Contextual Adaptation

Doctoral Seminar
Ubiquitous Information

ETH Zürich, WS 01/02

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Being Aware of the Context means..

- <ProG> to react to changes in the *environment*
- <ProG> and *adapt* the *application* behavior accordingly
- <ConG> But what is the environment?
- <ConG> ..and what is the application?
  - maybe the application component (e.g., Netscape)?
  - or maybe the application ***and*** the operating system?
  - what happens in case of a distributed system?

☺
<ProG>
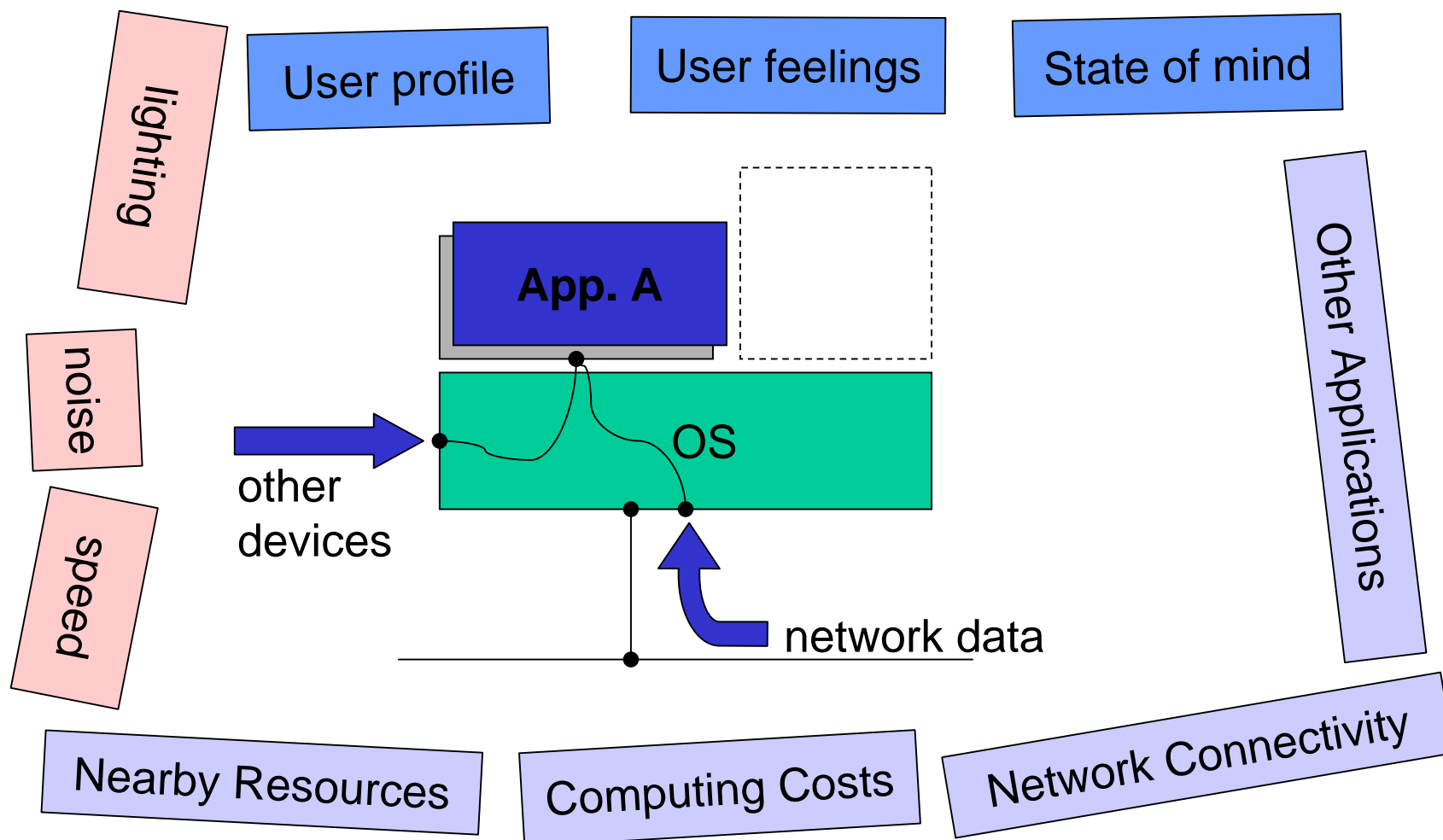
