ICT Convergence: Modeling issues

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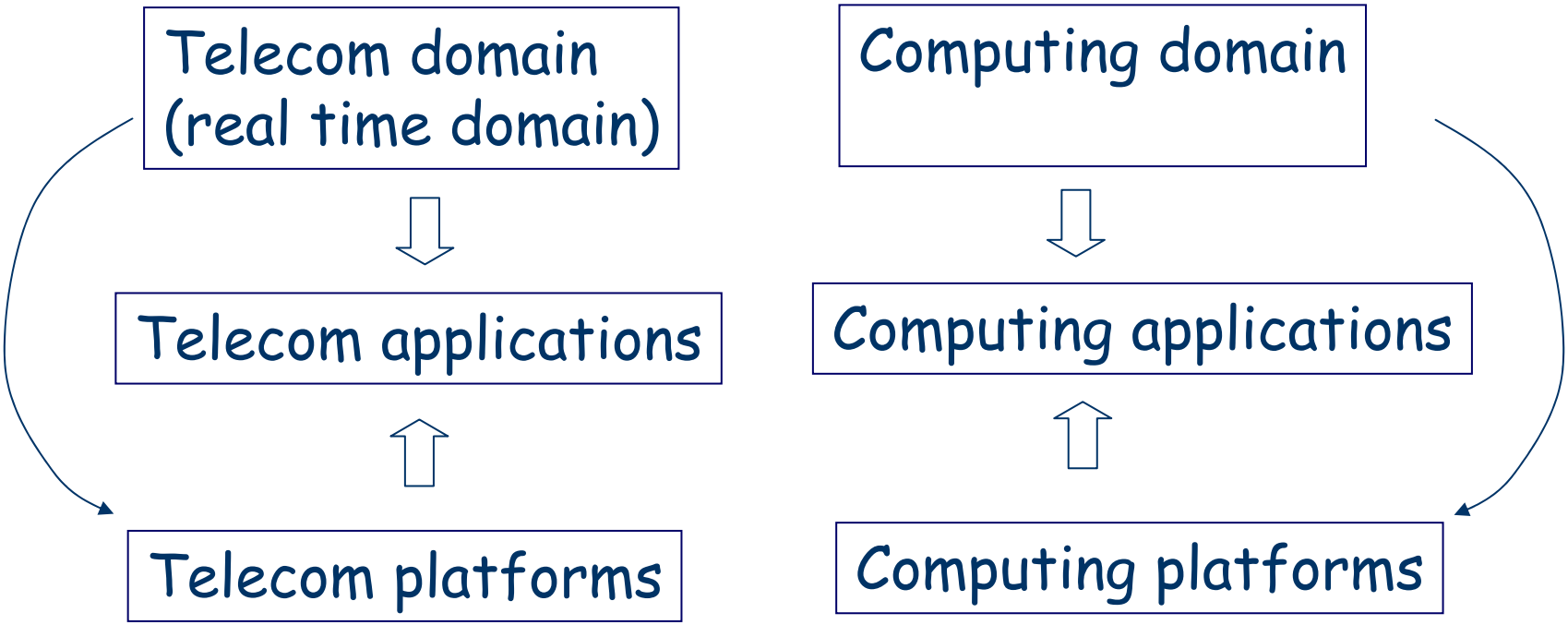
The Question

Is it possible to identify fundamental properties of services we may use to determine the right/best service architectures, delivery platforms and service engineering methods?

... are the differences between approaches of the computing domain and the telecom domain just accidental or well justified?

Shaping forces



The computing domain

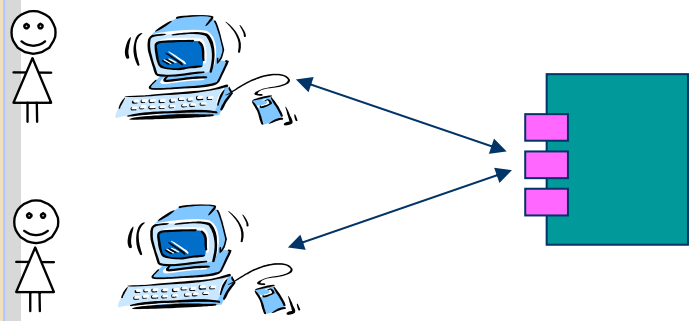
- *Information processing by means of data and algorithms (or objects and methods).* Encapsulating data in objects and introducing classes with inheritance does not fundamentally change this.
- *Communication by invocation.*
  The calling entity is blocked until control is returned from the called entity.
- *Asymmetrical, or client-server interactions.* *Asymmetrical* request-response types of communication dominate.
- *Concurrency as add-on.*

The telecommunication (RT) domain

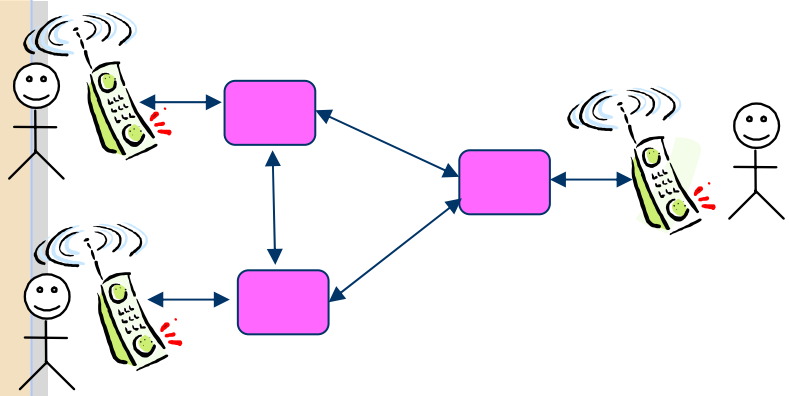
- *Active objects with concurrent behavior*.
  Real objects, like users, behave concurrently and need to interact and to be served concurrently.
- *Communication by signaling.*
  Active objects need explicit communication mechanisms such as signal sending, or messaging to interact.
- *Symmetrical or peer-to-peer interactions.*
  Objects need to communicate on an equal basis, with few restrictions. Initiatives may be taken independently and simultaneously and lead to conflicts that must be resolved.

