Next Wave of Internet Applications Based on Seamless Integration of Devices, Users, and Data

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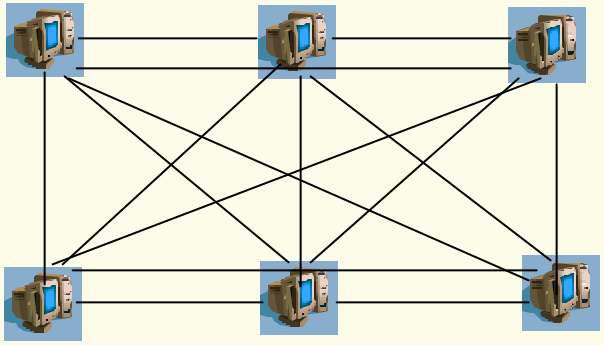
Content

- Vision
- Examples:
  - Home Networking
  - Factory automation
  - E-learning
- Summary

Vision



N = 6

C = 15

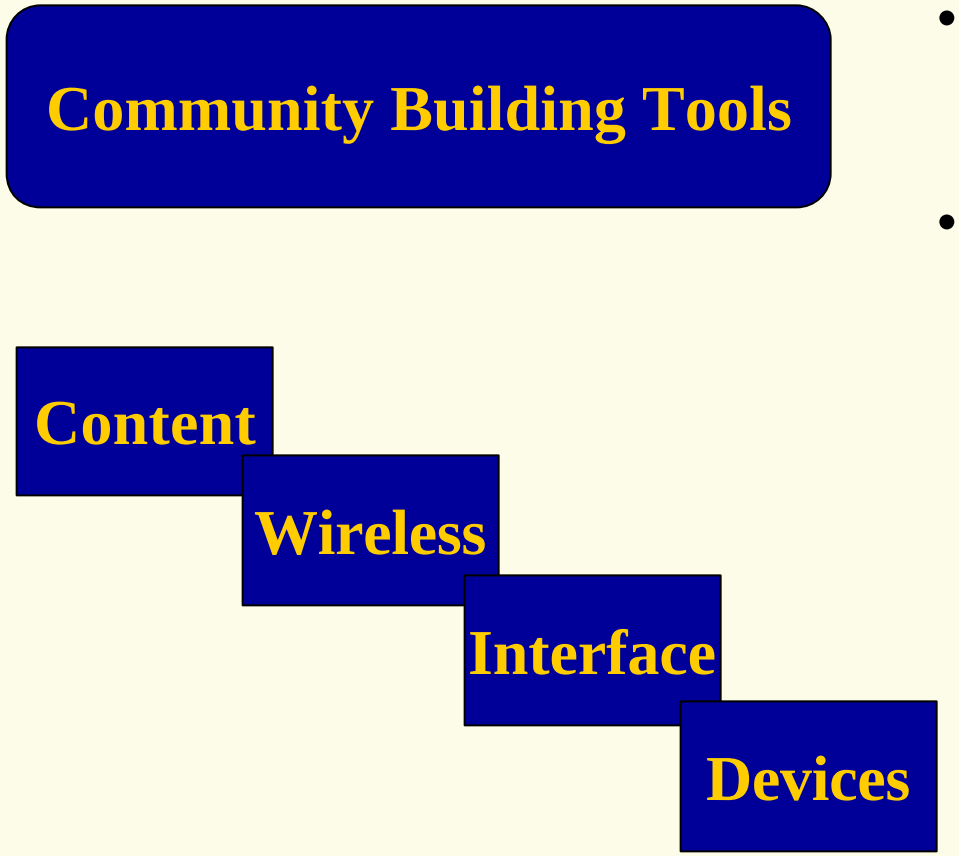
V ~ 36

Additional value:

- **Bandwidth of connections**
- **Shareable information stored**

- **Metcalfe's Law:**
  - The value of a network increases faster than its membership
  - History:
    - 1993: 2.5 M networked computers
    - 1997: 25M
  - V ~ N^2 for bi-directional connections
    - 1999 Internet value: $301B (Cisco)
    - 2008: ~6B connected devices (Bell Labs)

"Communities" Add Value

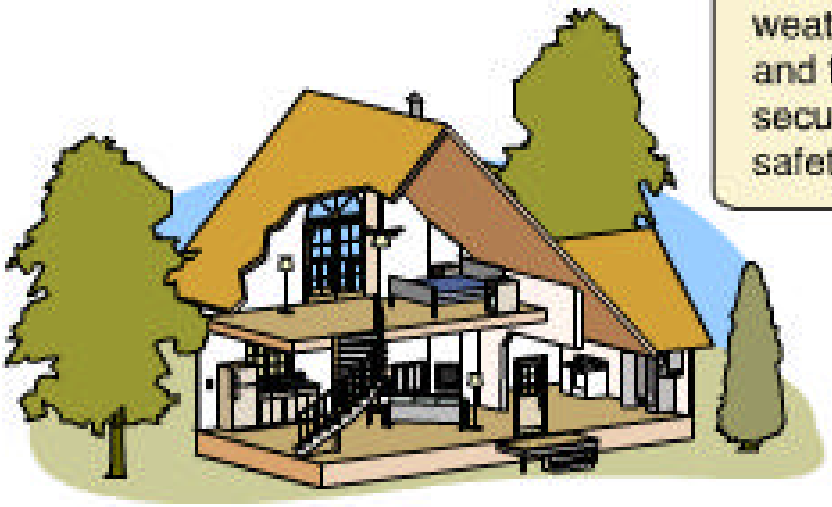


- Community:
  - A number of interacting people (devices)
- Three modes of interaction over the web:
  - One-to-many: Home page
  - One-to-one: Business to customer
  - Many-to-many: Virtual communities

Applications

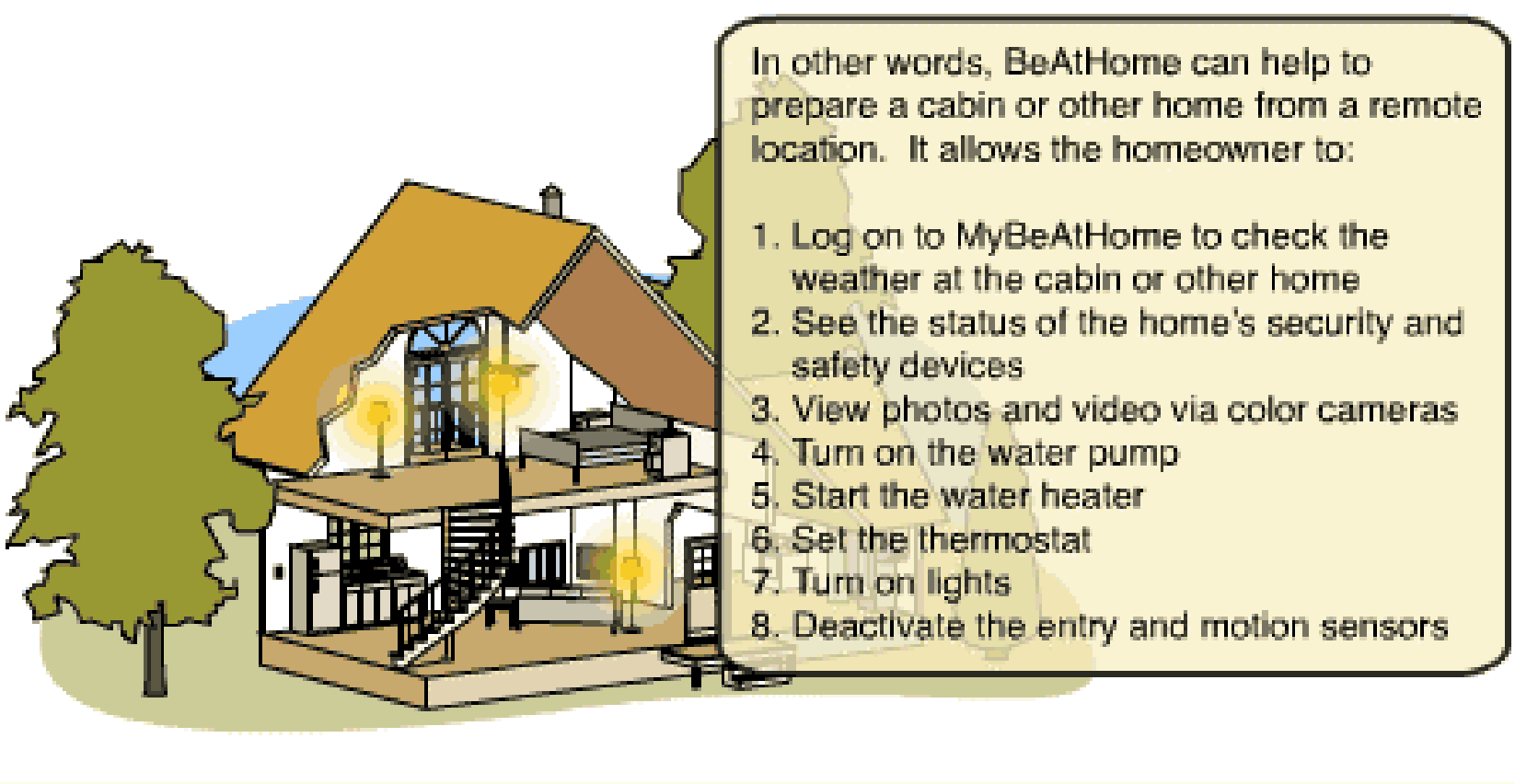
- Three sample applications:
  - **Home networking**
  - Factory automation
  - E-learning

Home Networking Vision



Tim logs on to MyBeAtHome from work to check the weather at his cabin and the status of its security system and safety devices.

