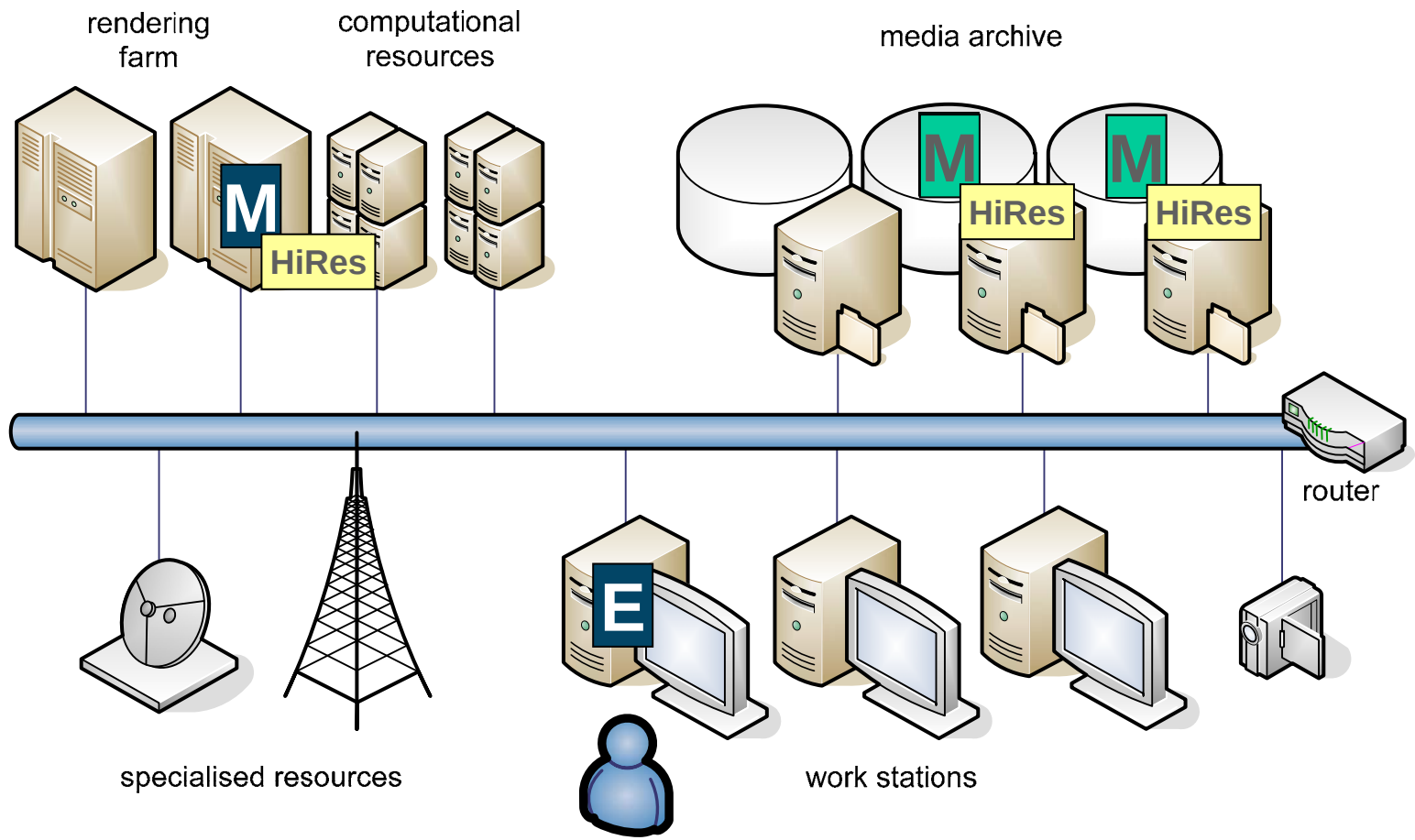
Outline

- Media Grid
- Consumer Grid
- Thin Client
  - Why ?
  - What ?
  - Requirements ?

WHY Grid for media production ?

