

Traditional Systems can Work Well for Pervasive Applications. A Case Study: Plan 9 from Bell Labs Becomes Ubiquitous.

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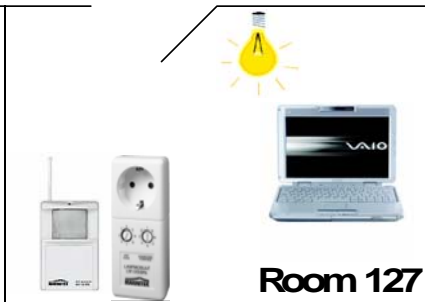
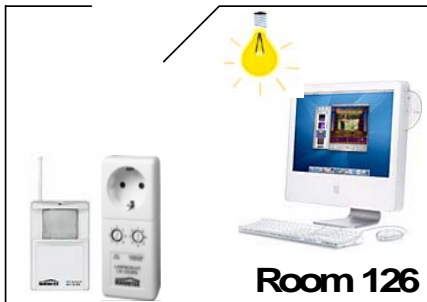
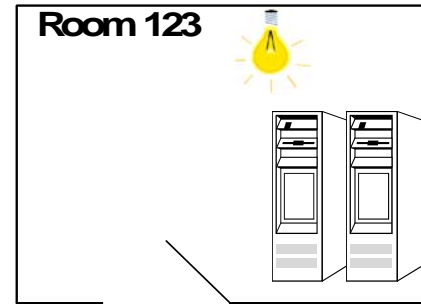
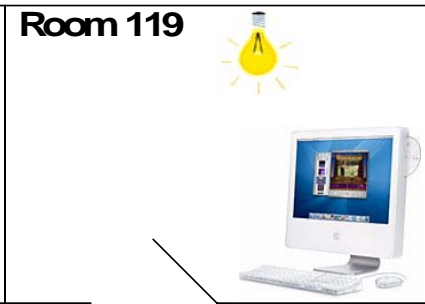
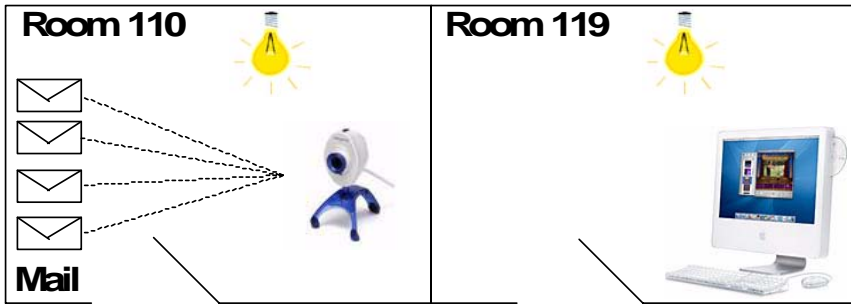
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Do we really need middleware?

- We do not think so. We will show that:
 - The operating system **already** provides enough functionality to support a smart space.
 - Our users do not need to install new SW to use the new services.
 - Old programs still work.

The URJC Systems Lab's Smart Space



Main Idea

We follow the principles of Plan 9, a distributed system developed in the late 80s and early 90s.