Home Networking Vision

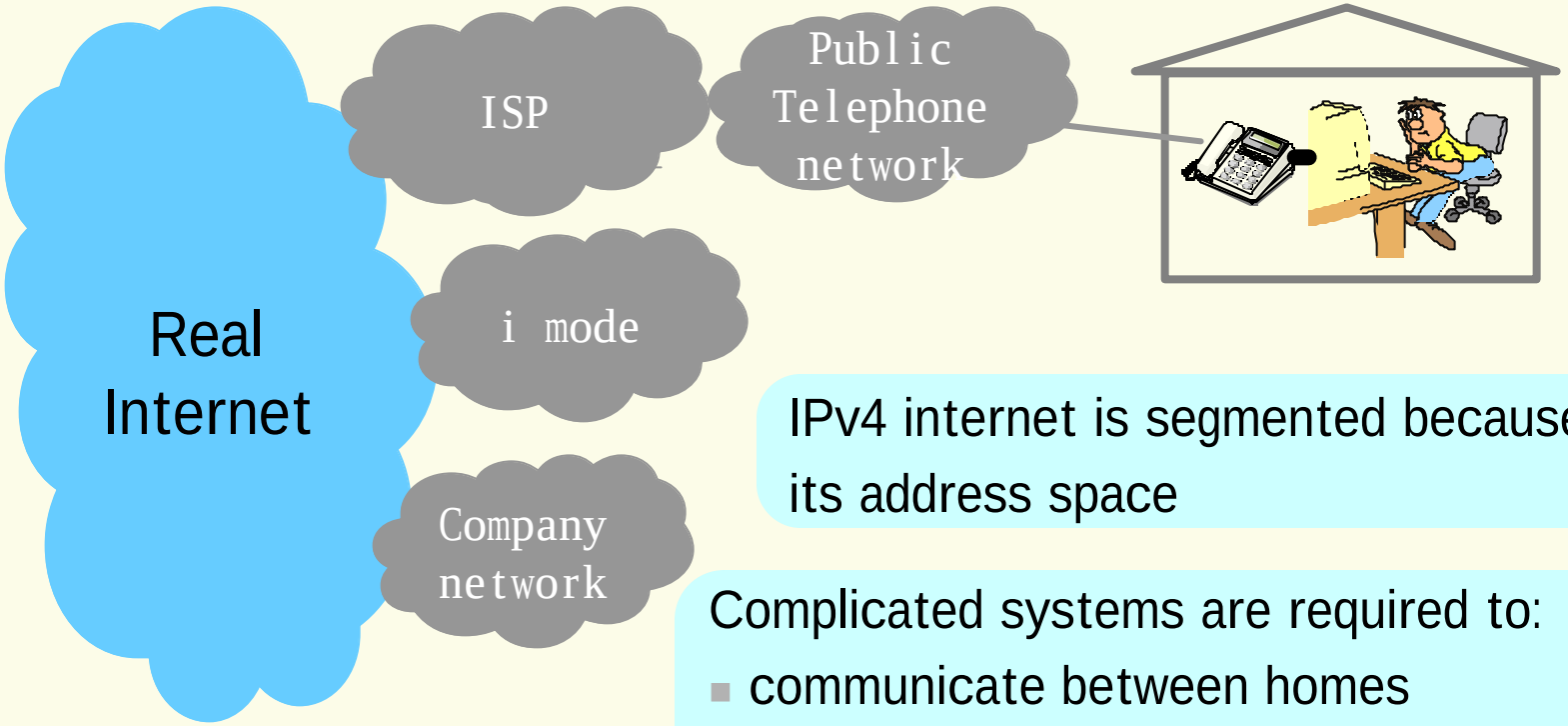


In other words, BeAtHome can help to prepare a cabin or other home from a remote location. It allows the homeowner to:

1. Log on to MyBeAtHome to check the weather at the cabin or other home
2. See the status of the home's security and safety devices
3. View photos and video via color cameras
4. Turn on the water pump
5. Start the water heater
6. Set the thermostat
7. Turn on lights
8. Deactivate the entry and motion sensors

Problems: Current Internet Using IPv4

IPv4 internet structure and problems



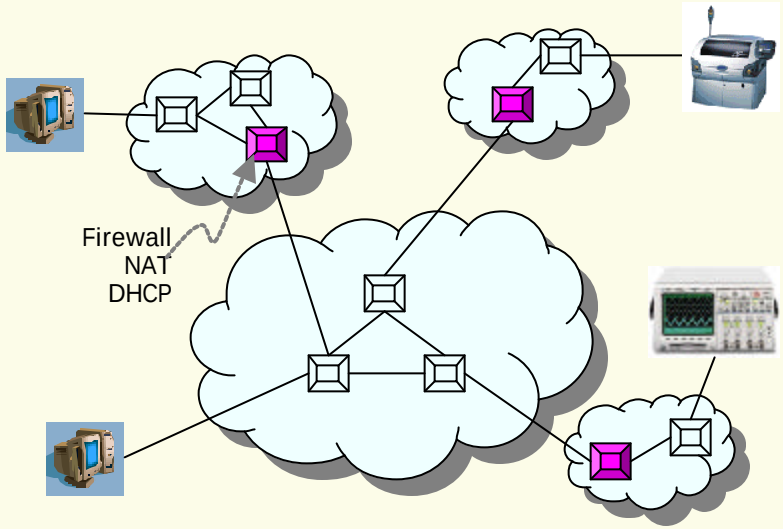
IPv4 internet is segmented because of its address space

Complicated systems are required to:

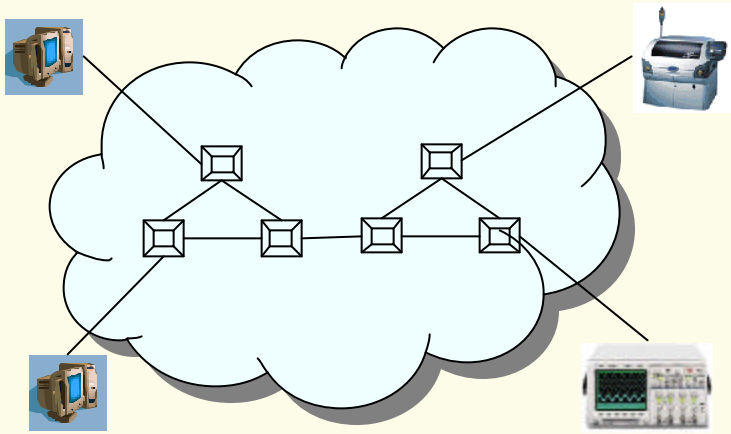
- communicate between homes
- control in-home equipment from internet
- distribute the gateway bottleneck

Goals of Pure IPv6

IPv4



IPv6



Problems in IPv4

- scarcity of addresses
- end-to-end transparency is often blocked behind NAT and firewalls

