Pervasive Dependability

- Moving Dependable Computing Towards Mainstream Systems -
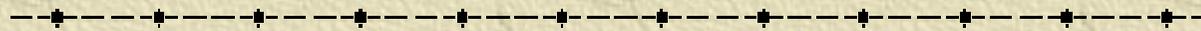
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Pervasive Dependability (PD)

✴ Future computing likely to be **pervasive**:

◆ Networked, heterogeneous, highly dynamic, highly complex, autonomous, ….

✴ **Example**: Networked homes

➡ **Pervasive computing requires pervasive dependability!**

What is Pervasive Dependability?

* **Intuitive Definition**:
  * scope of dependability mechanisms extended to non-critical domains, all devices, and all software layers.
* **New requirements**:
  * High degree of diversity:
    * different applications
    * different hardware platforms
  * Low initial cost & low maintenance cost!
  * (Almost) no system administrators!
  * Very dynamic environment (application mix, mobility)
  * Mobility & wireless network support, …

Why do we need PD?

* Pervasive systems (we are interested in) are neither mission-critical nor safety-critical.
* We consider low-margin systems:
  * "Profit = f(Dependability)"
  * Need to increase dependability to be profitable!
* Example:
  * each customer service call costs money
  * need to reduce customer calls to be profitable
  * also: initial costs have to be low!

Research Challenges

- **Collection of abstractions and techniques**:
  - Handling changes and mobility $\Rightarrow$ ensuring seamless operation and enabling adaptation.
  - No system administrators $\Rightarrow$ Support of automation (e.g., automatic fault-diagnosis)

- **Programming challenges**:
  - Suitable models, everyware, and tools.
  - Customization and reuse.
  - Integration of COTS hardware & software

- **Resource control:**
  - Bandwidth, battery life,…

# Dependable Computing Utility

(Christof Fetzer and Karin Hogstedt)
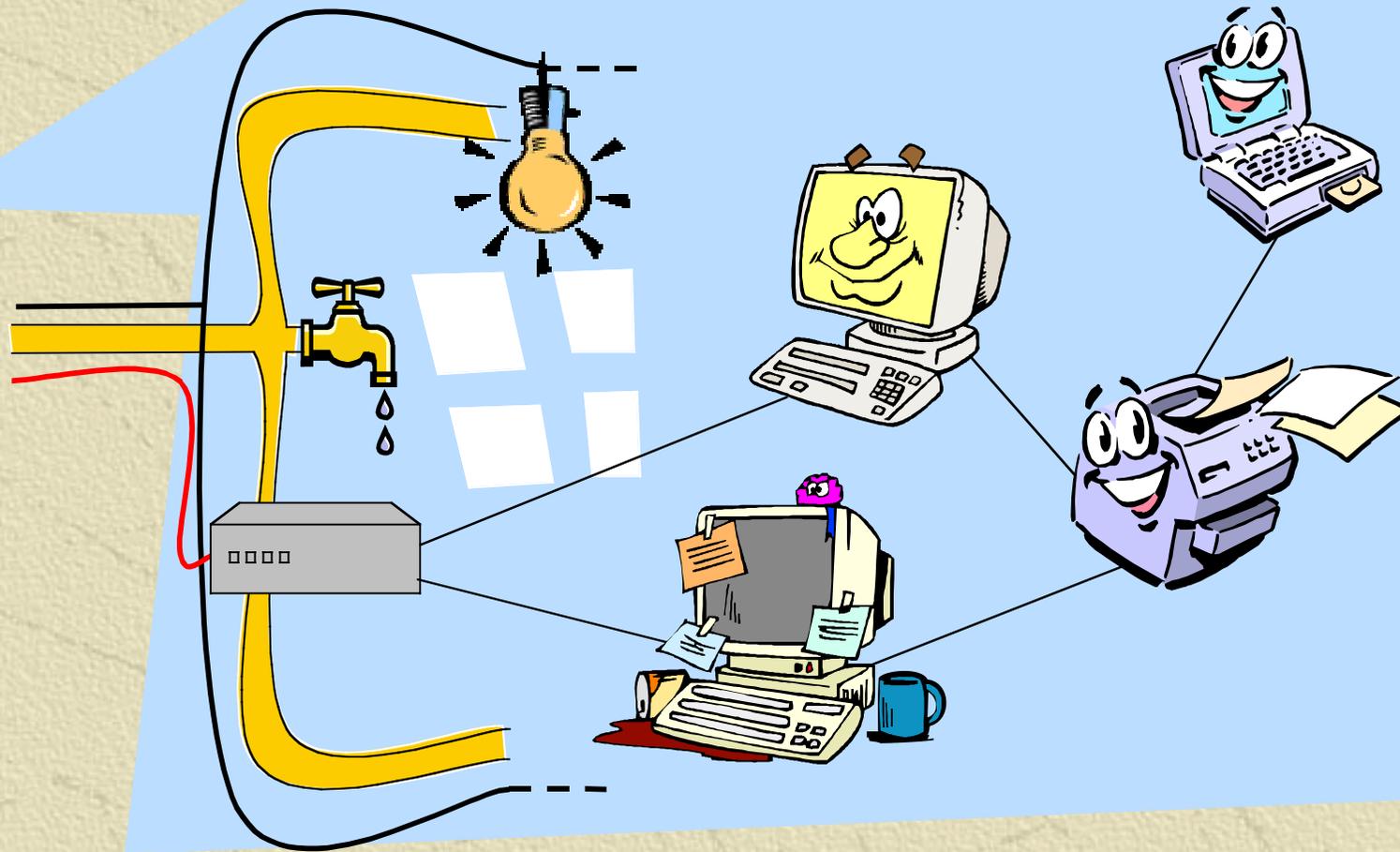
Our Approach