Two kinds of functionality:

- Client-server (computing domain)
  - One-way initiatives
  - A service as an interface
  - Communication by invocation
  - Restricted structure
  - Passive objects



- Peer-to-peer (telecom and real-time)
  - Multi-way initiatives
  - A service as a collaboration
  - Asynchronous communication
  - General structure
  - Active objects



... now meeting each other

Two modeling approaches

Computing domain:

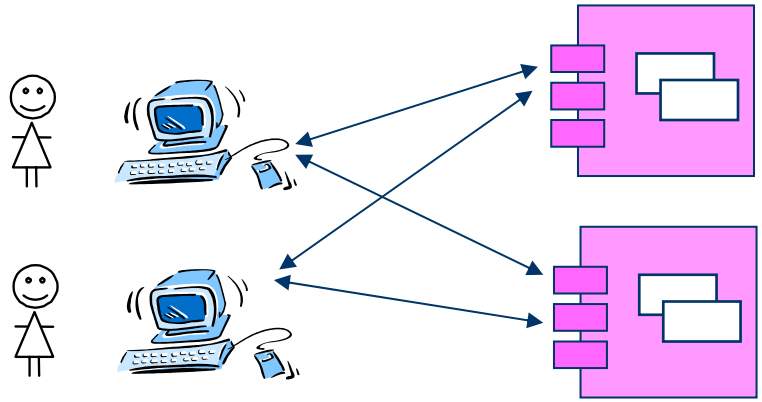
- Passive objects
- Associations
- One-way interfaces and operations
- Client-server with one-way initiatives
- Communication by invocation
- Three-like structure

Telecom domain:

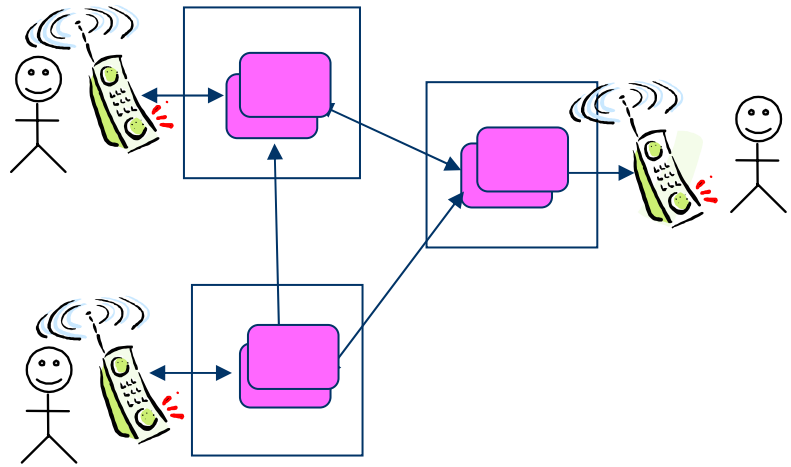
- Active objects
- Channels
- Two-way interfaces and protocols
- Peer-to-peer with multi-way initiatives
- Asynchronous communication by messaging
- General network structure

Two design approaches

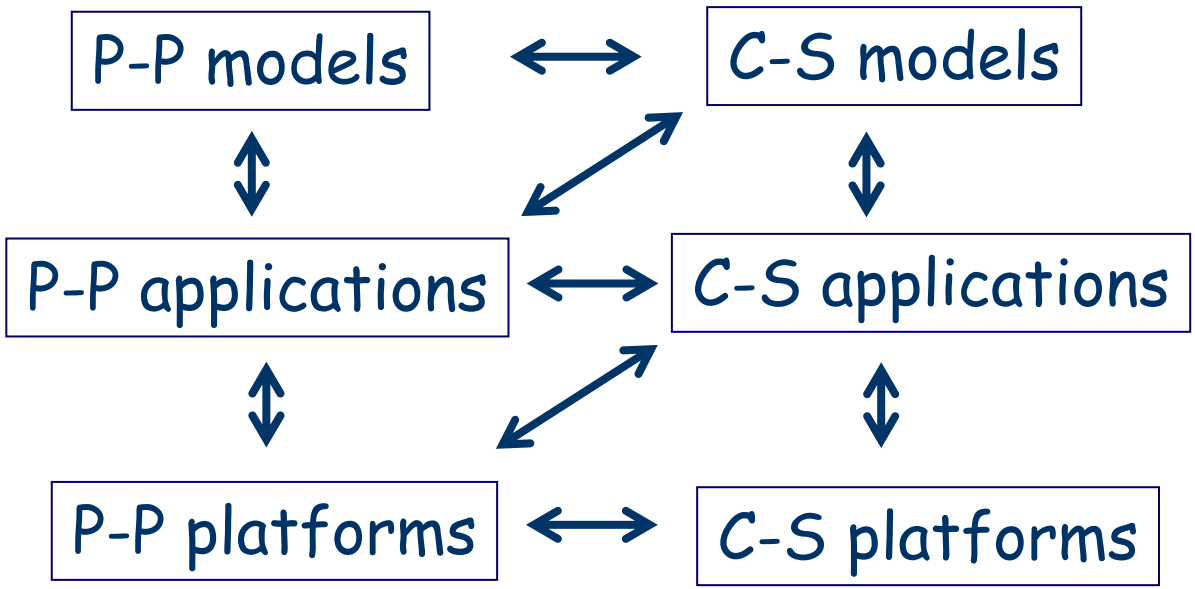
- Server oriented approach
  - One interface - one service - multiple users
  - Class-operation focus