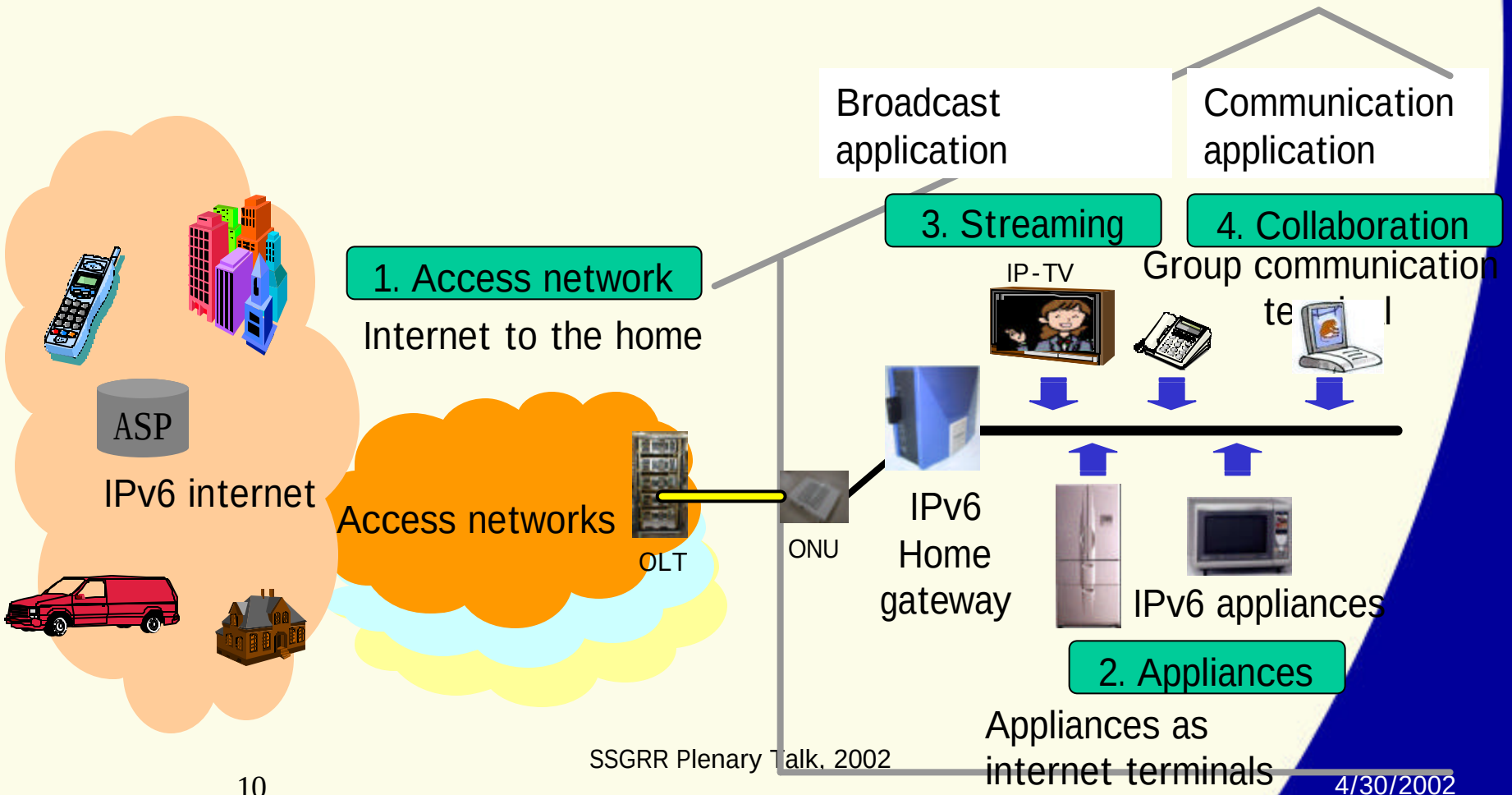
IPv6 is addressing the future.. (*)

- More addresses for new devices, new applications, and new users
- **Restoring the end to end model**, for performance, robustness, security, manageability, and enabling rapid innovation
- Enhancing IP for next-generation applications: multicast, mobility, plug-and-play, security, and multiple qualities of service

(*) F. Baker (CISCO fellow)
http://www.isoc-au.org.au/Events/IPv6Direction.ppt

Targets for IPv6 Implementation

Four targets must be realized for the “New Internet”

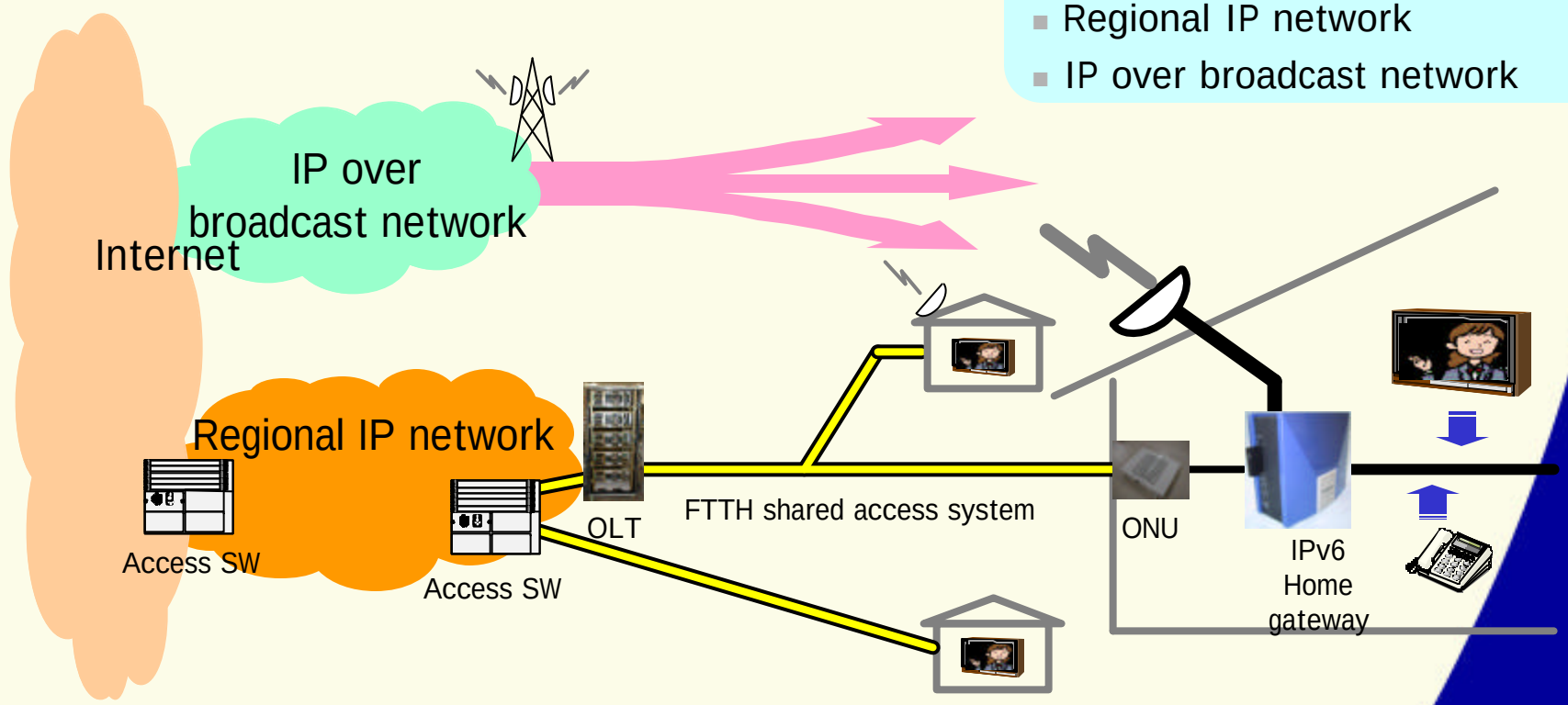


Target 1: Access network

Internet To The Home

Technologies connecting home to Internet

- FTTH shared access system
- IPv6 home gateway
- Regional IP network
- IP over broadcast network



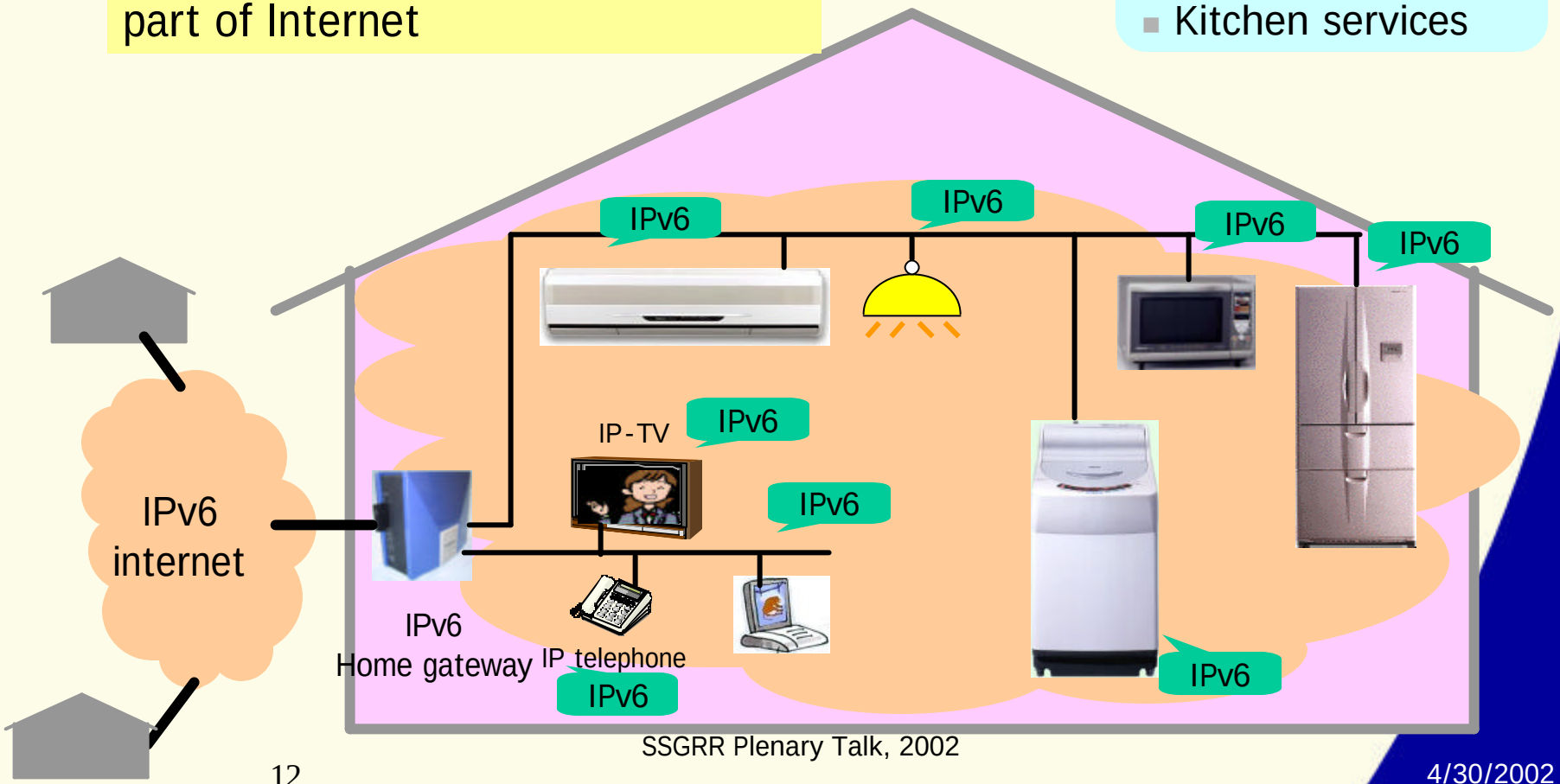
ISP | Carrier | Access network | Home network