* System/failure model for hybrid systems
* Component-oriented framework
* Automatic wrapping of libraries & components
* Complete error tracking
* Topology discovery for hybrid networks
* …

System Model

* Failures
  * Broken links (e.g., due to mobility)
  * Performance and crash failures
* Hybrid network
  * Mixed wireless and wired network
* Wireless network:
  * Base station mode
  * Ad hoc mode

System Model


wireline nodes

Wireline Network

gateway nodes

wireless link

wireless nodes

B1 B2 G1 G2 --- G3 W1 W2 W3 W4 W5
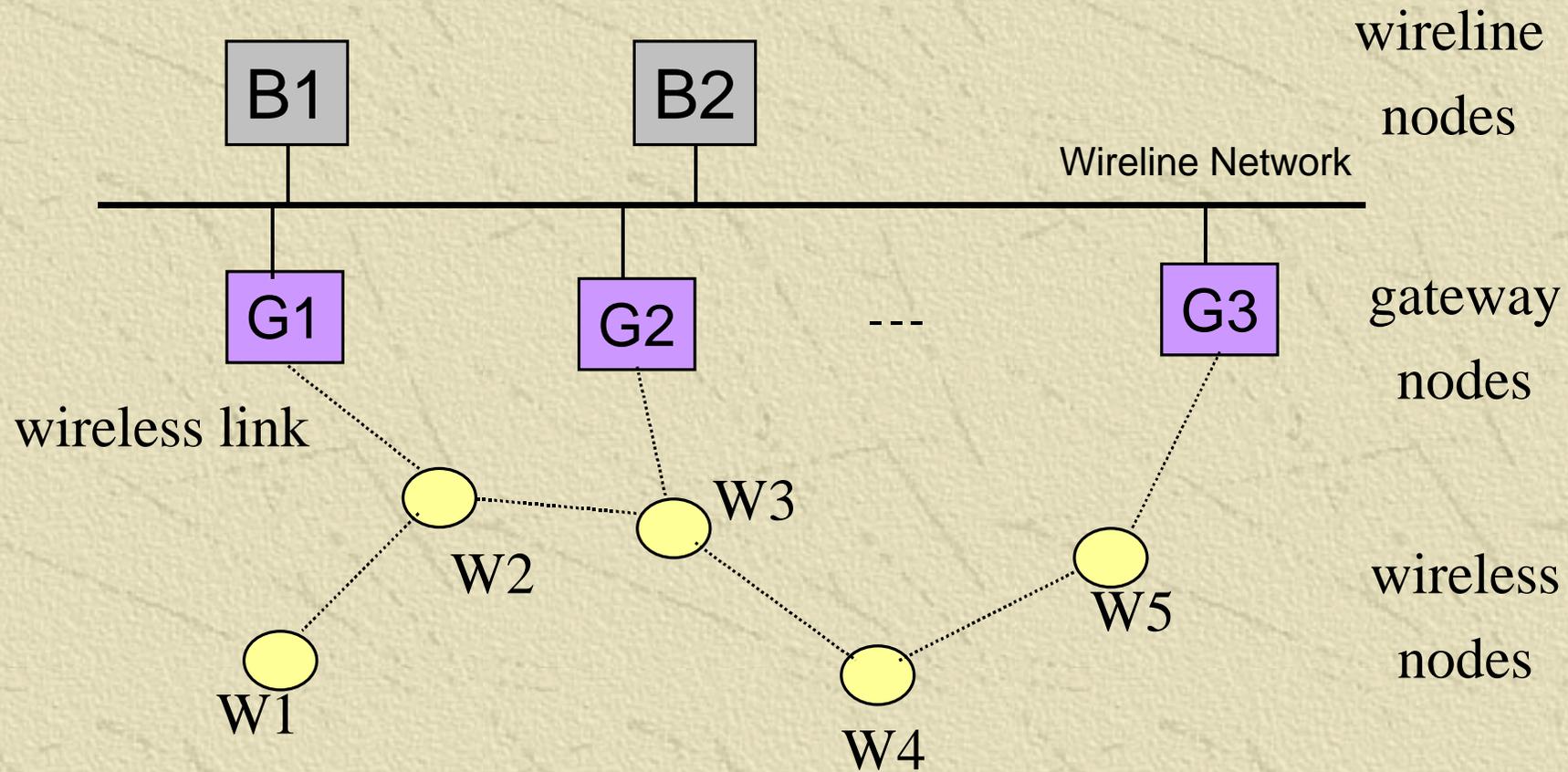
Use Moore's law!
Use Scientific method!