- Broadcasters, Content Producers, Film Studio's, Cinema… move from tape based to file based environments
  - Fast ingest and flexible processing
  - Hierarchical storage (online, near-line, off-line)
  - Easy management, search and retrieval of media assets (based on meta-data)
  - Easy distribution and sharing of video material (towards other professional players but also towards public market)

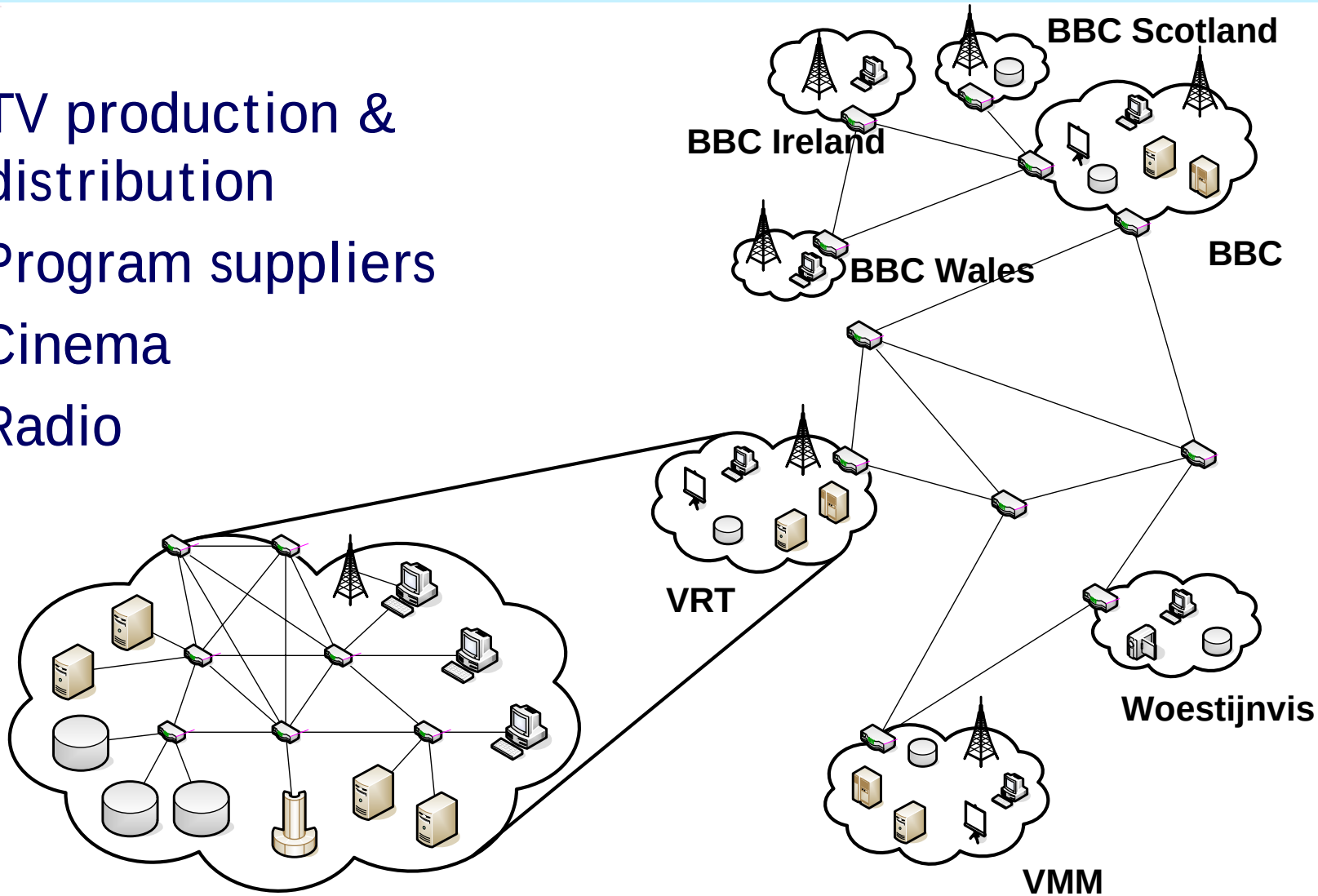
WHAT ? Typical MediaGrid site



WHAT ? Media Grid cooperation

ITU-T

- TV production & distribution
- Program suppliers
- Cinema
- Radio



ITU-T

REQUIREMENTS

- Processing power (video editing, rendering, transcoding, …)
- Storage capacity (low resolution, high resolution, hierarchical)
- Network connectivity for distributed access and collaborative working