- Agent oriented approach
  - One interface - one user - multiple services (as roles)
  - Object-interaction focus



Convergence



We believe the most general approach is

Peer-to-peer with active objects and asynchronous communication by messaging,

because:

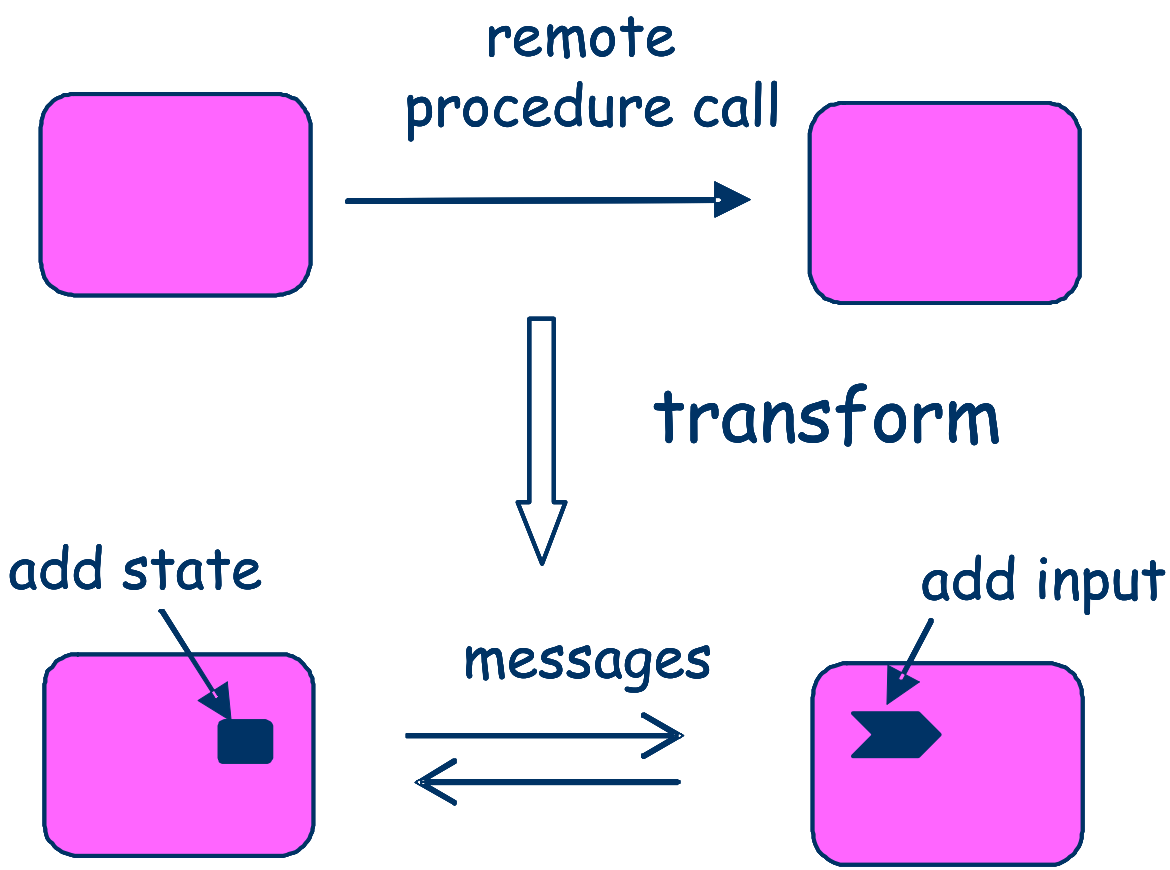
- It reflects real world domain and distributed platform issues
- It can support both peer-to-peer and client-server structures without restrictions
- It supports distribution transparency in a simple way and uses the basic mechanism for information transfer over networks
- It should therefore be at the core

…combined with synchronous communication by invocation

- For programming within a single address space and thread of computing (Active object).
- When necessary to interface with legacy systems and APIs.
- When convenient for application programming.
- When speed can be gained
  (but remote interactions are bound to be slower)

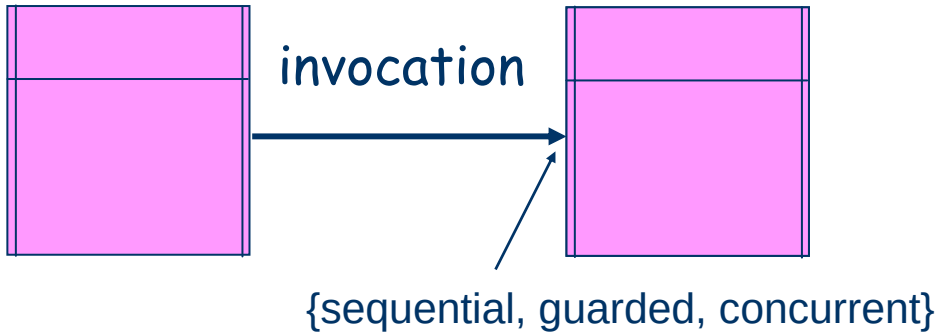
How, then, can invocation and messaging be combined?

