# Broadband Switching Systems — Challenges and Evolution

Andrzej Jajszczyk
ATR & ITTI Ltd.
Poland

# Outline

- Introduction
- Changes in telecommunication environment
- Existing technologies
- Trends
- Research issues
- Conclusion

itti

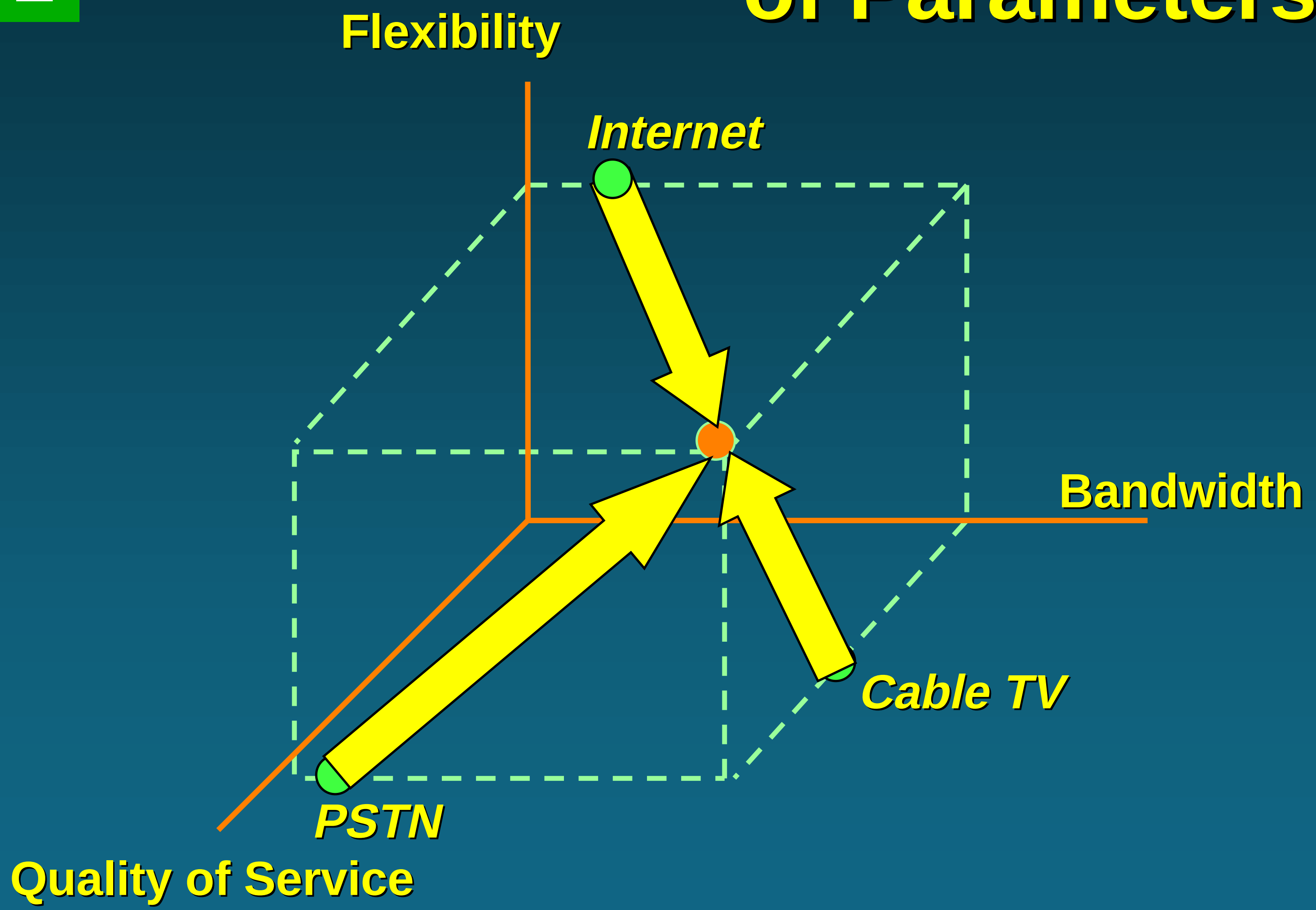
# Three cultural groups

- Communications
- Computer
- Content suppliers

# Comparison of alternative networks

| Telephone Networks | Internet | Cable TV |
|---|---|---|
| Extensive Infrastructure | Dynamic growth | Access mainly to users in cities |
| Good access to users (developed access networks) | Access to a large variety of information sources | Broadband access to users |
| Guaranteed QOS | No guaranteed QOS | Good quality of TV service |
| Connection-oriented | Connectionless | Broadcasting |
| Synchronous and symmetric comm. | Asynchronous and asymmetric comm. | Synchronous and asymmetric comm. |
| Typical service: telephony | Typical services: e-mail, www access | Typical service: access to TV program |

# Convergence of Parameters



itti

# The network of the future will probably be a collection of networks:

- of existing networks
- of emerging networks
- of yet unknown networks

**This network, from a user point of view, must provide the same service regardless of the underlying transport network to which the user happens to be connected**