Target 2: Appliances

i-Home

Technologies making home network part of Internet

- IPv6 appliances
- Slim IPv6 stack
- Kitchen services



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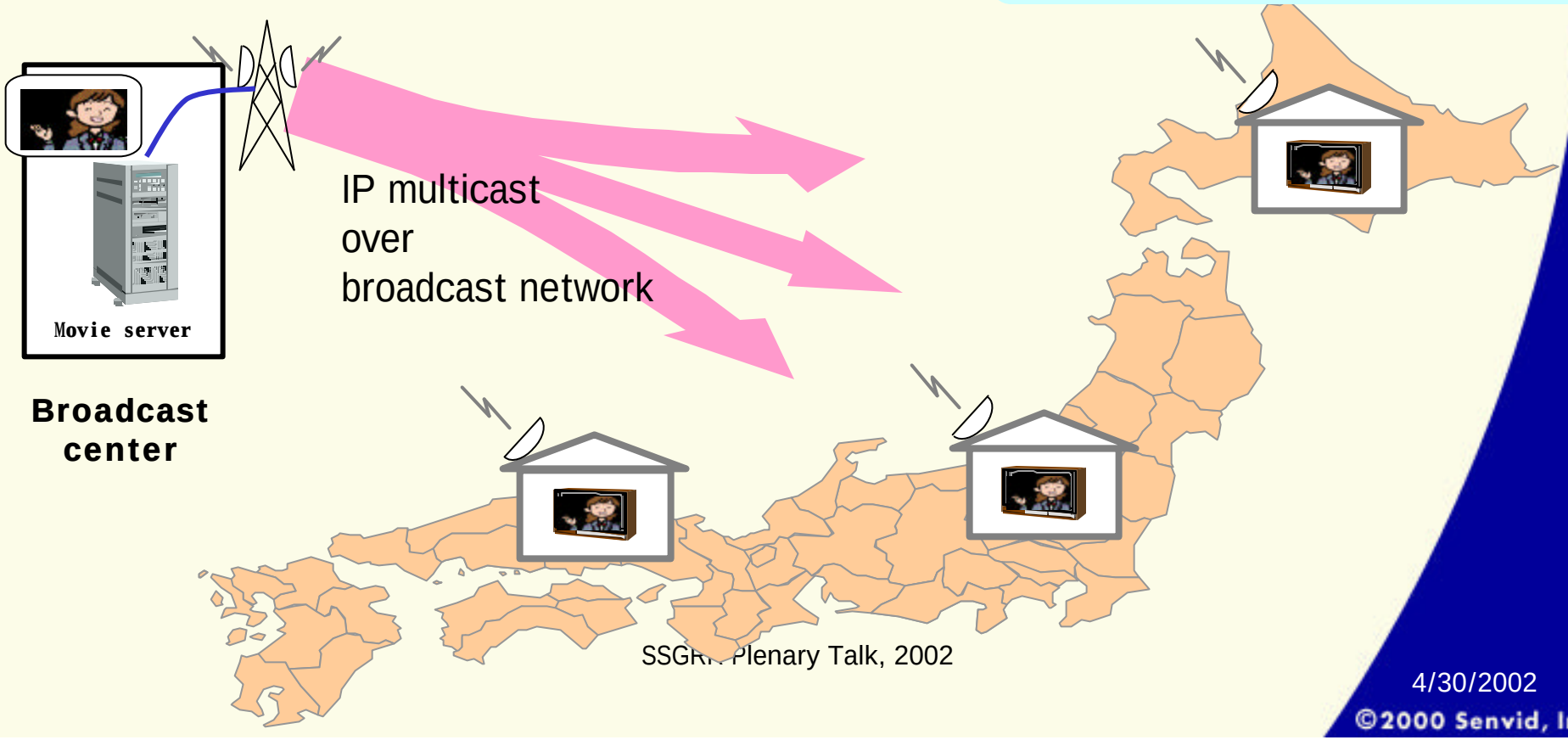
Target 3: Streaming

i-Broadcast

Technologies enabling real broadband
on one-way and large capacity broadcast

- real-time multicast transmission
- IP-TV



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Target 4: Collaboration

i-Communication

Technologies enabling multi-point peer-to-peer communications like existing telephone

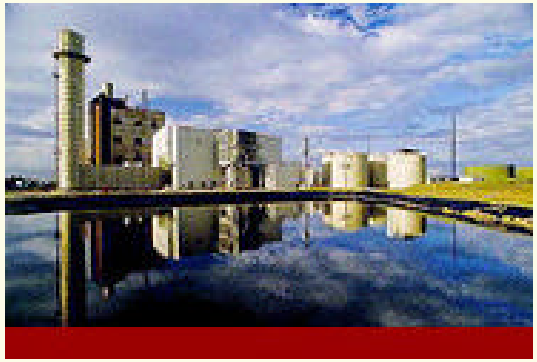
- Multicast session management
- Starcast

Applications

- Three sample applications:
  - Home networking
  - **Factory automation**
  - E-learning

What If It Can't ...

... generate?

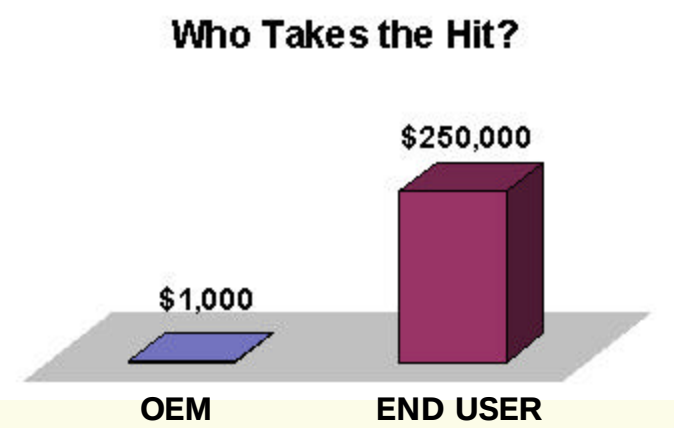


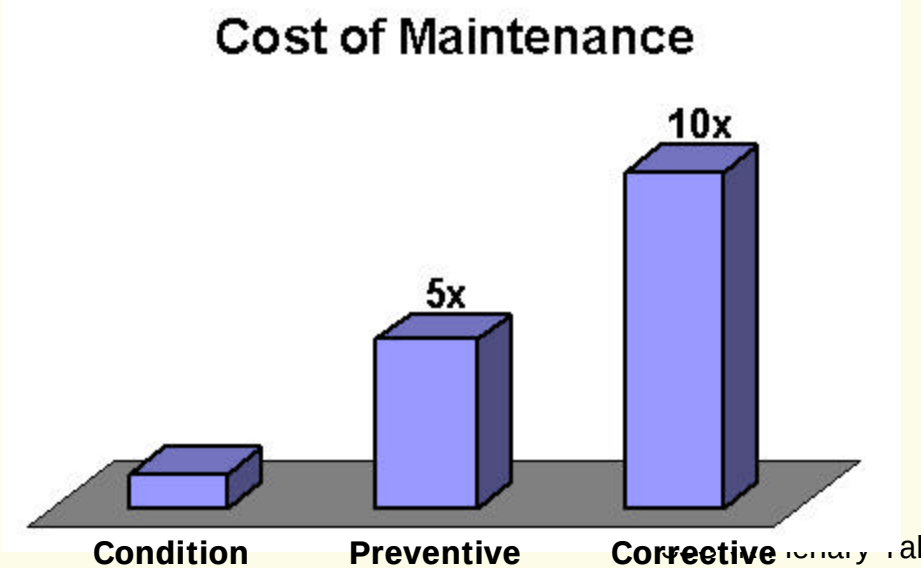
... fly?