Plan 9 approach

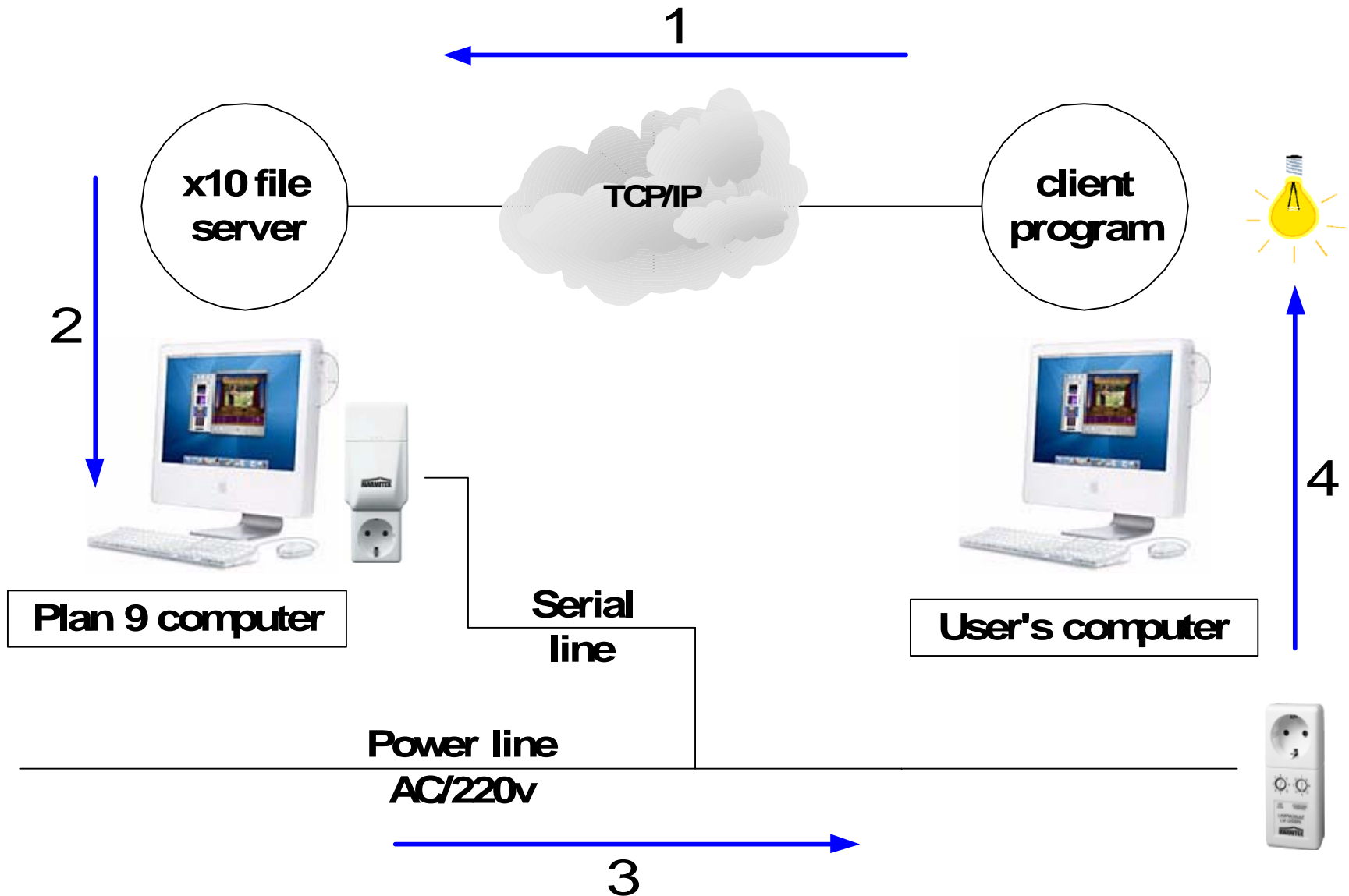
- **Everything is a file:**
 - Lights, audio, network connections, windows....
- **All files are accessible remotely:**
 - 9P, CIFS, NFS, HTTP, SMB...

Therefore



A Windows client can use the Notepad to switch off the lights.