The SDL solution

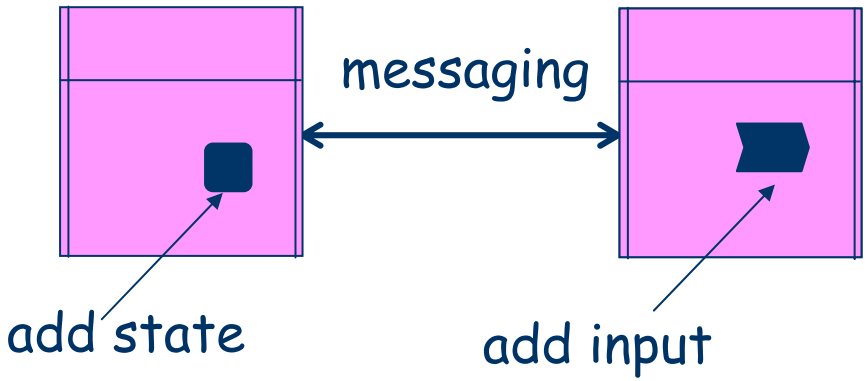


Active-active invocation

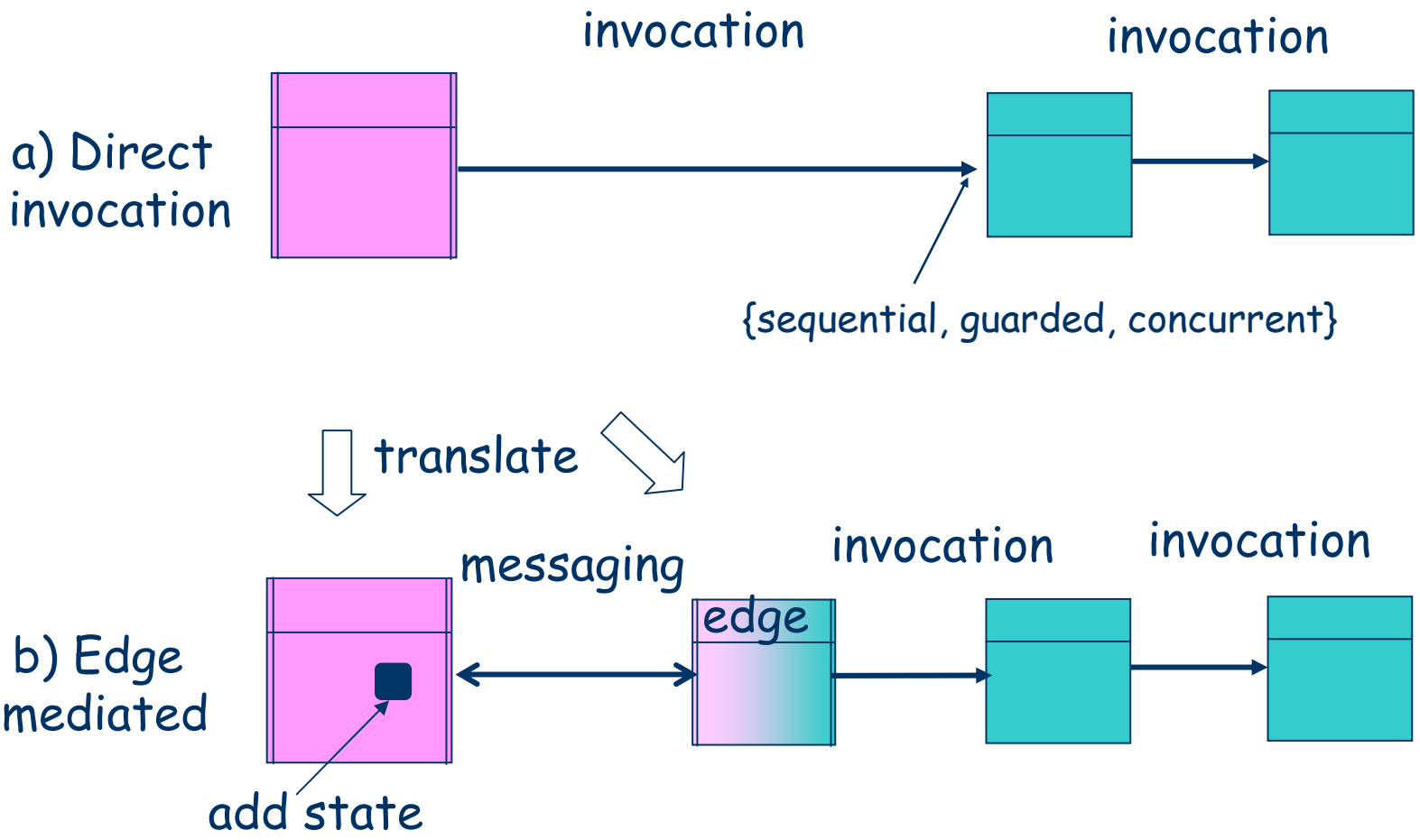
a) Direct invocation



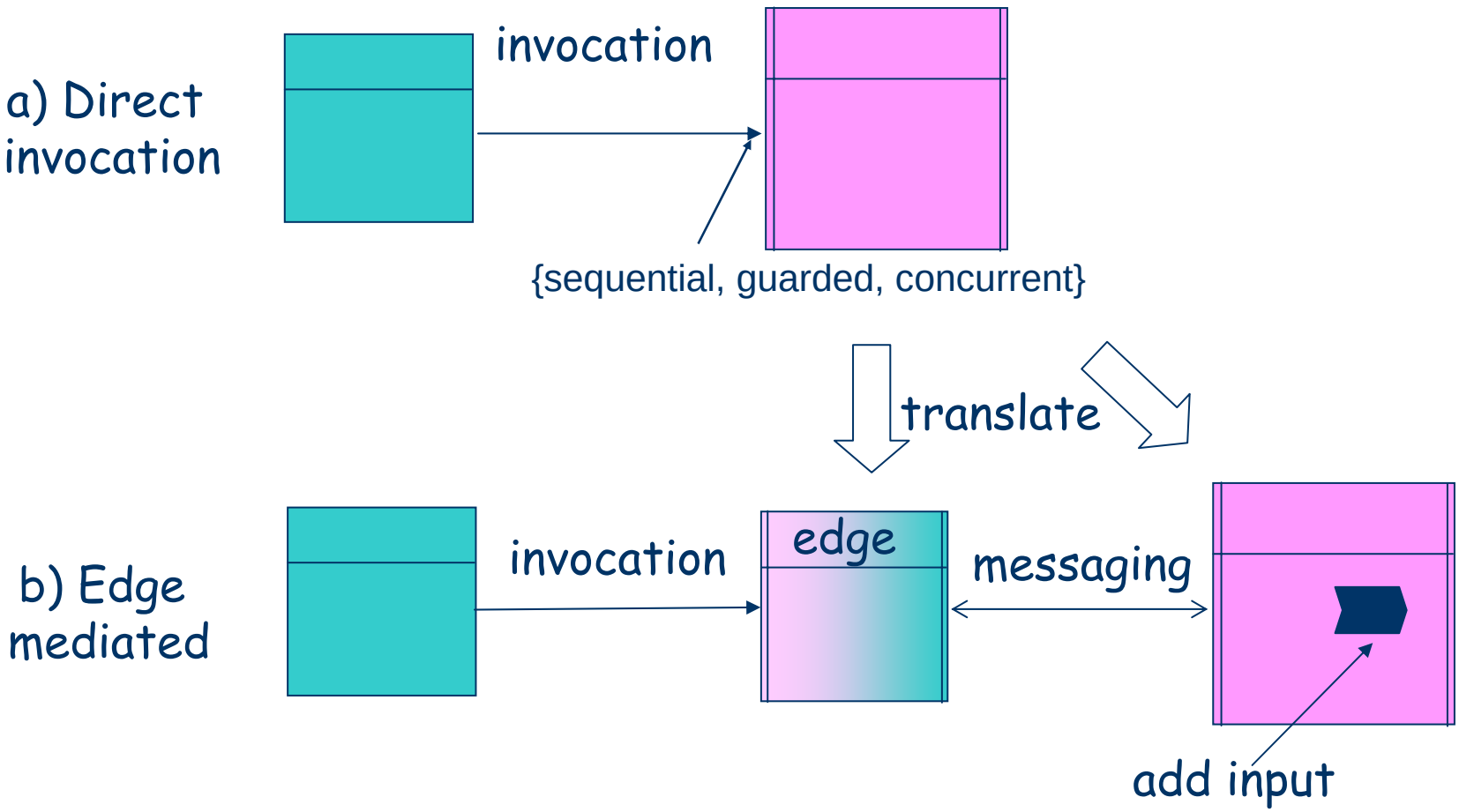
b) "Invocation" by messaging



Active-passive invocation



Passive-active invocation