... refine?

Hidden Costs

- Lost Revenue
- Excess Carrying Costs
  - ✓ Capital & Maintenance
- Recovery Costs



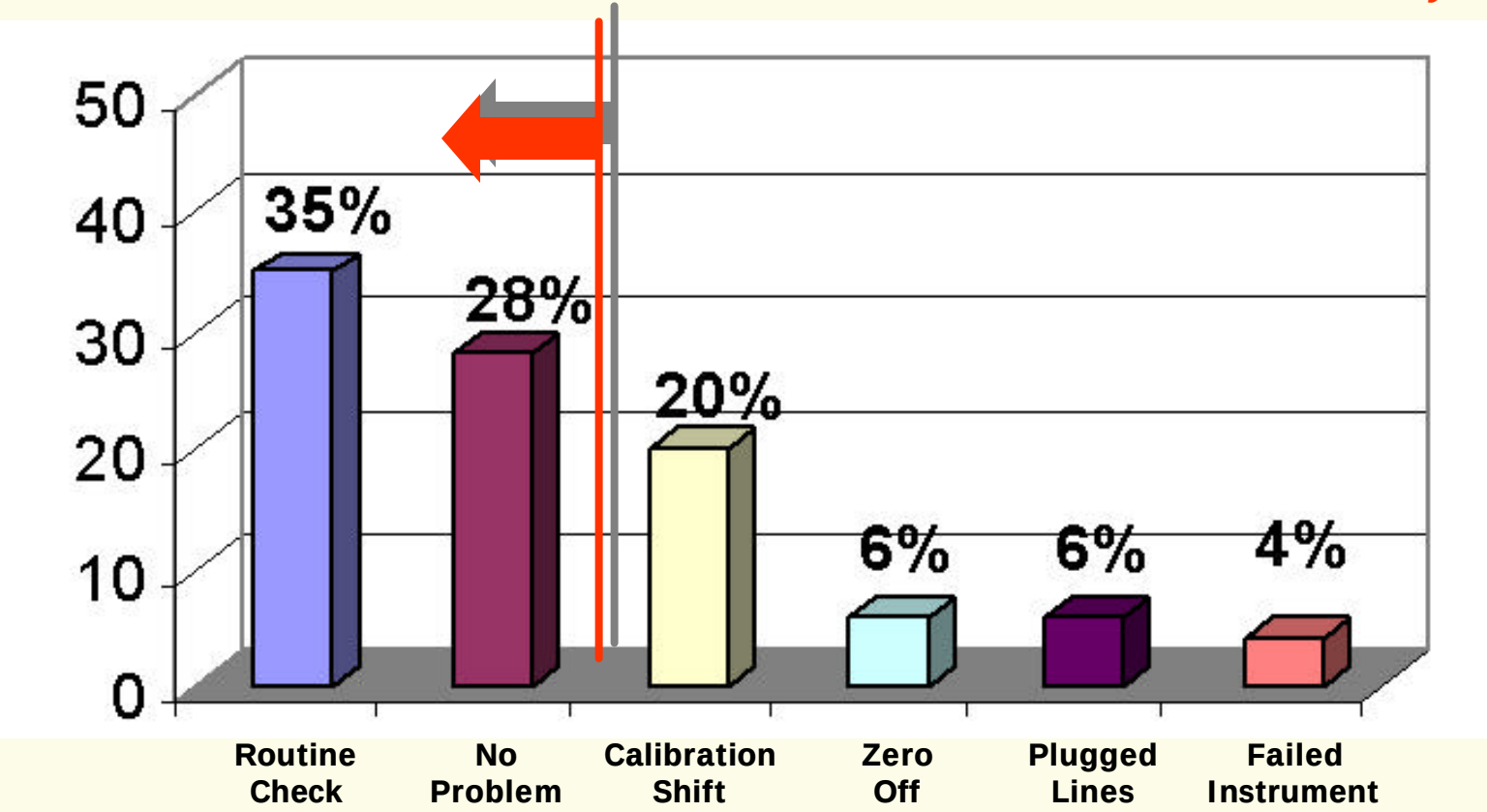


"1/2 of all planned maintenance is unnecessary."
ARC Advisory Group

alk, 2002

Excess Maintenance Costs

63% of instrument maintenance is unnecessary.

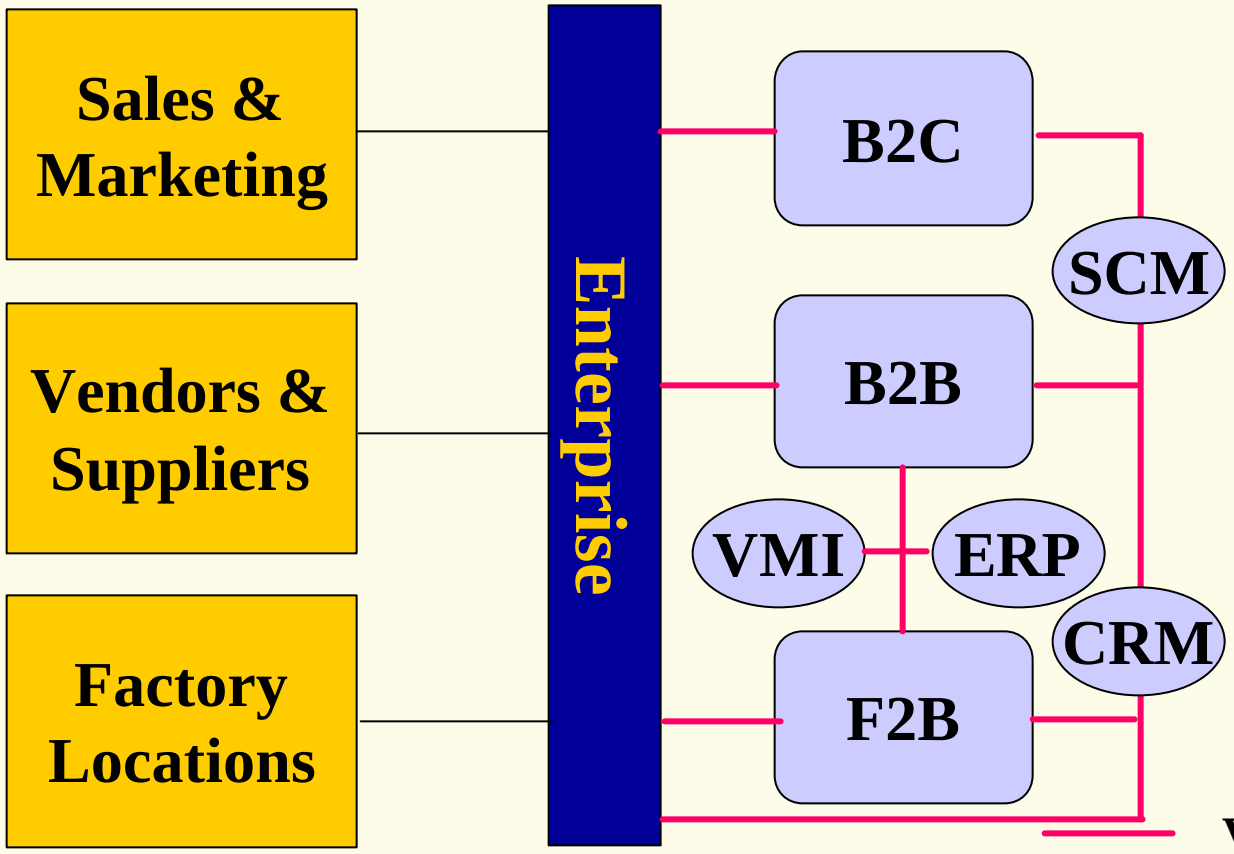


Source : Multi National Chemical Co. & Fisher Rosemont

SSGRR Plenary Talk, 2002

Solution: Connect Everything

Functional Space NEC Network Categories

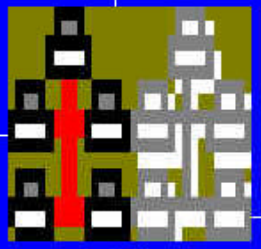


Legend: VMI= Virtual Management Inventory; VPN= Virtual Private Network; SCM = Supply Chain Management ERP = Enterprise Resource Planning; NEC = Networked Enterprise Core; CRM = Customer Resource Management

Example: Remote Maintenance & Service

END USER PREMISES:

Copy Machine, Printer, Duplicator, Fax, Multi Function Machine, etc.