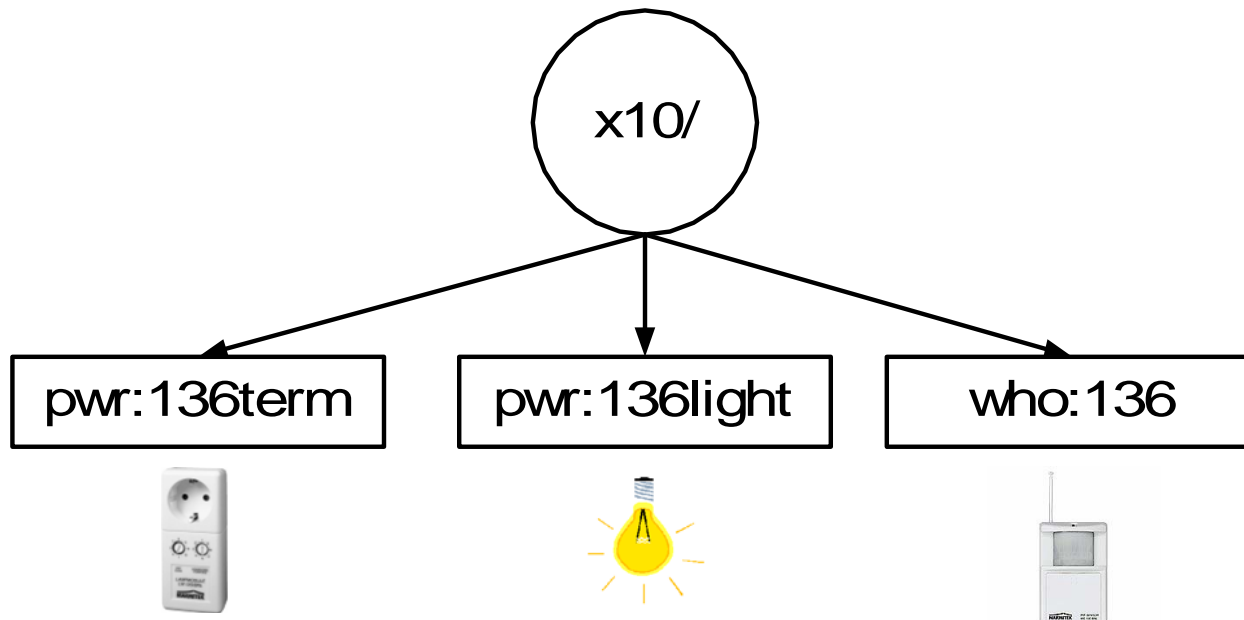
The X10 service (1/2)



The X10 service (2/2)