✳ Executable models

✳ Collect data

✳ Want to use data-mining

- ◆ adjust parameters of executable models
- ◆ to optimize resource usage
- ◆ for automatic and manual fault diagnosis
- ◆ …

Data Mining

B1　　　**B2** 　Data storage and mining

Wireline Network

G1　　　**G2**　---　**G3**
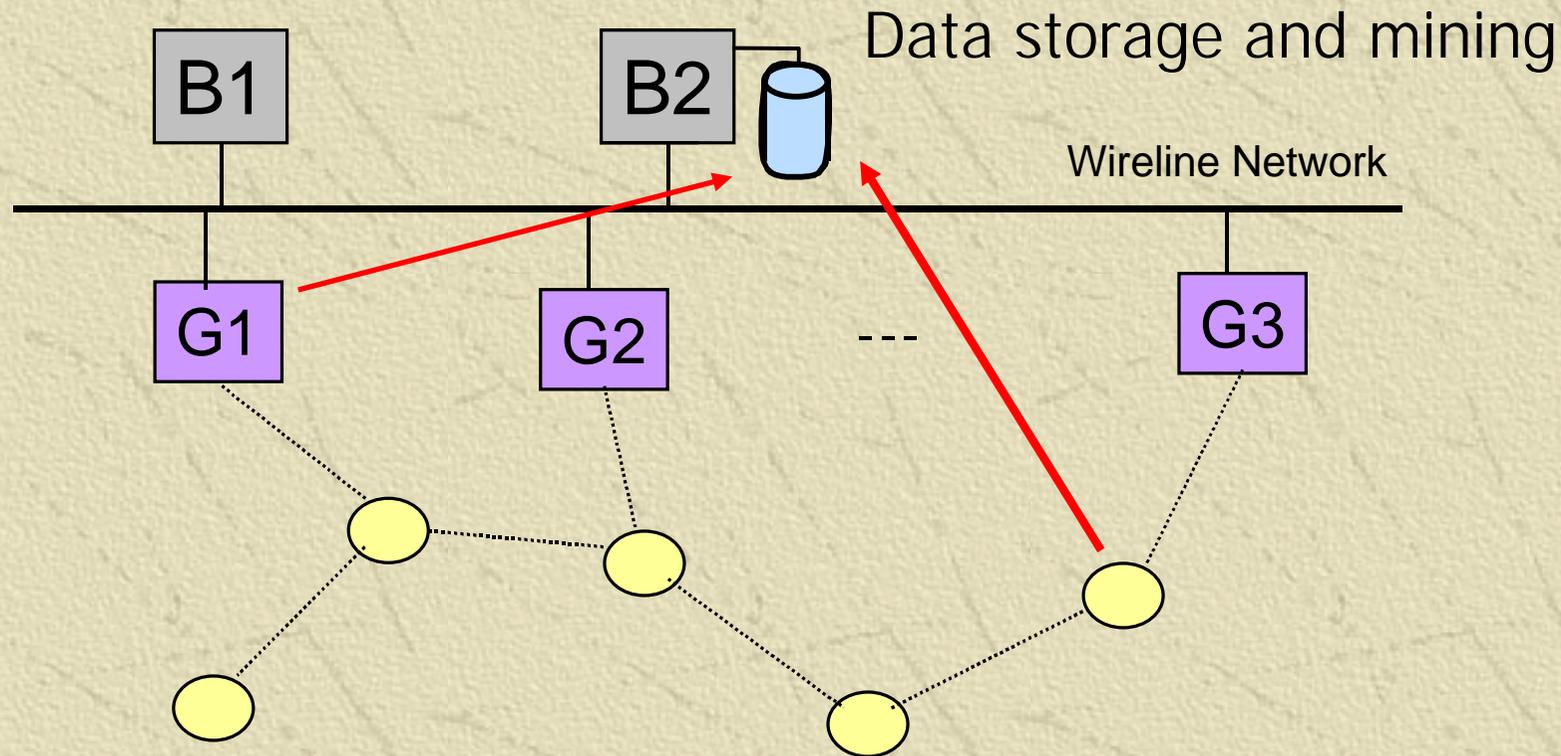
✳ To facilitate data-mining: Store events on disk

✳ No soft-state (we need to keep data)!

Summary

✳ Pervasive Dependability:
new requirements
$\Rightarrow$ new research challenges
$\Rightarrow$ new dependability techniques.

✳ **We want/need techniques for:**

- ◆ Automatic reconfiguration: emphasis on time rather than space redundancy.

- ◆ Automatic fault-diagnosis: to allow reconfiguration.

- ◆ Automatic installation: customized configurations.

- ◆ Automatic adaptation: change for different applications, environments, and access patterns.