LAN
PSTN

COMMUNICATION VIA:
- Internal or External Modem
- *Shared* Telephone Line
- LAN Network - TCP/IP
- Wireless

HOST MONITORING COMPUTER(S):

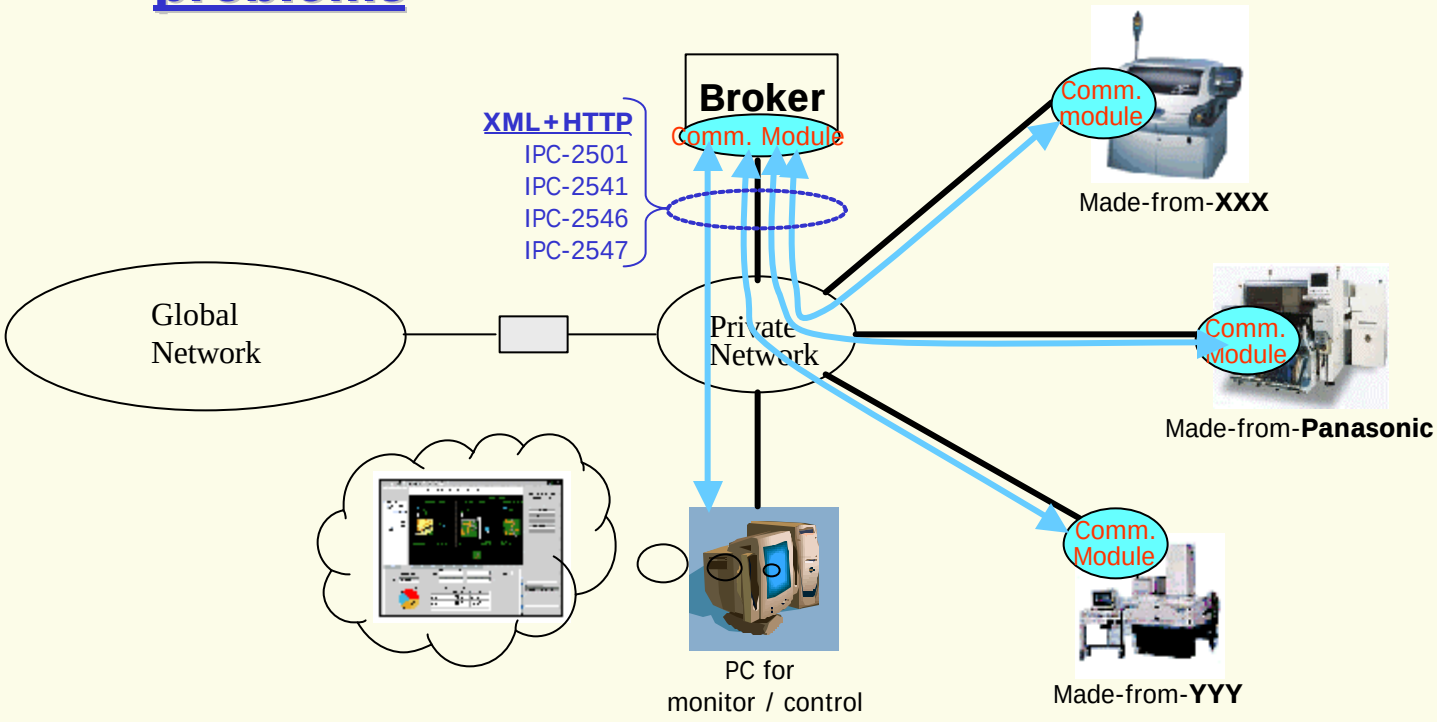
SERVICE OPERATION MONITORS:
- Machine Activity/Usage:
  - Volume (# of Sheets)
  - Preventive Maintenance Schedules
  - Service Contract Administration
  - Consumables Monitoring
- Optional Fault Reporting
  - Service Dispatch
- Status Reporting/Thresholding
- Remote Adjustments

BILLING OPERATION MONITORS:
- Machine Activity/Usage:
  - Invoicing, Monthly or Weekly
  - Collection

Ref: "http://www.monitel.com/howit.htm"

FA System Using IPC Standards

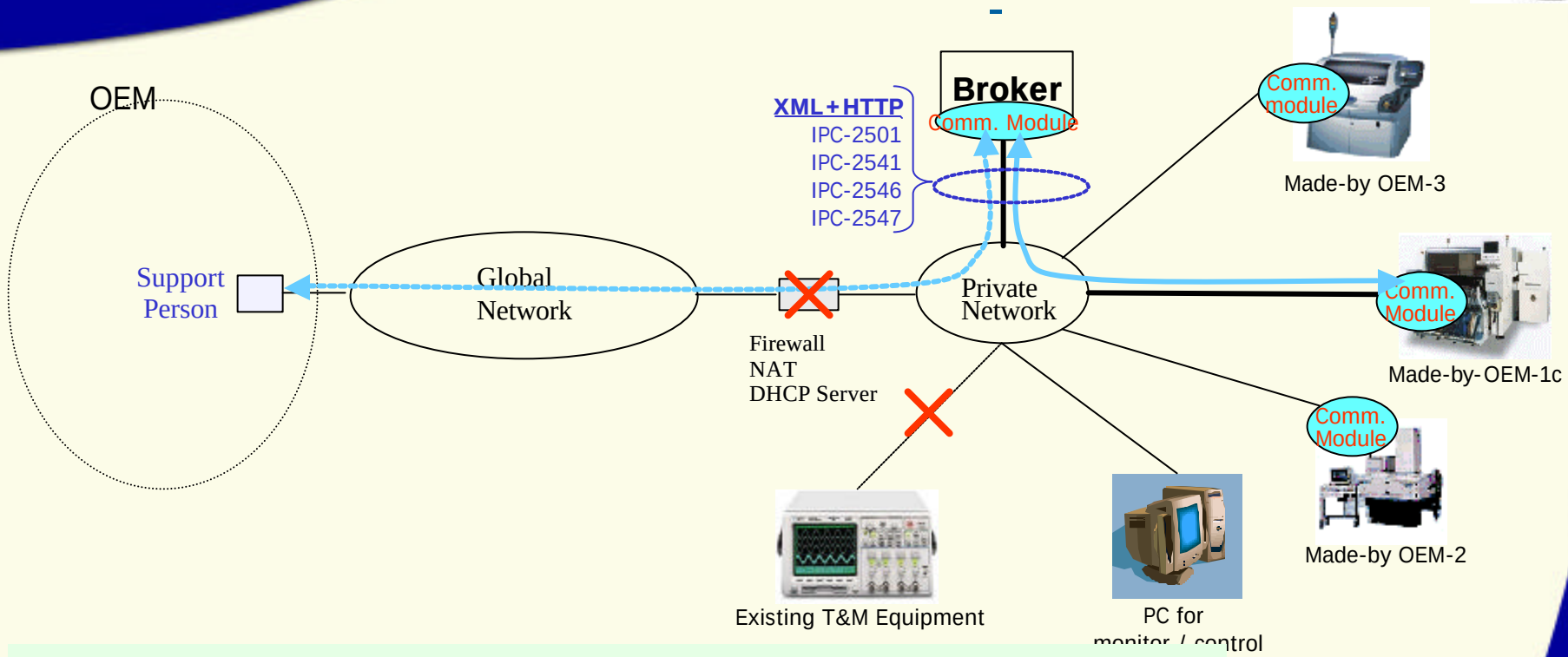
Standards for Factory Floor Communication using HTTP and XML will solve connectivity problems