Core invocation considerations

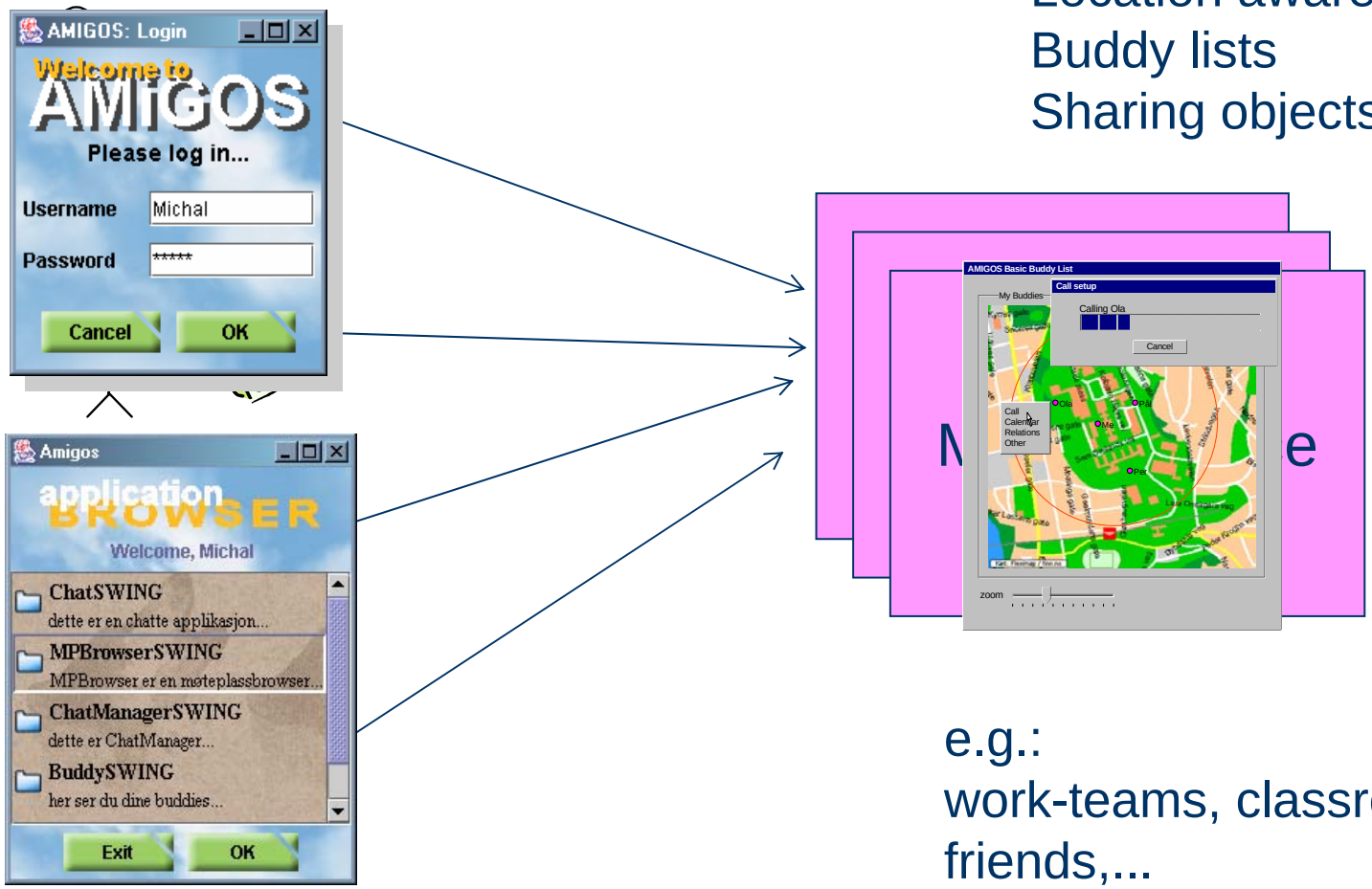
- Concurrency: are the parties concurrent or not?
- Initiative patterns: one-way or two-way?
- Communication structure: three-like or networked?
- Blocking delays: are they acceptable?
- Synchronisation delays: are they acceptable?