REQUIREMENTS: Media company profiles

ITU-T

	Bandwidth	CPU	Storage	QoS	nr
Ingest	Lo- or HiRes A/V	Low	0,65-25,7 GB/h	High	1
Quality check, HiRes browse	HiRes A/V	Low	25,7GB/h	Low	2
LoRes browse	LoRes A/V	Medium	0,65GB/h	Low	3
LoRes rough EDL	LoRes V; Lo- & HiRes A	High	0,5GB/h;0,15-0,7GB/h	Medium	4
Send/Restore archive	Lo- or HiRes A/V	Low	0,65-25,7GB/h	Medium	5
Craft editing	5-10 HiRes A/V	High	5-10 25,7GB/h	High	6
Rendering, conforming, transcoding	HiRes A/V	High	25,7GB/h	Low	7
Playout	1-40 HiRes A/V	Low	1-40 25,7GB/h	High	8
Audio editing	Lo- or HiRes A/V	High	0,65-25,7GB/h	Medium	9
Graphic creation	HiRes V	High	25GB/h	Low	10

	ingest	video journ.	audio ed.	video ed.	prod./director	playout	archivist
Regional TV prod.	2	30-50	2-3			2	2
National TV prod.	3	300-500	20-30			3	4
TV post prod.	1	10-50	1-3	5-20	10	1	1
TV broadcast	1	5-10	1-5			1	1
TV program supplier			25		25		
Video on demand	2		5			2	1
Radio prod./broadcast			30		20	50	

IBBT

ITU-T

Outline

- Media Grid
- Consumer Grid
- Thin Client
  - What ?
  - Why ?
  - Requirements ?
  - Solutions ?