☺
<ConG>

Context Awareness Fact Sheet

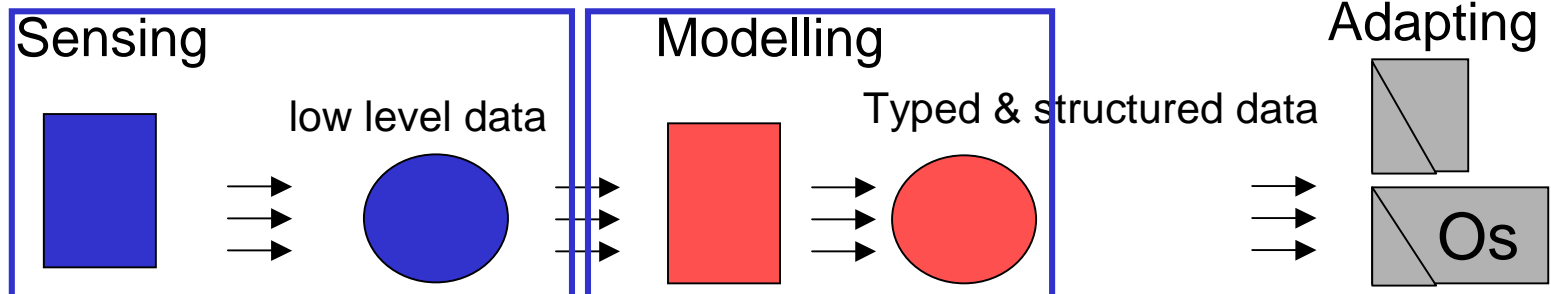| Term of Context Awareness	Bill Schilit '94 [SAW94]
It became a Buzzword	When computers became mobile
Origins and Idea	Human-Computer Interaction '80s
Problems	Vague, Everybody understands something slightly different under Ctx Awareness.

Outline

- Context awareness overview
- Adaptation in context awareness
- Application-aware adaptation
  - Idea
  - Techniques
- Run-time extension of services
  - Application aware networks
  - Application aware Jini networks