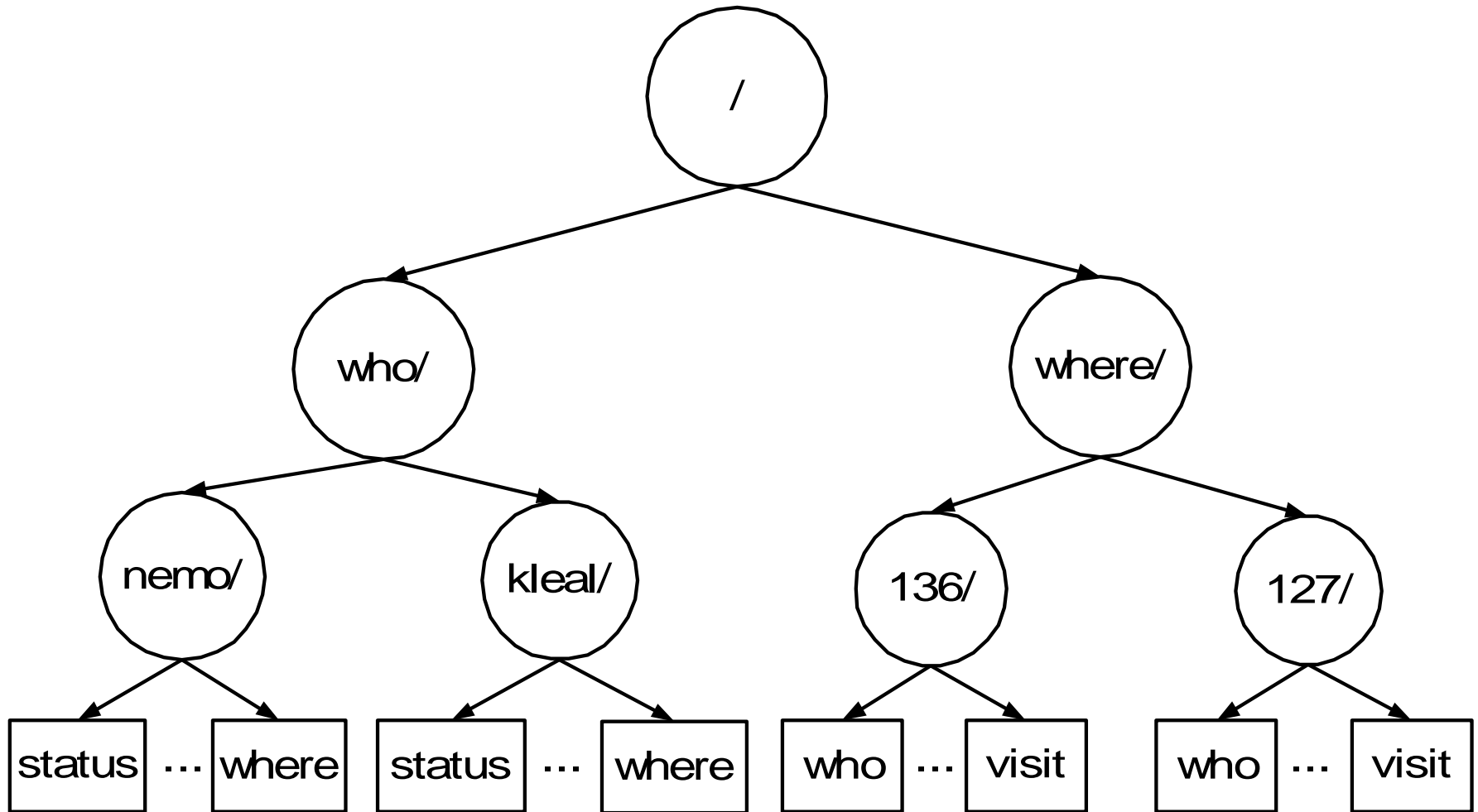
The X10 file system

- Flat directory with a file per X10 device.
- Device file operations:
 - **Read** to get the device status.
 - **Write** to update it.
- Each X10 file appears to contain: on or off.



Context Handling: we use the same approach

Our “framework” for context-awareness is a file hierarchy



Good news: using old programs to do new things (1/3)

```
; 9fs x10 #mounts the X10 file servers
; ls -l /n/x10/*136*
--rw-r----- t 0 nemo 16:14 /n/x10/pwr:136term
--rw-r--r-- t 0 nemo 16:14 /n/x10/pwr:136light
--r--r--r-- t 0 nemo 16:14 /n/x10/who:136
; grep off /n/x10/*136*
/n/x10/pwr:136light: off
```


... we can use the **Winzip** program to archive/recover the state of the power switches at a particular moment.

Good news: using old programs to do new things (3/3)

- We do not need a new security-framework.
- We can use 'chmod'.

```
sh> ls -l /n/x10/*136* /n/x10/*124*
--rw-r----- t 0 nemo nemo 0 Mar 22 16:14 /n/x10/pwr:136term
--rw-r--r-- t 0 nemo nemo 0 Mar 22 16:14 /n/x10/pwr:136light
--r--r--r-- t 0 nemo nemo 0 Mar 22 16:14 /n/x10/who:136
--rw-r----- t 0 kleal kleal 0 Mar 22 16:14 /n/x10/pwr:124term
--rw-r--r-- t 0 kleal kleal 0 Mar 22 16:14 /n/x10/pwr:124light
--r--r----- t 0 kleal kleal 0 Mar 22 16:14 /n/x10/who:124
sh> chmod o-r /n/x10/who:124
```

Bad news: problems found

There are problems adapting to changes

- What does it happen if a **server** goes down?
- What does it happen if a **user** moves to other location?

We still rely on centrally administered servers

- Who is going to be the **authentication server**?
- Who is going to be the **file server**?
- What do we do **if they fail**?

Plan B

- Resource discovery service.
- Means for users to specify their preferences about resources.
- Peer-to-peer, human centered, approach to security.

Conclusions

- Files already provide:
 - naming, protection, interoperability...
- Our users *do not need to install new SW* to use the new services.
- Old programs *still work*.

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