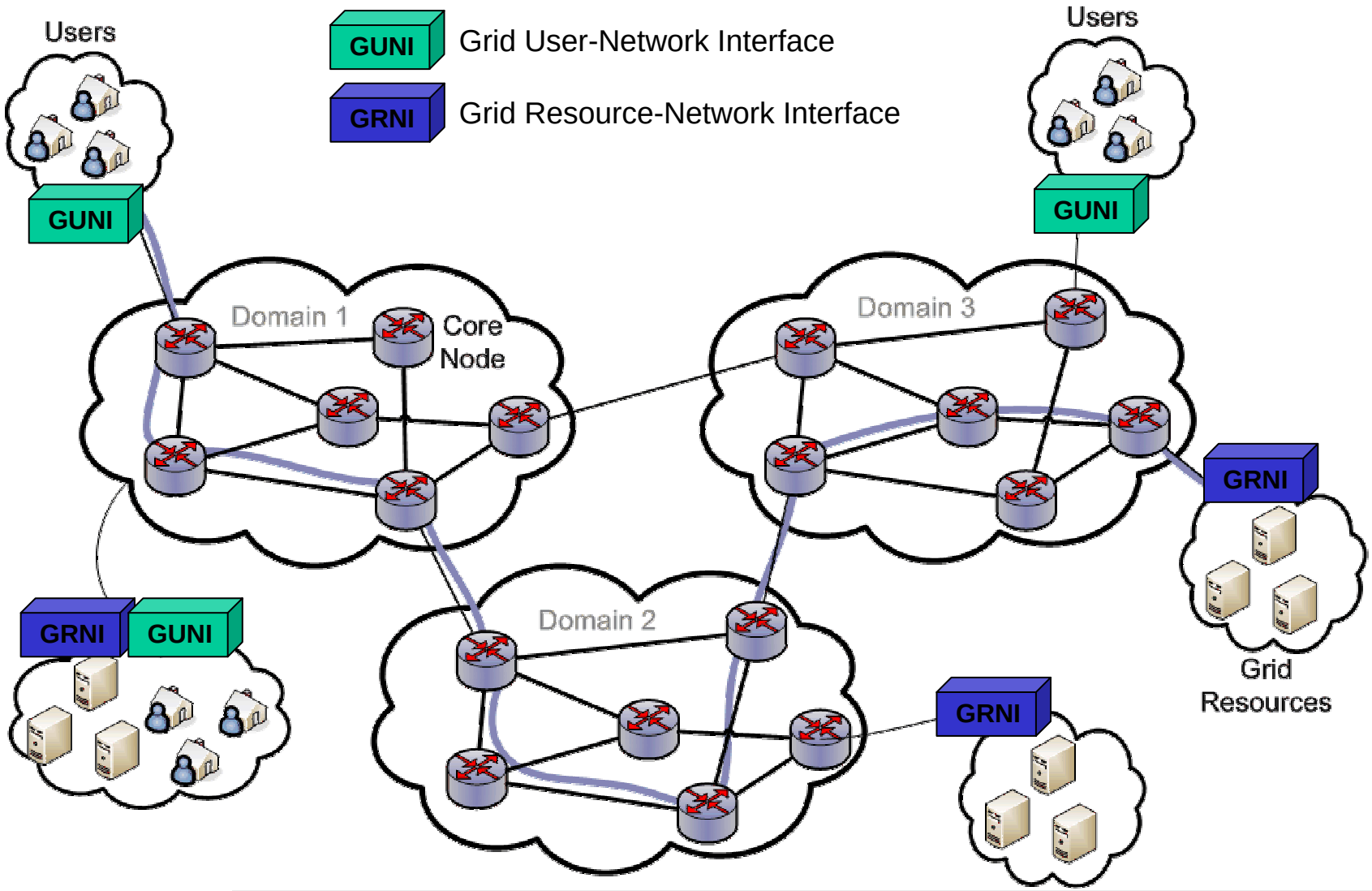
ITU-T

WHY grid for consumers ?

- Storage capacity and computing power: managed utilities (water, electricity, …)
- Storage and retrieval of personal multimedia assets (audio, video, photo, …)
- Processing of multimedia information (personal content creator, 3D rendering, gaming, virtual reality, …)
- OPEX (frequent hardware upgrades) and CAPEX (management, security, data protection, …) reduction

WHAT are Consumer Grids ?

ITU-T



WHAT are Consumer Grids ?

- GUNI = Grid User Network Interface
  - Interoperable procedures between user and Grid
  - Submits jobs (with requirements, e.g. data/CPU, time constraints, …)
  - Directly via control plane, or middleware

- GRNI = Grid Resource Network Interface
  - Resources can dynamically enter/leave network
  - Announces processing and/or storage resources
  - Signaling & control interface between NE and network

REQUIREMENTS

- Eg. **video editing**: 2Mpx/frame for HDTV, suppose effect requires 10 flops/px/frame, then evaluating 10 options for 10s clip is 50 Gflops (today's high performance PC: <5 Gflops/s)

Online gaming:
e.g. Final Fantasy XI: 1.500.000 gamers

Virtual reality: rendering of $3*10^8$ polygons/s → 10^4 GFlops

Multimedia editing

REQUIREMENTS

- Invisible and transparent for the user
- Capable of processing a very large amount of small jobs from a large amount of users and processes
- Capable of managing large amounts of very heterogeneous media assets
- Cost efficient

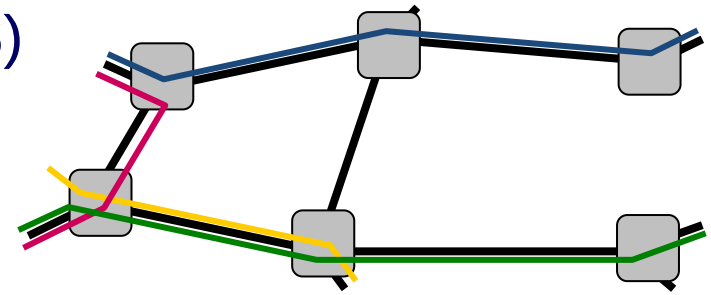
Application	CPU	Data	Network	Robust	#users	Secure	RealTime
Online Gaming	++	++	++	+	+++	+	+++
Virtual Reality	+++	++	++	+	+	+	+++
Coll.Working	++	++	++	++	++	+++	++
Multimedia edit	+++	+++	+++	++	+	+	+
Data Mining	+++	+++	+++	++	++	+++	+