Awareness
Adaptation
App. Aware Nets

Application and Environment

lighting

noise

speed

User profile

User feelings

State of mind

App. A

OS

other devices

network data

Other Applications

Nearby Resources

Computing Costs

Network Connectivity

Awareness
Adaptation
App. Aware
Nets

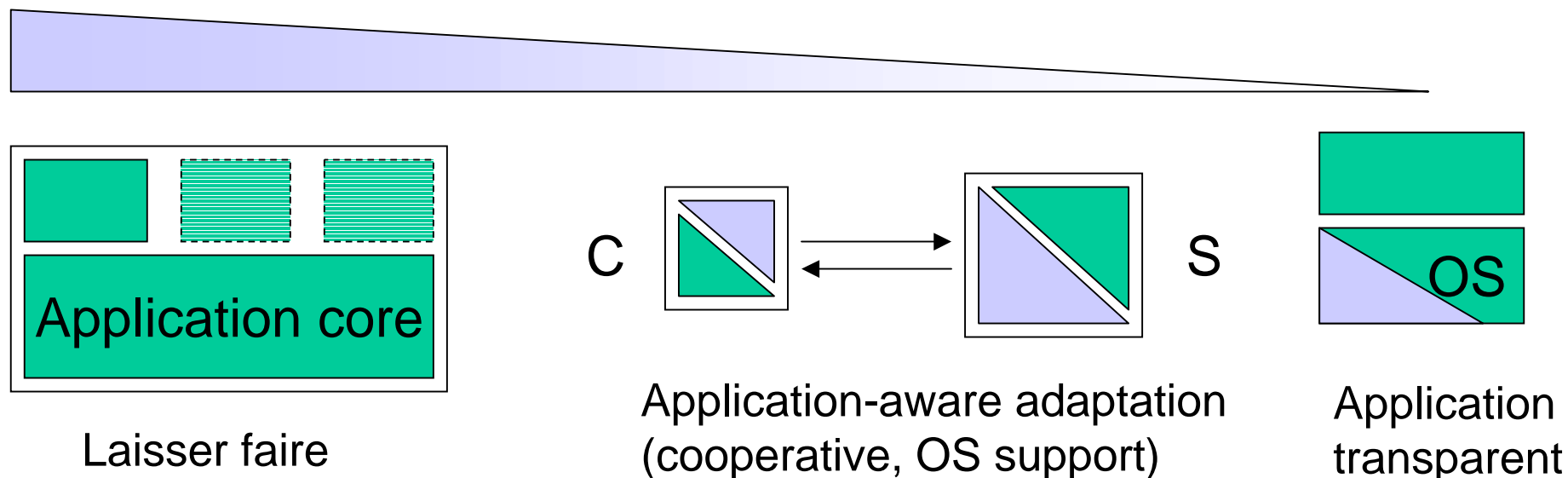|	Sensing	Modelling	Adapting
	low level data	Typed & structured data	Os
Goals	•Larger set of inputs •Accurate data	•Better Abstractions •Tool support	•Old: ctx transparency •New: ctx sensitiveness

Example	•Bandwidth
	•Location
	  –Indoor
	  –Outdoor (gps)
	•Exotica
		•Location
		  –Symbolic
		  –Geometric
		•Context Toolkit
			•Everybody
			•CMU
			  –CODA
			  –Odyssey

Technology	•Low-level
	•Hardware:rf/ir,other
	•Software:profiling/OS
		•Algorithms
		•Sound Modeling
		•Good SE
			•Passive
			•Active
			  –Obvious (ifs)
			  –Cooperative

➔ No killer application[ChKo00]

Ctx. Awareness
Adaptation
App. Aware Nets

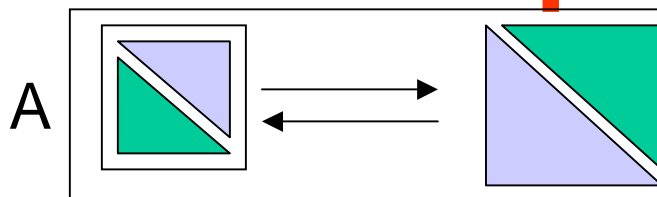# **Adaptation**

- *Passive* adaptation: display something
- *Active* adaptation: change behavior
  - <Con>: change behavior of WHOM?
- Classification (Satya)

Application core

Laisser faire

C   S

Application-aware adaptation
(cooperative, OS support)