# Approaches to network intelligence

- “Thinking” network

  Intelligence inside network’s nodes

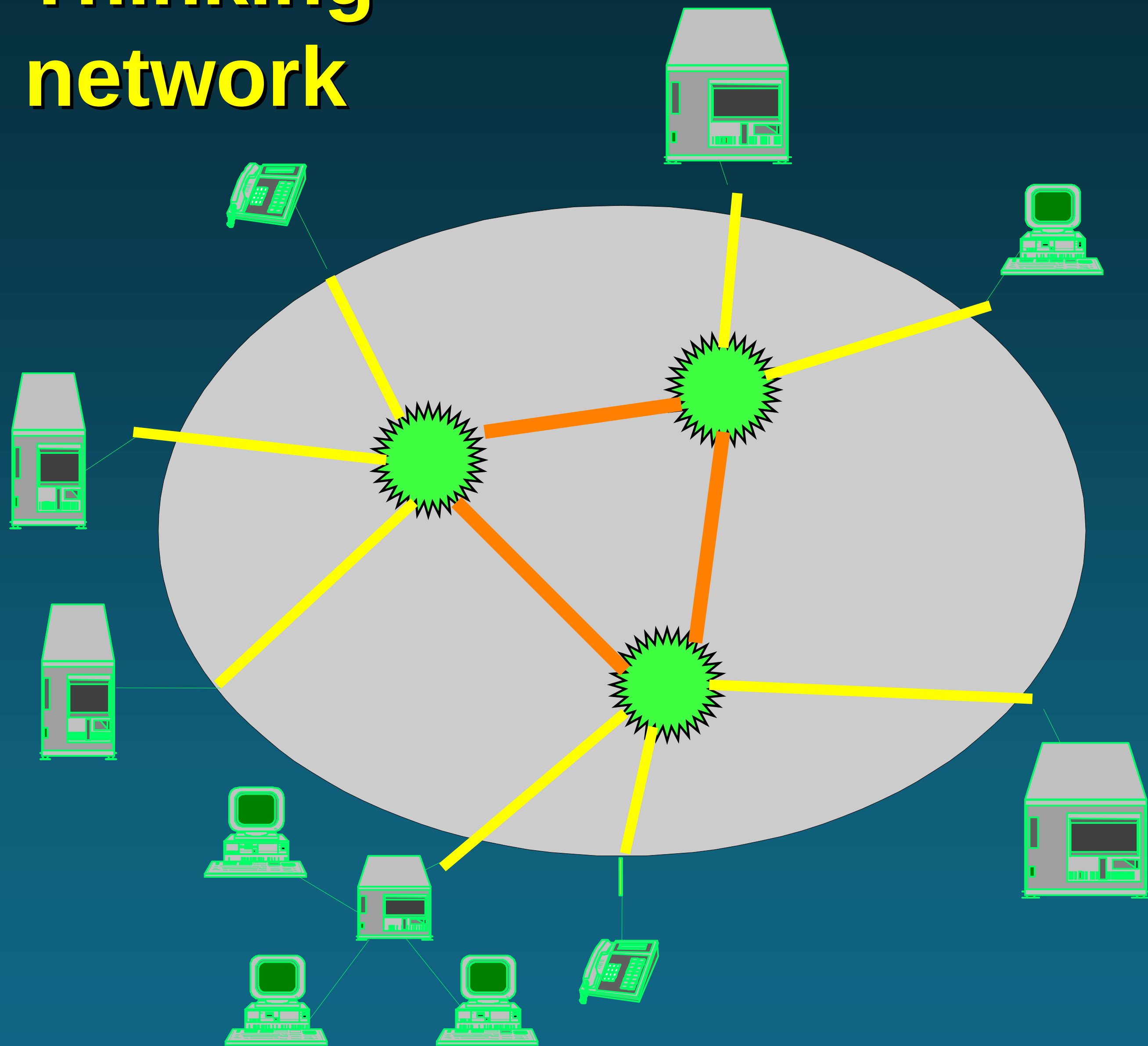
  Examples:

  - PSTN
  - Active computer networks

- Transparent network

  Intelligence only at the network edges

# Thinking network



# Active networks

**Active networks allow the network to perform customized computations on the user data**

These networks are “active” in two ways:

- Routers and switches within the network actively process, i.e., perform computations on the user data flowing through them;
- Individual users and/or administrators can inject customized programs into the network, thereby tailoring the node processing to be user and/or application specific.