Conventional requirements

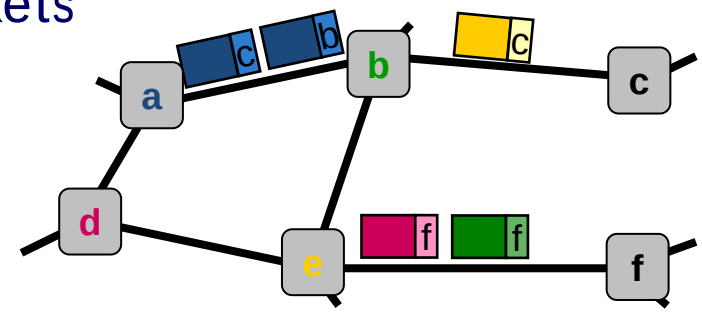
Next Generation Grids

SOLUTION: Optical Networks

- Optical Circuit Switching (OCS)
  - continuous bit-stream
  - pre-established light-paths
  - should be dynamic



- Optical Burst/Packet Switching (OBS/OPS)
  - chunks of bits, in bursts/packets
  - forwarding based on header
  - e.g. label switching, GMPLS



- Hybrids

Optical Circuit Switching

- Pro:
  - ✓ Guaranteed service quality once set-up (cf. reserved lambda), thus fixed latency, no jitter, etc.
  - ✓ Fixed signaling overhead, independent of (large) job size
- Con:
  - × Signaling overhead† not acceptable for relatively small jobs
    - × Requires (complex) grooming if frequent set-up and tear-downs are to be avoided (i.e. if too slow)
  - × Less flexible, dynamic than OBS/OPS, cf. light-path set-up and tear-down

†: *[7] cites 166ms/switch → RSVP-TE speedup needed*

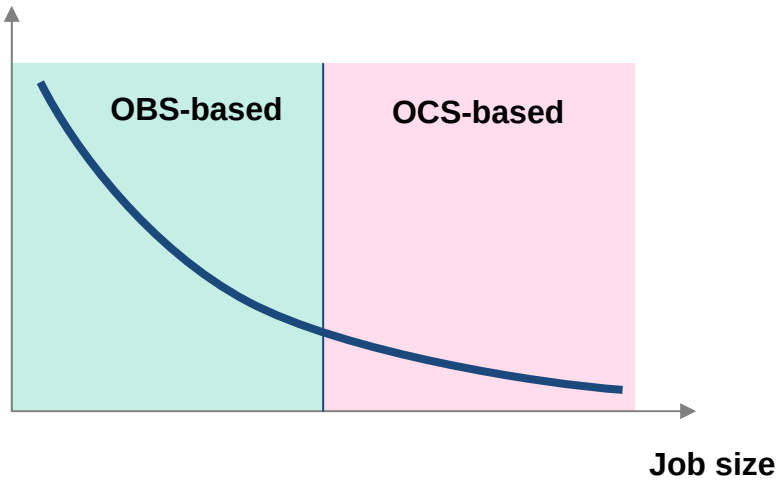
Optical Burst / Packet Switching

- Pro:
  - ✓ Extremely flexible, dynamic
  - ✓ Inherent statistical multiplexing of available bandwidth (over multiple lambdas)
- Con:
  - × Packet / Burst header processing overhead
    - × Requires job aggregation if job size too small compared to header overhead
  - × Difficult to deliver strict QoS guarantees without 2-way reservation
  - × Technology not that mature

Hybrid OCS/OBS

- Choosing between OCS and OBS depends on…
  - Optical technology (OBS requires faster switches, burst mode Rx/Tx and regenerators, …)
  - Job sizes:

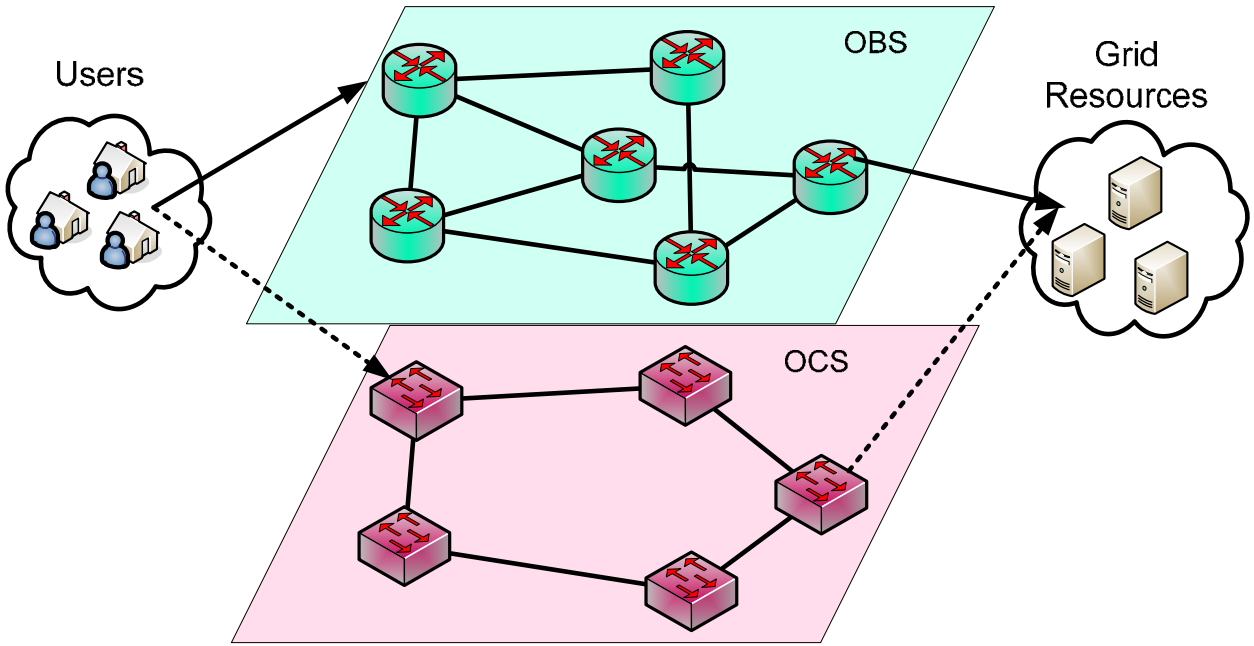
$$\frac{\text{Signaling time}}{\text{Job transmission time}}$$