OS

Application
transparent

Application-aware adaptation

A

- Application contains a piece of OS functionality

- The OS receives Client/App specific features
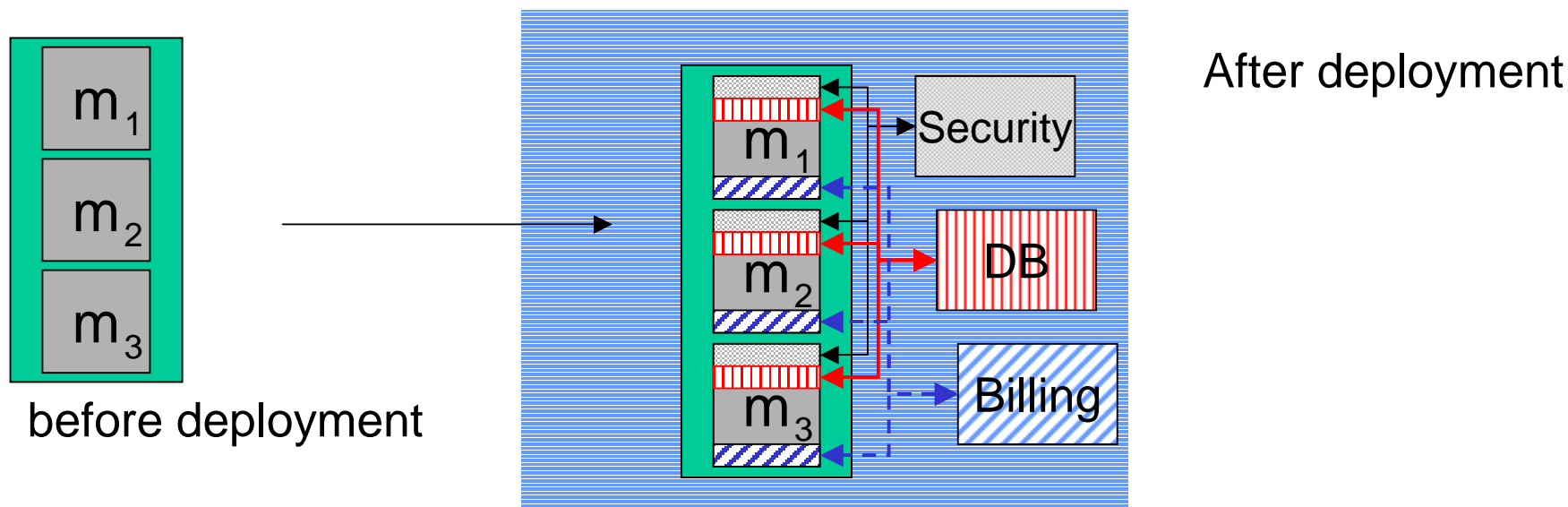
Suitability with respect to mobility:
- – Laisser faire: what could be foreseen by developers
- – Application-aware: leads to real context-specific behavior

➔ Extensible applications:

container technology/run-time environments

Ctx. Awareness
Adaptation
App. Aware Nets

Run-time environments -container technology-

before deployment

After deployment
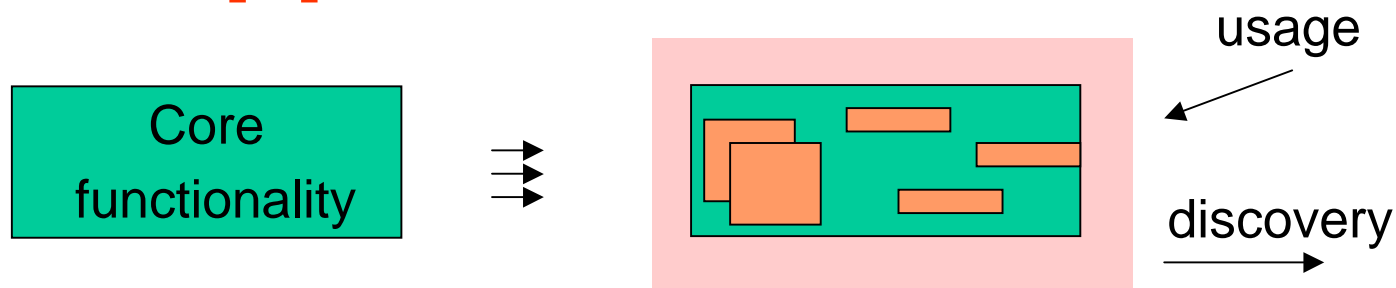
Changes range from *generic* to *application-specific*:

–e.g., EJB like (security, transactions, persistence)

–e.g., organization-specific billing

!!!Container-technology unfit for mobility!!!

➔ Make container technology fit for mobile nodes

Application-aware nets

Core
functionality

usage

discovery

Powerful adaptation of container technology plus network awareness[1] of spontaneous networks.