Suitable for:

- One logical thread of behaviour
- One-way initiatives
- Three-like structure

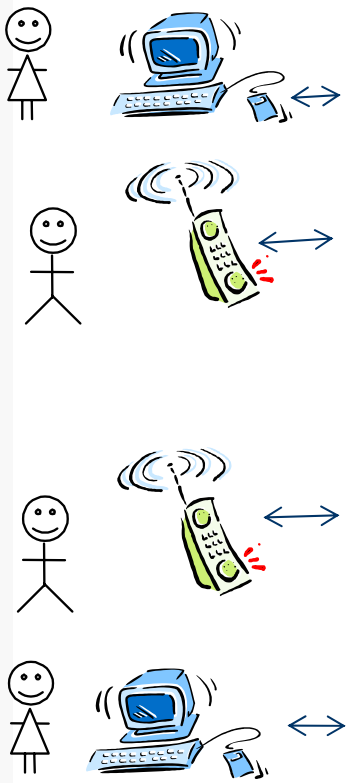
AMIGOS – meeting people

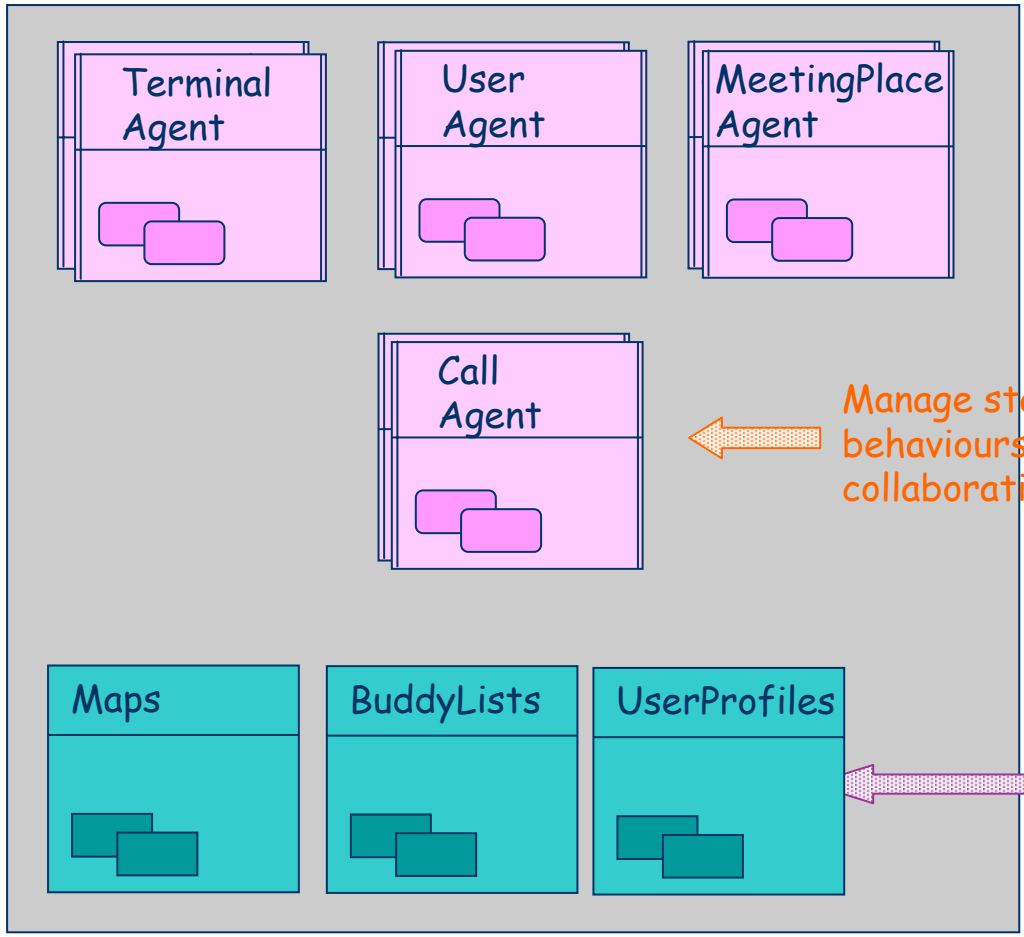
Calls, Chat,
Multimedia
conferences,
Location awareness,
Buddy lists
Sharing objects



e.g.:
work-teams, classrooms,
friends,...