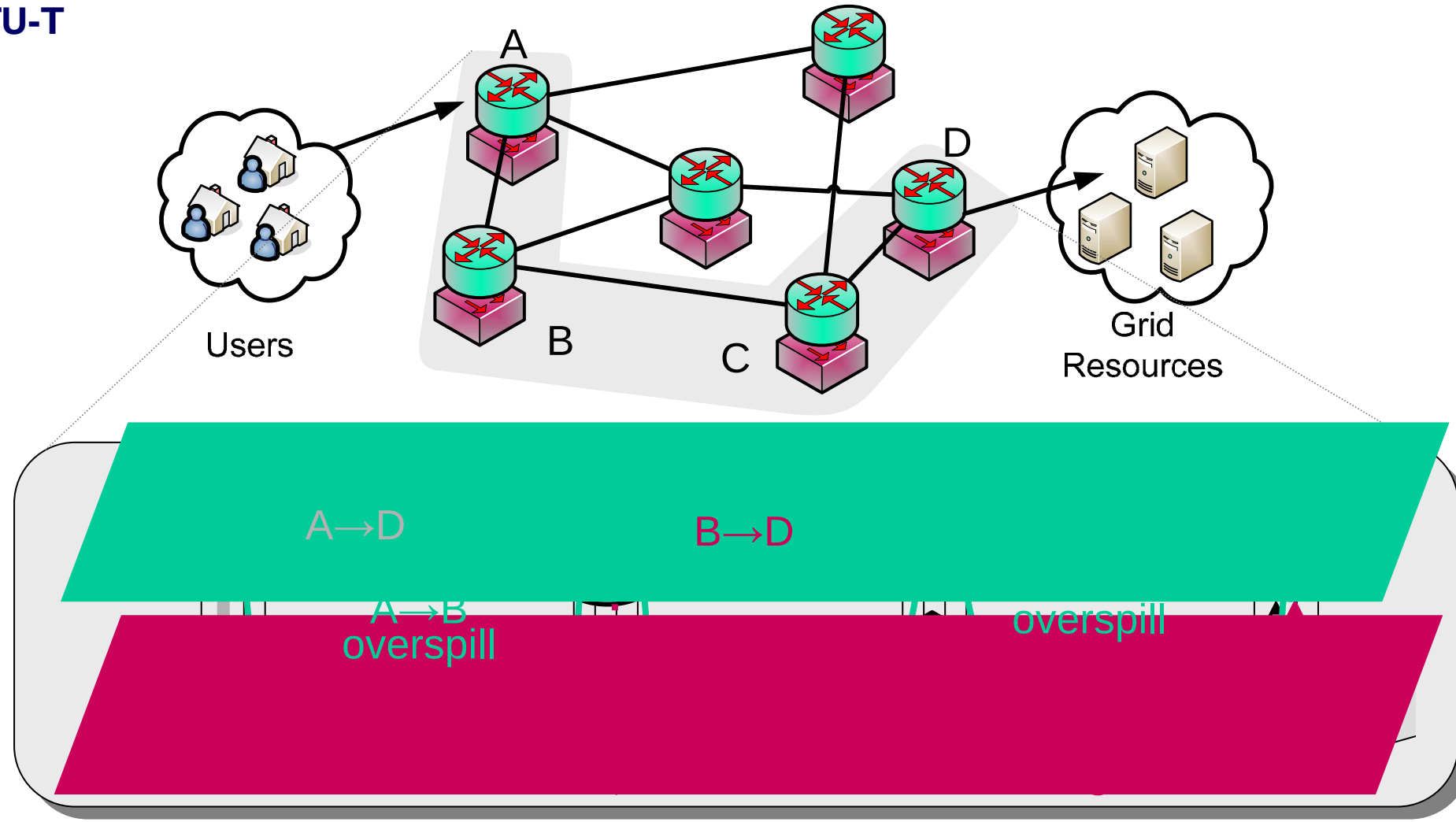
- Hybrid architectures can offer a compromise

Hybrid OBS/OCS

- Parallel: choice to either set-up OCS circuit between source & destination, or use OBS
  - Note: can be overlay, where OBS makes use of OCS connections between OBS nodes



Hybrid OBS/OCS: overspill routing



ITU-T

Outline

- Media Grid
- Consumer Grid
- Thin Client
  - What ?
  - Why ?
  - Requirements ?

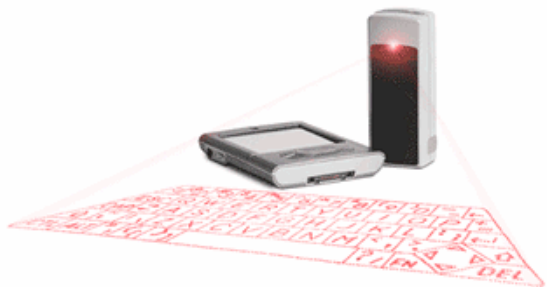
ITU-T

WHY grid for mobile terminals ?

- Rapid improvements in network bandwidth, cost, and ubiquity combined with the security hazards and high total cost of ownership of personal computers have created a growing market for thin-client computing
- Currently the concept is mainly applied to wired thin-client computing ➔ extend towards wireless thin-client computing

WHAT are W-Thin Clients ?

- The user ends up with wearable interfaces (input and output)
- Interfaces get more lightweight
- All other functions are provide by "the wireless networked grid"



REQUIREMENTS

- Network: always on
- Terminal: lightweight, low power and flexible, I/O as basic functionality
- Data: accessible everywhere
- Processing power: accessible everywhere
- Applications: thin client enabled in a mobile environment (e.g. power optimized, close to the user, …)

Conclusions

- Multimedia processing is a major driver for new grid applications
- Evolution from the professional market (Media Grid) towards the home/office (Consumer Grid) and mobile market (W-Thin Client Grid)