- Defines enhancements for a whole community of nodes/applications of the same domain
- Inserts functionality as applications join the community
- Withdraws functionality when applications leave the community

➔ Platform for run-time Adaptation: PROSE

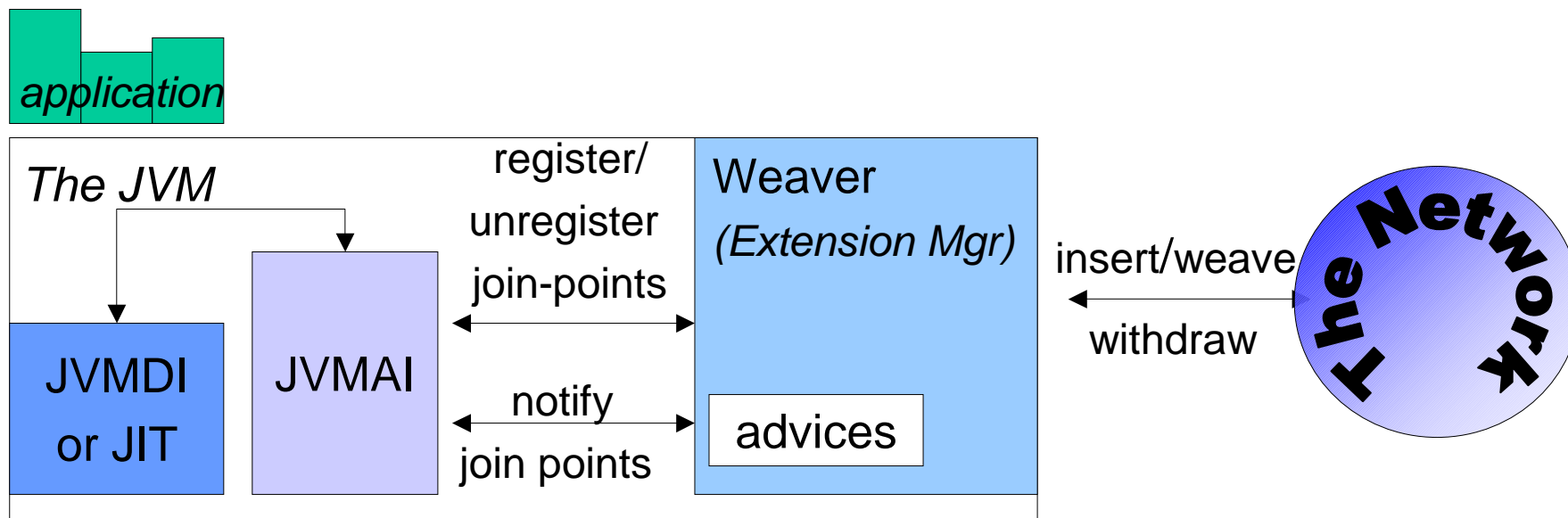1. Network awareness in spontaneous nets ⬅➔ passive context awareness