Amigos: a mixed approach

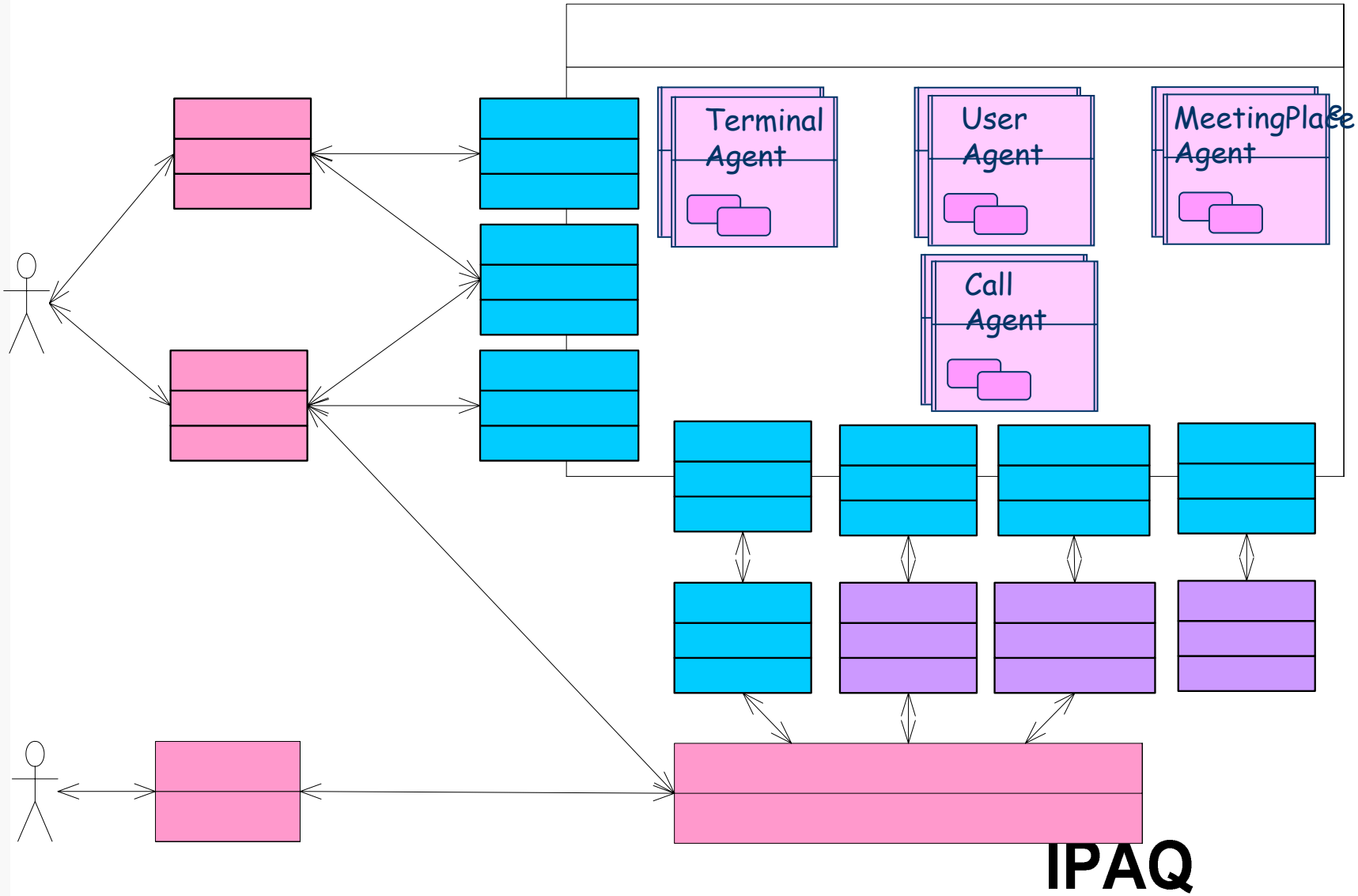




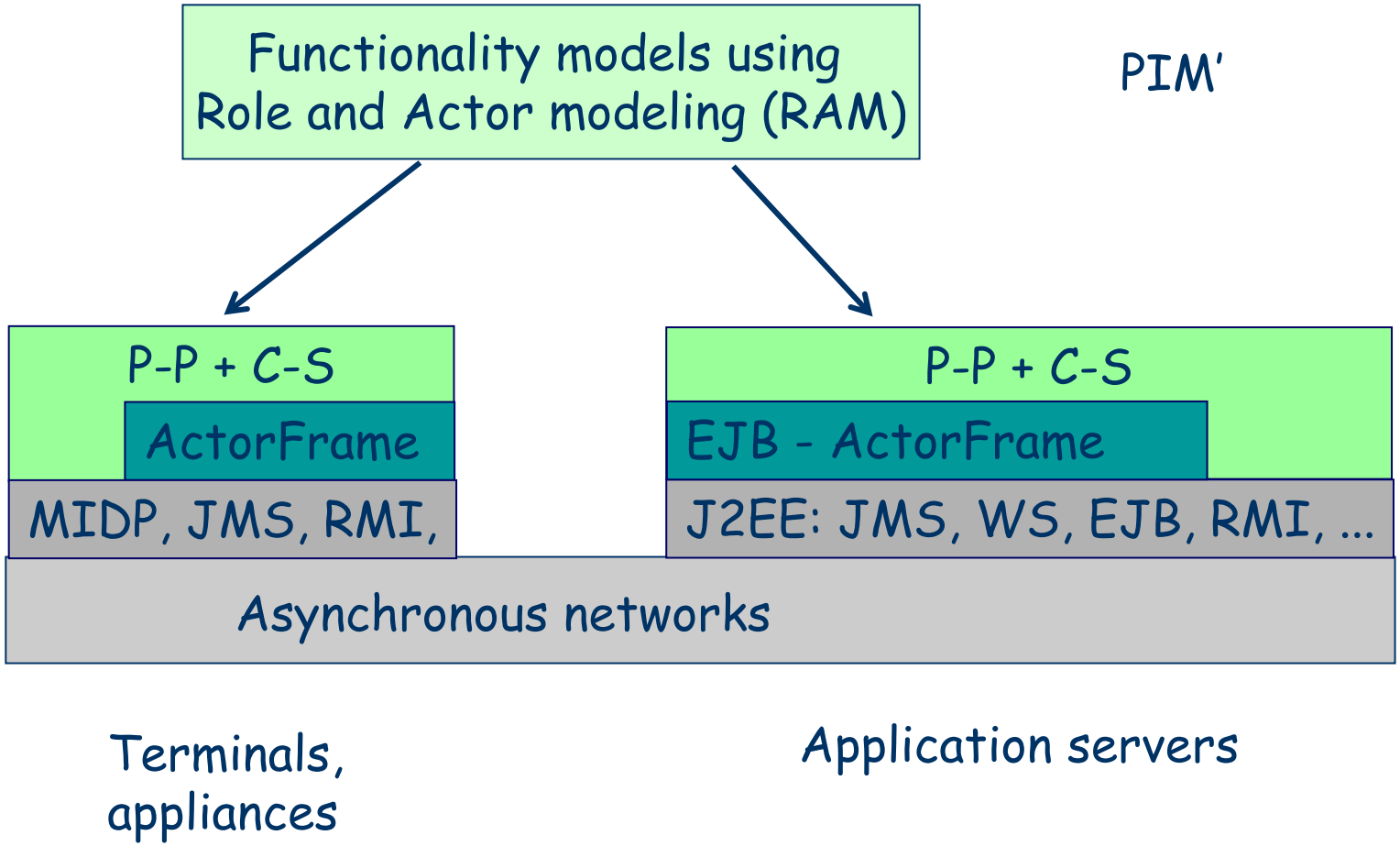
Manage stateful behaviours and collaborations