# Physical limits of switches

- Aggregate throughput

  Example:
  Switch of 100000 lines; 10% usage
  Lines of 64 kb/s $\Rightarrow$ 0.64 Gb/s
  Lines of 155 Mb/s $\Rightarrow$ 1.5 Tb/s

- Power consumption

itti

# Trends

- Processing capacity: doubles every 12 – 18 months
- Transmission capacity: increases 100 to 1000 times faster than processing capacity

**Shift in network design principles:**
**using less processing**
**and more transmission capacity**

# ATM — unfulfilled promise?

**Major assumption:**

Bandwidth is a scarce resource, which has to be shared

**Major consequence:**

Sharing resources among significantly different users has led to excessively complex control structures

# All-optical networks

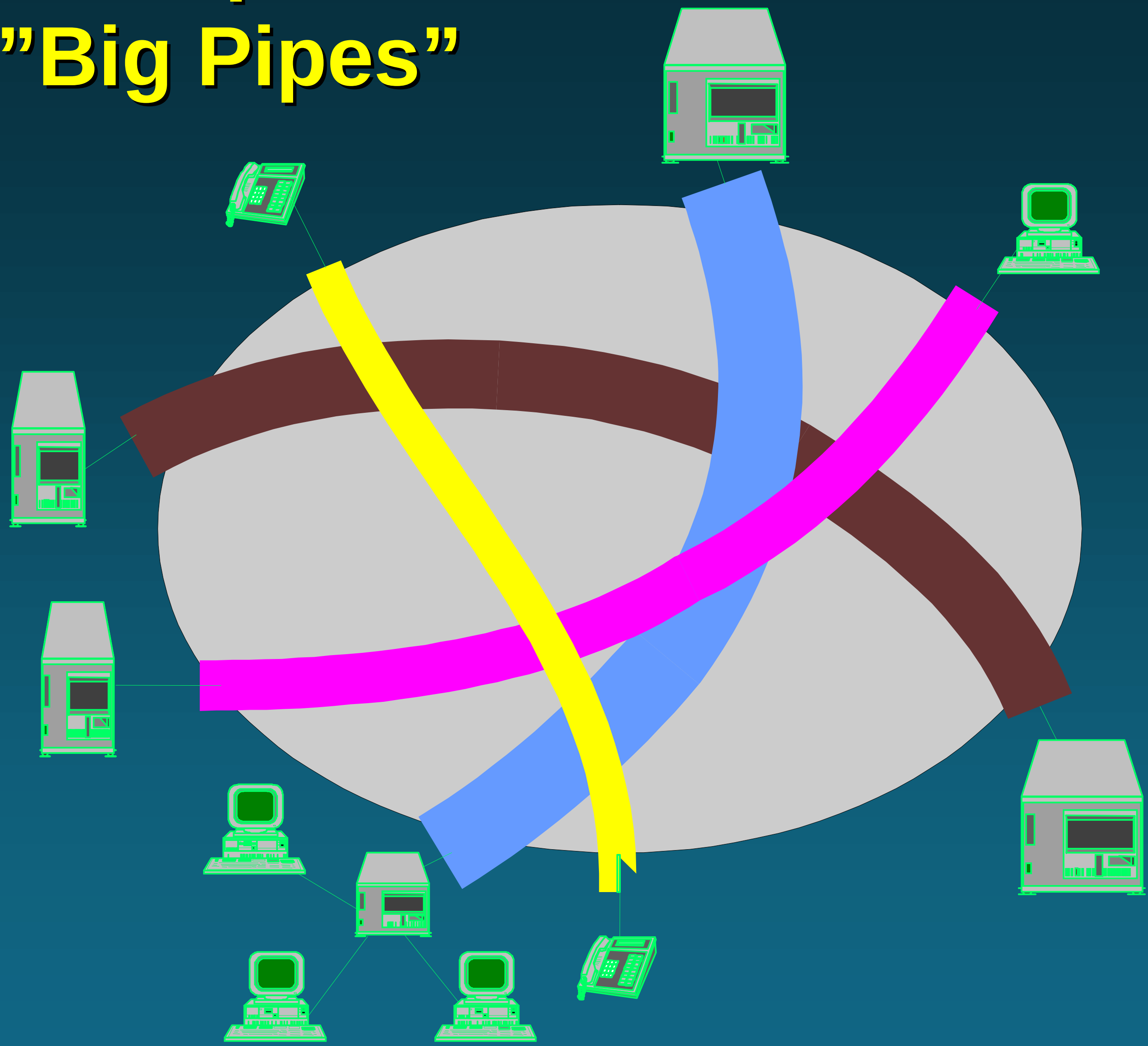
**Bandwidth available:**

**1.3 μm window:   8 THz**
**1.5 μm window: 10 THz**

**Opportunity:**

**All-optical core with simpler and more predictable resource management schemes**

# Transparent network: "Big Pipes"



# So, Where's Switching?

- At network edges
  - Switches in LANs
  - Switches in remote units
- In crossconnects (controlled by network management systems)

# No more Central Office buildings

- Routing function in transport nodes
- Operator positions in the operators' homes
- All line cards in remote units
- OAM positions in normal office buildings
- Service intelligence in dispersed servers

itti

# Some open problems

- Optimal distribution and replication of hardware & software components to maximize performance
- Performance in multi-protocol environments
- Multicasting
- Photonic networking architectures

# Conclusion

- Multiple players in telecommunications market
- Traditional switches are disappearing
- More stress on performance of upper layers and network management