Problems remain for heterogeneous systems

Problems

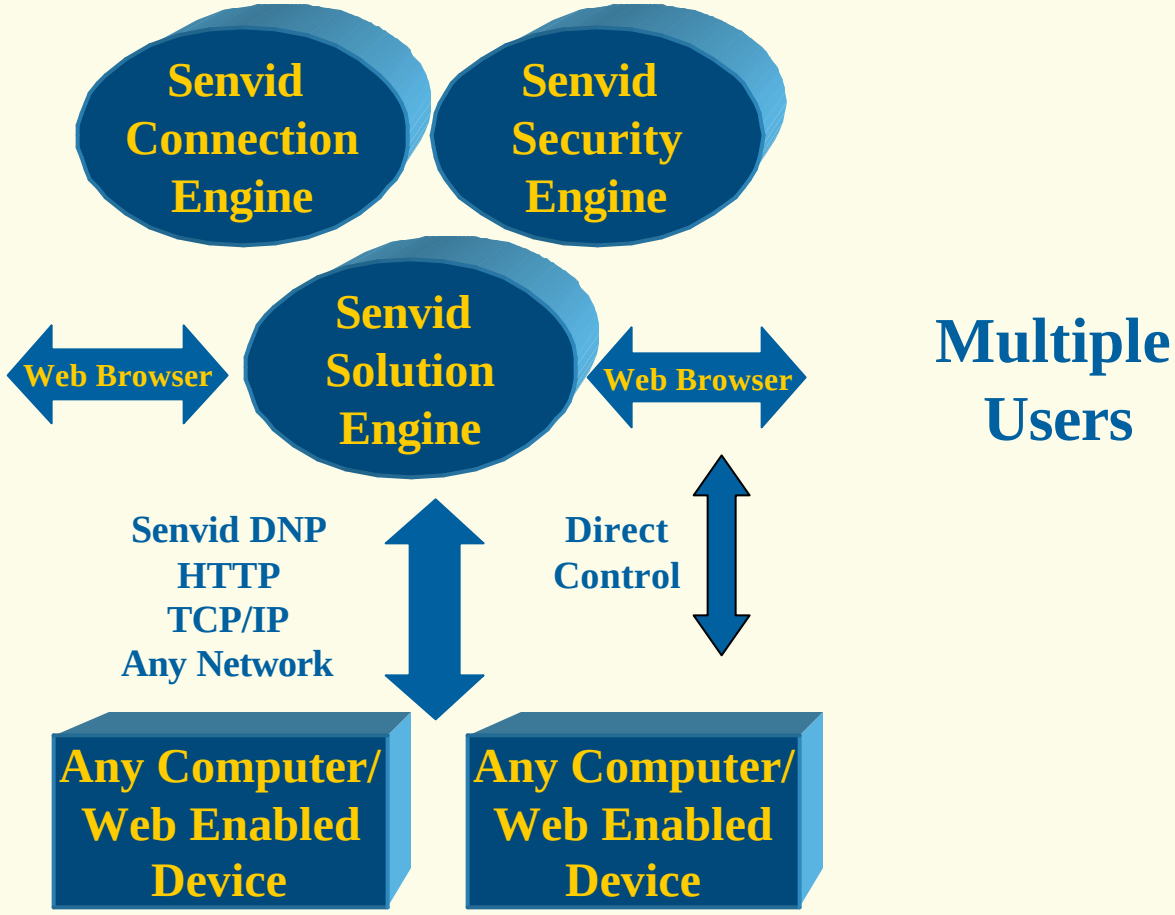
- remote maintenance and diagnosis -



Problems

- no connectivity to existing equipment which is not IPC compliant.
- one-to-one connectivity
- no connectivity outside the private network
- security issues (no authentication or encryption ability)
- no functionality for video monitoring
- no functionality for collaboration of multiple support personnel

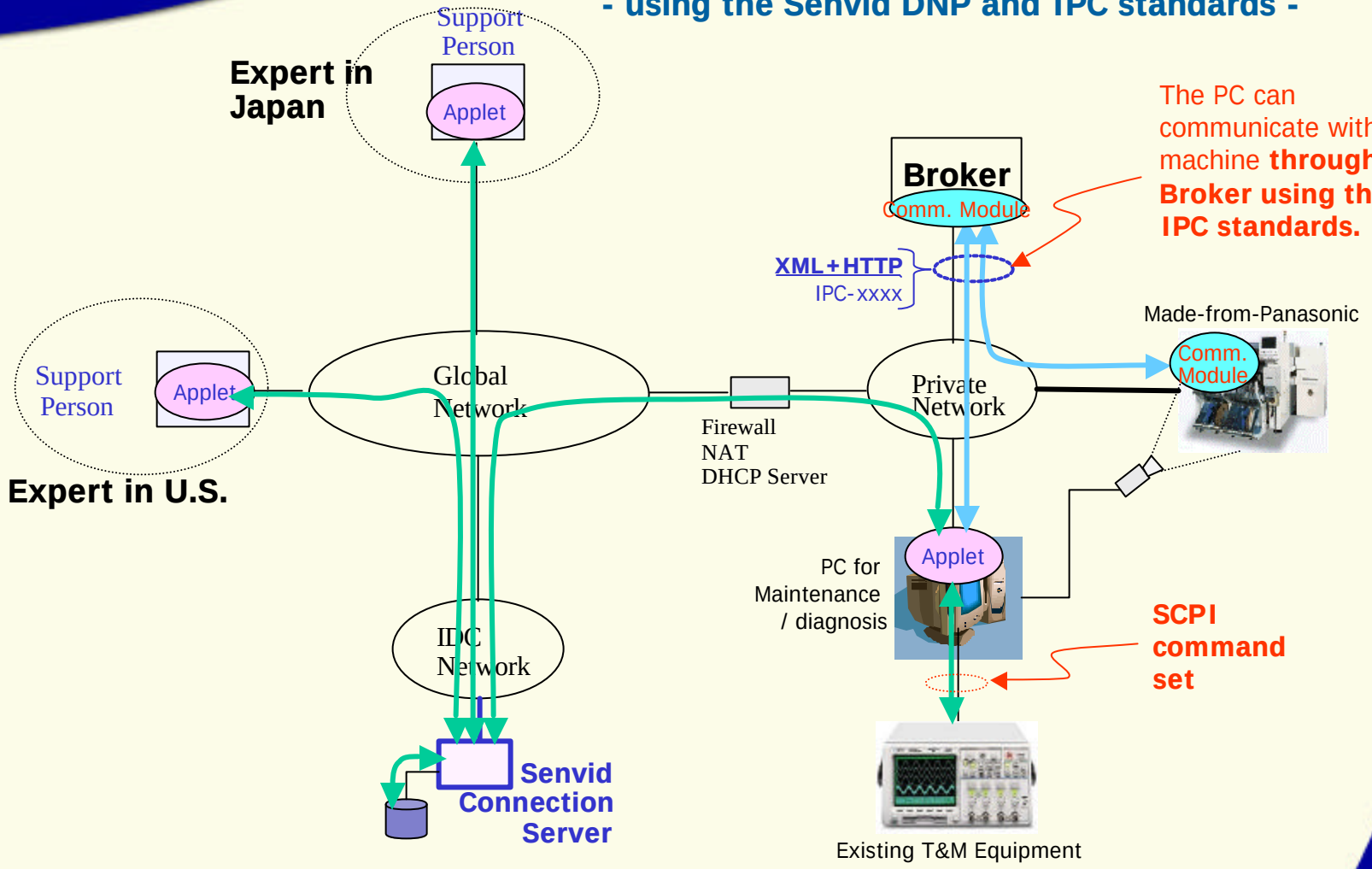
One Solution



Seamless, plug-and-ply integration of devices, users and data
Based on new protocol (DNP) and system architecture