PROSE

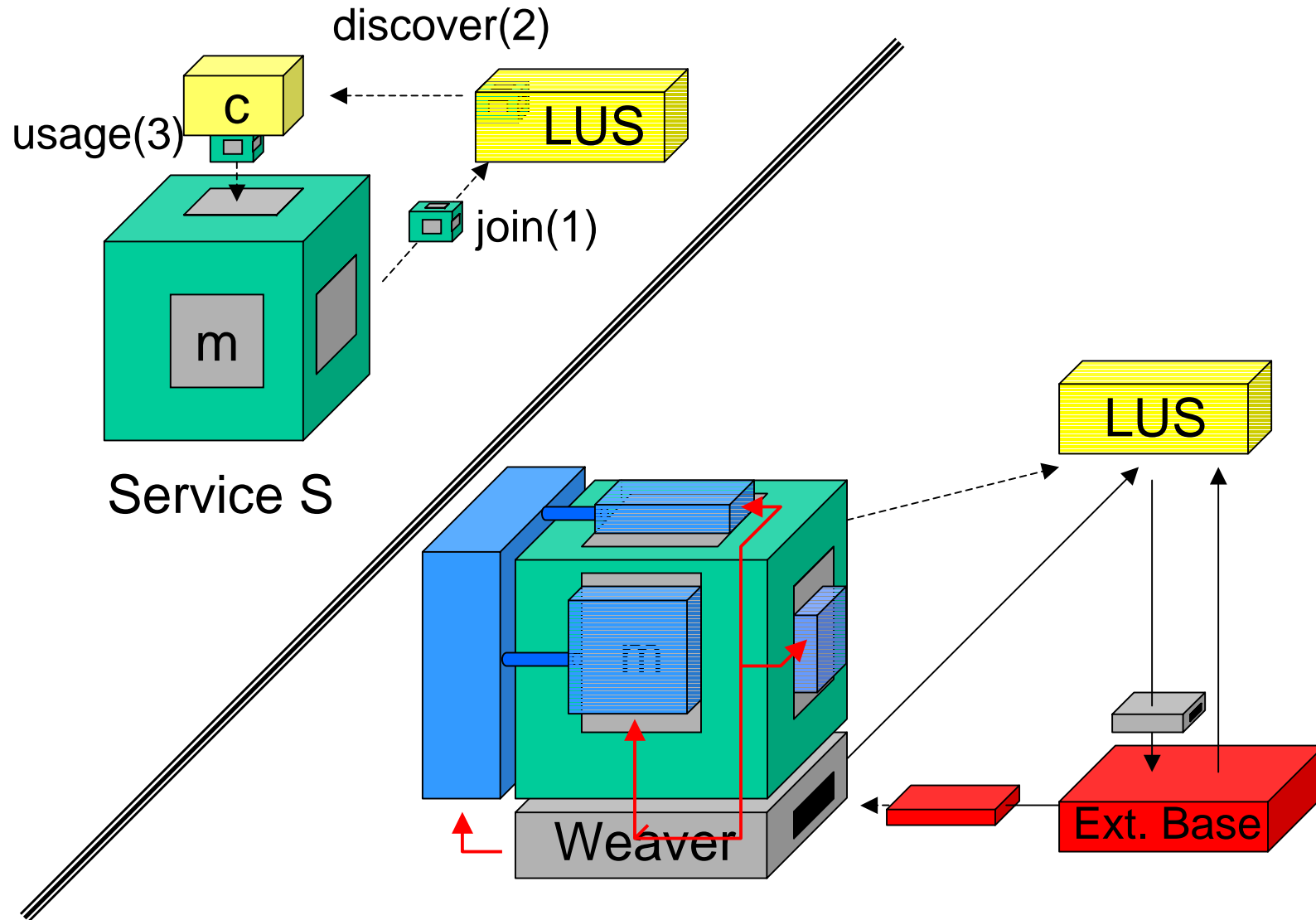PROSE allows dynamic extensions of services

Generic extensions (AOP idea):

Add action **a** at the beginning of
(methods matching **".*foo.+"**) and
((defined in classes that extend **Remote**) or (defined in class **"Bar.*"**)

application

The JVM

JVMDI or JIT

JVMAI

register/
unregister
join-points

Weaver
(Extension Mgr)