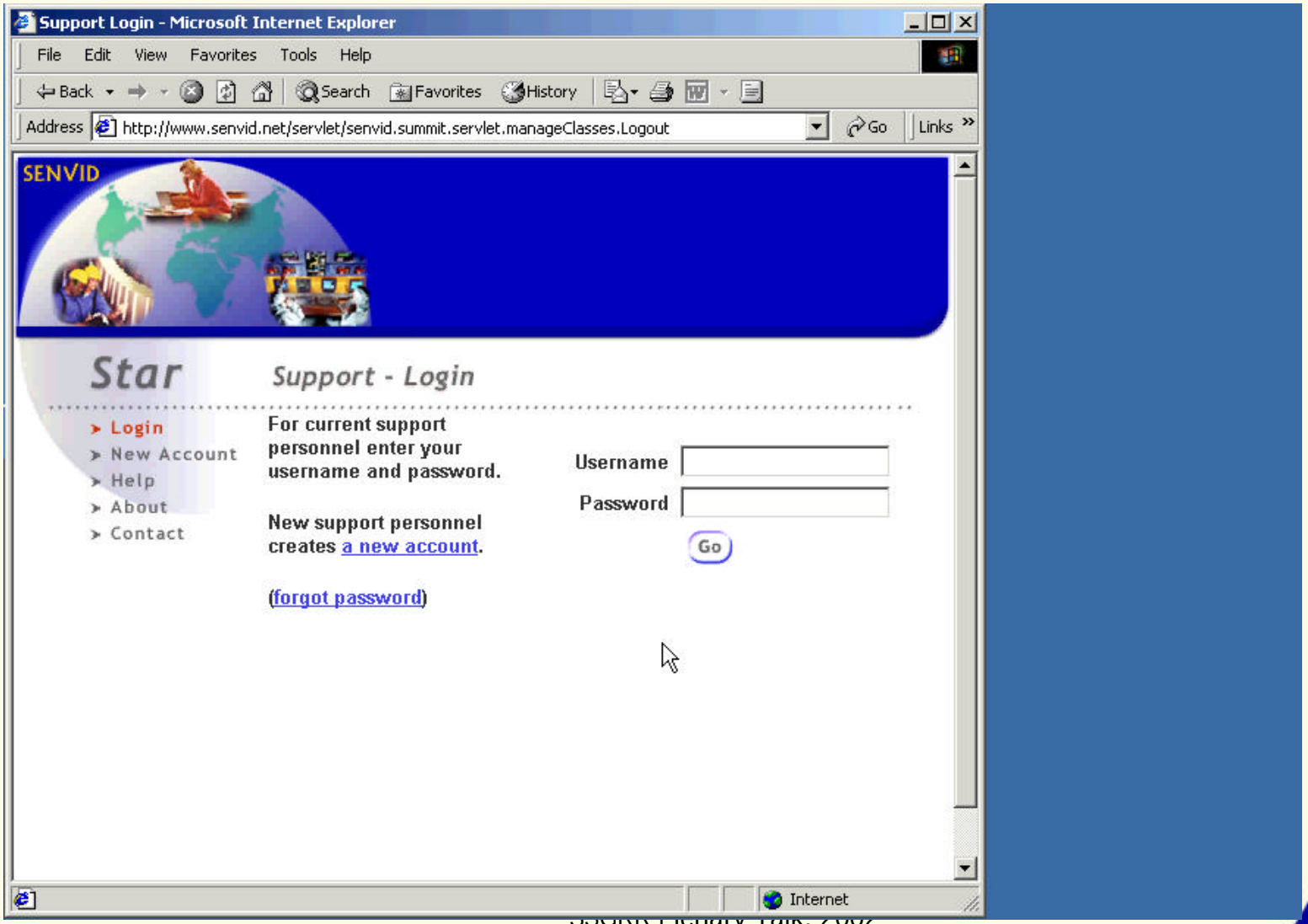
Remote Maintenance and Diagnosis system

- using the Senvid DNP and IPC standards -



Senvid platform integrates diverse equipments utilizing the IPC and other standards.

Remote Diagnosis and Control Demo



Applications

- Three sample applications:
  - Home networking
  - Factory automation
  - **E-learning using remote laboratories**

Education / Problem Statement

- Primary objective of education:
  - Teach students to Learn to Think, to Gain Knowledge
- Constraints:
  - I/O bandwidth into the brain, brain processing power, limited resources, assets, time, existing infrastructure
- In past one-on-one education has been most effective
- Problem Statement:
  - Optimize a student's learning process under the constraints.

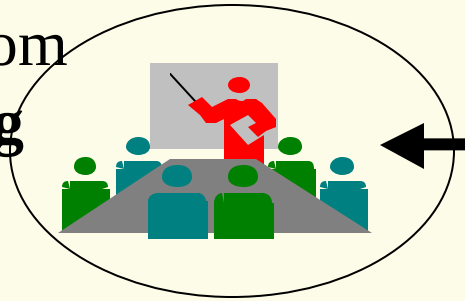
Conventional Approach

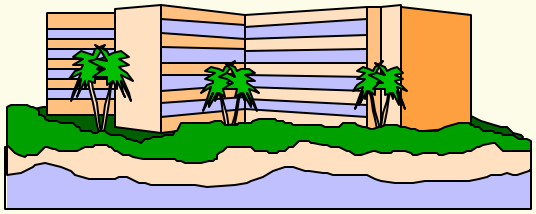
Traditional learning: 3-Body Problem

Administration

$$, employment

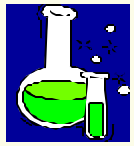
Classroom **teaching**





Universities

Laboratory



Time, effort, learning rate

$$, Degrees

High Inertia System

Students

Learning Process: My Observation!

Information

I/O limited

Creation of new knowledge, understanding, innovation

Very low I/O

Richard Feynman

- Storage: repetitive reading
- Processing: difficult, takes time and effort
- Feedback loop system

What role can the Internet play in this process?

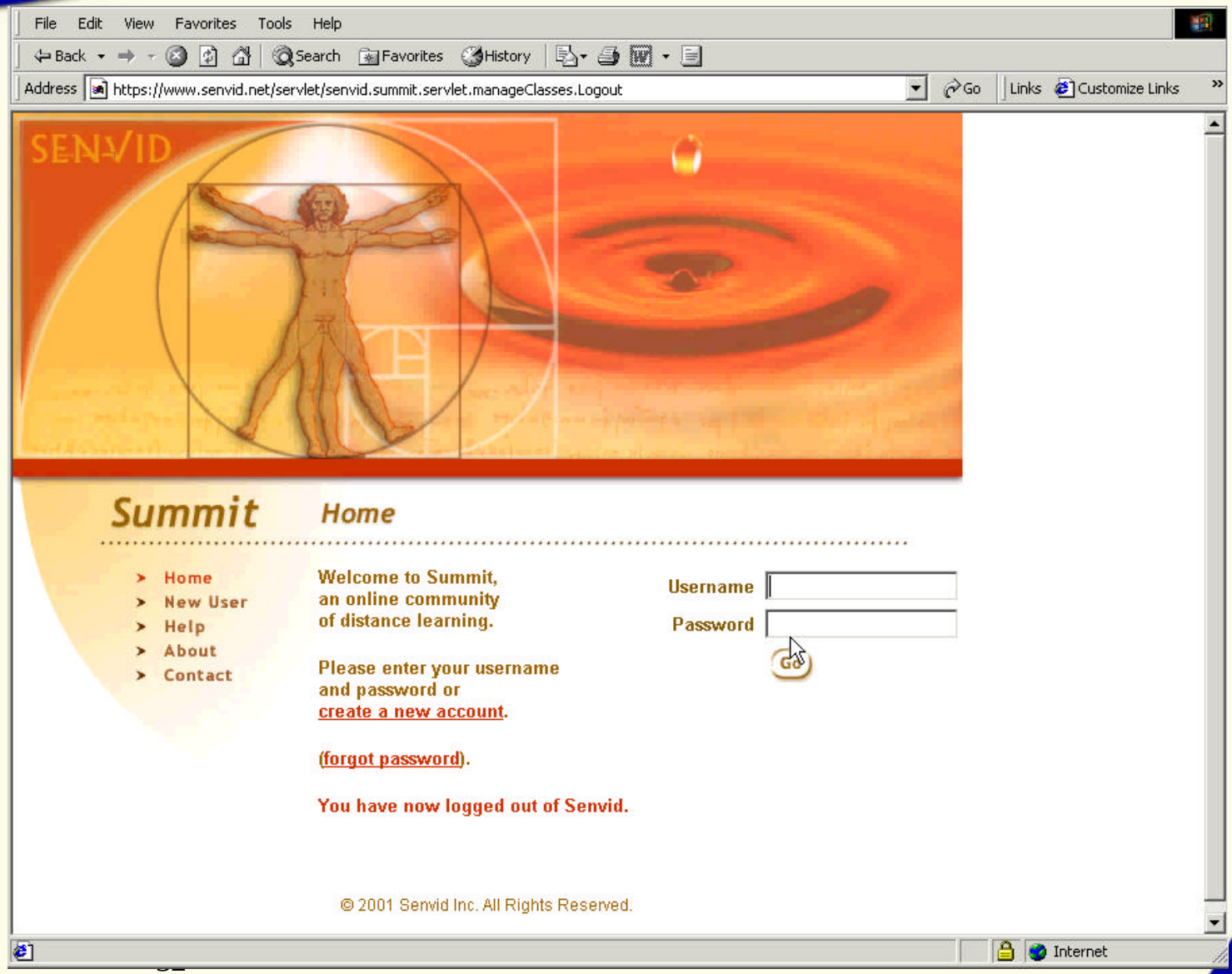
The Role of the Internet

- Efficient Reading Machine
  - **"Live Book"**
  - **Internet make teacher/student tasks easier, more efficient**
- Benefits:
  - Efficient information provider: Students, labs and teachers can be at separate locations and times
  - Frees the teacher and student from cumbersome tasks
  - Provides more time for learning through more personal contact with the teacher, and others
- Build on top of the current educational infrastructure

CyberLab Value Proposition

- Provide:
  - Reliable, well thought-out laboratory system
  - Access to scarce resources to a wider population of students through time sharing
- Benefits:
  - Reduce cost of education through efficiency
  - Reduce the barrier to entry to laboratory work
  - Promote discovery through experimentation
  - Improve classroom teaching and distance learning through demonstrations
  - Allow more time for personalized education

Remote Laboratory Demonstration



Benefits

- CYBERLAB

- Instill good laboratory practices
- Student excitement stimulates learning
- Provide access to laboratory, computational, and reference facilities worldwide
- Cost effective learning tool
- Sharing of resources
- Convenient and fun
- Remote hands-on experience

- WET LAB

- Instill good laboratory practices
- Student frustration often impedes learning
- Does not provide efficient access to laboratory, computational, and reference facilities worldwide
- Expensive learning tool
- Difficult to share resources
- Often frustrating and tedious
- Hands-on experience

Summary

- **Internet:**
  - Glue that connects everything, devices, people, data
    - Increases network value
    - Increases productivity
  - Requires improvements:
    - Connectivity standards, IPv6, OSGi
    - Reliability and quality of services
  - Makes many new applications possible:
    - Remote asset management
    - Individualized services:
      - Education, “Live Book”
      - Training
      - My everything
  - Should allow more time for truly important tasks