advices

notify
join points

insert/weave

withdraw

The Network

Application-aware JINI network

12/16

Ctx. Awareness Adaptation
App. Aware Nets

discover(2)
c
LUS
usage(3)
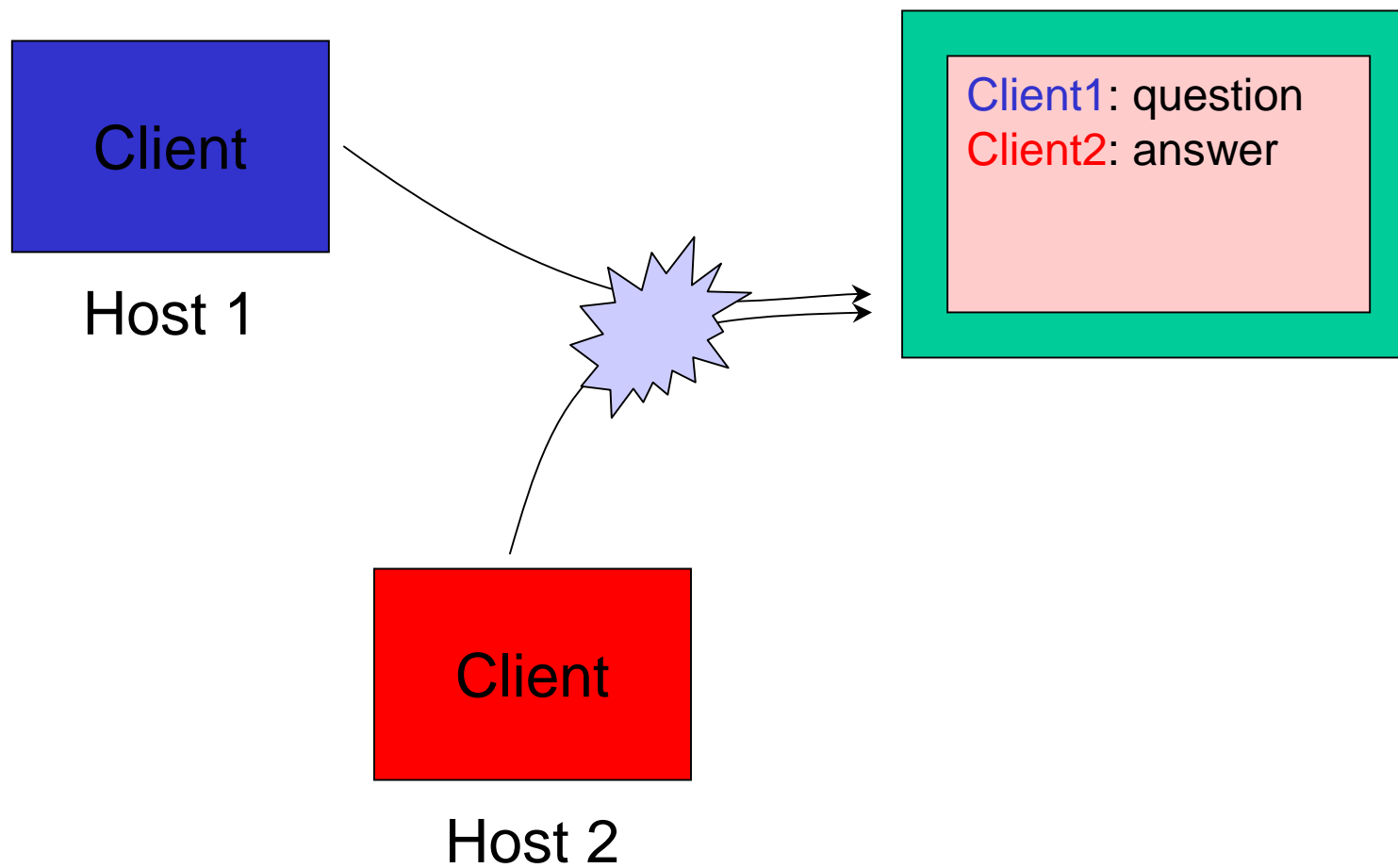join(1)
m
Service S
LUS
Weaver
Ext. Base

Application-aware network issues

- Security:
  - Extensions must be signed
  - Trust relationships

- Transient functionality
  - Added components are leased. When a node leaves a network, the leases expires and the added components are discarded.

- Performance
  - Adaptation must be fast, the added functionality must be executed without a major overhead.

Ctx. Awareness
Adaptation
App. Aware Nets

Demo 1

Client

Host 1

Client1: question
Client2: answer

Client

Host 2

Ctx. Awareness Adaptation
App. Aware Nets

Demo 2

- A Jini/mindstorms environment:
  - remote controlled device as a Jini service
- Record what commands were issued, at what point in time, by whom
  - replay parts of the history
  - query the past
  - perform inverse operations

Some References

W94 B. Schilit, N. Adams, R. Want; *Context-Aware Computing applications*

NSN97 M. Satyanarayanan et.al; *Agile application aware adaption for mobility*

WSA96 R.Want, B. Schilit,…; *The ParcTab Ubiquitous computing experiment*

SBG98 A.Schmidt, M.Beigl,..; *There is more to context than location*

ChKo00 G.Chen, D.Kotz: *A suvery of Context-Aware Mobile Computing Research*