Associate profiles with agents

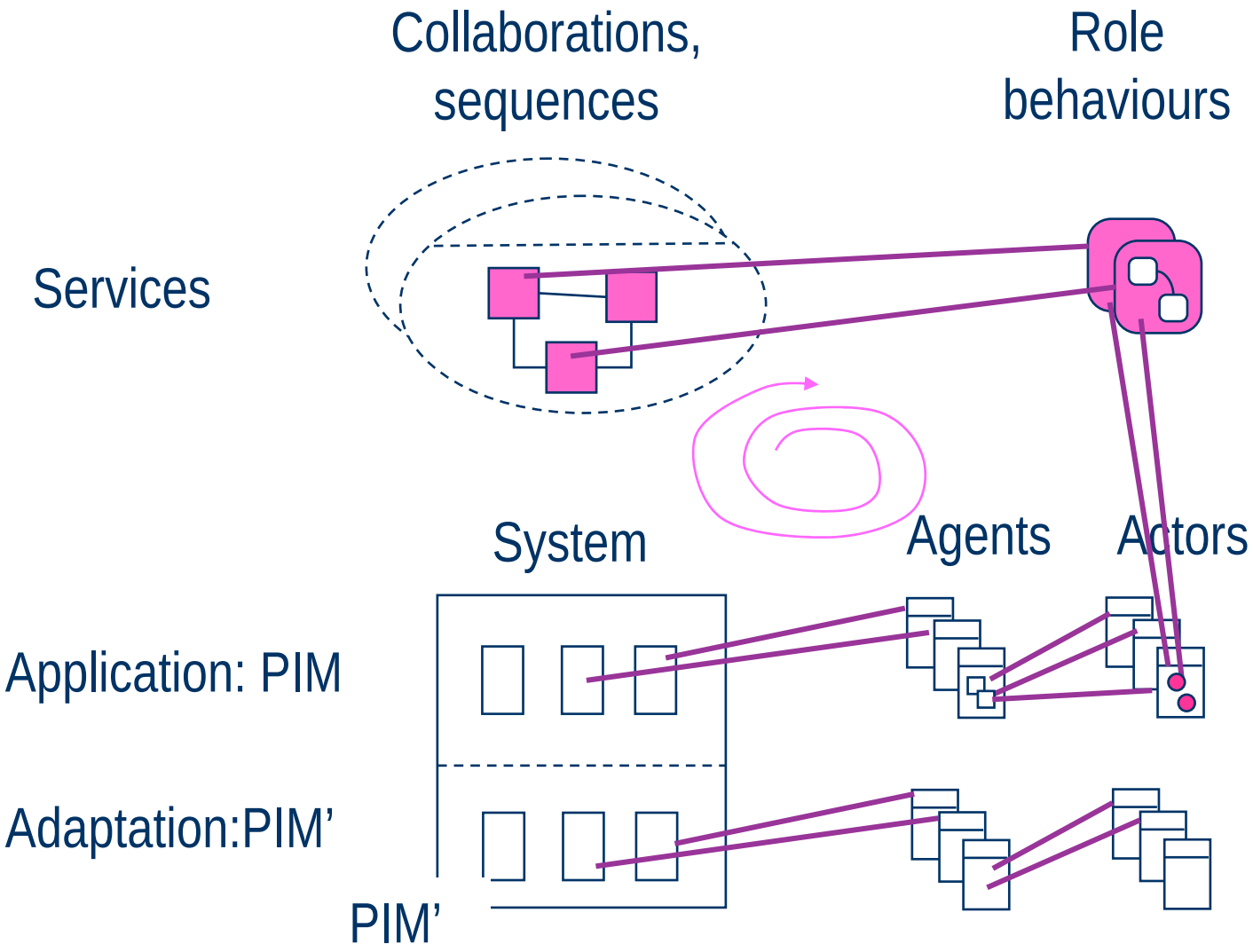
Environment and edges



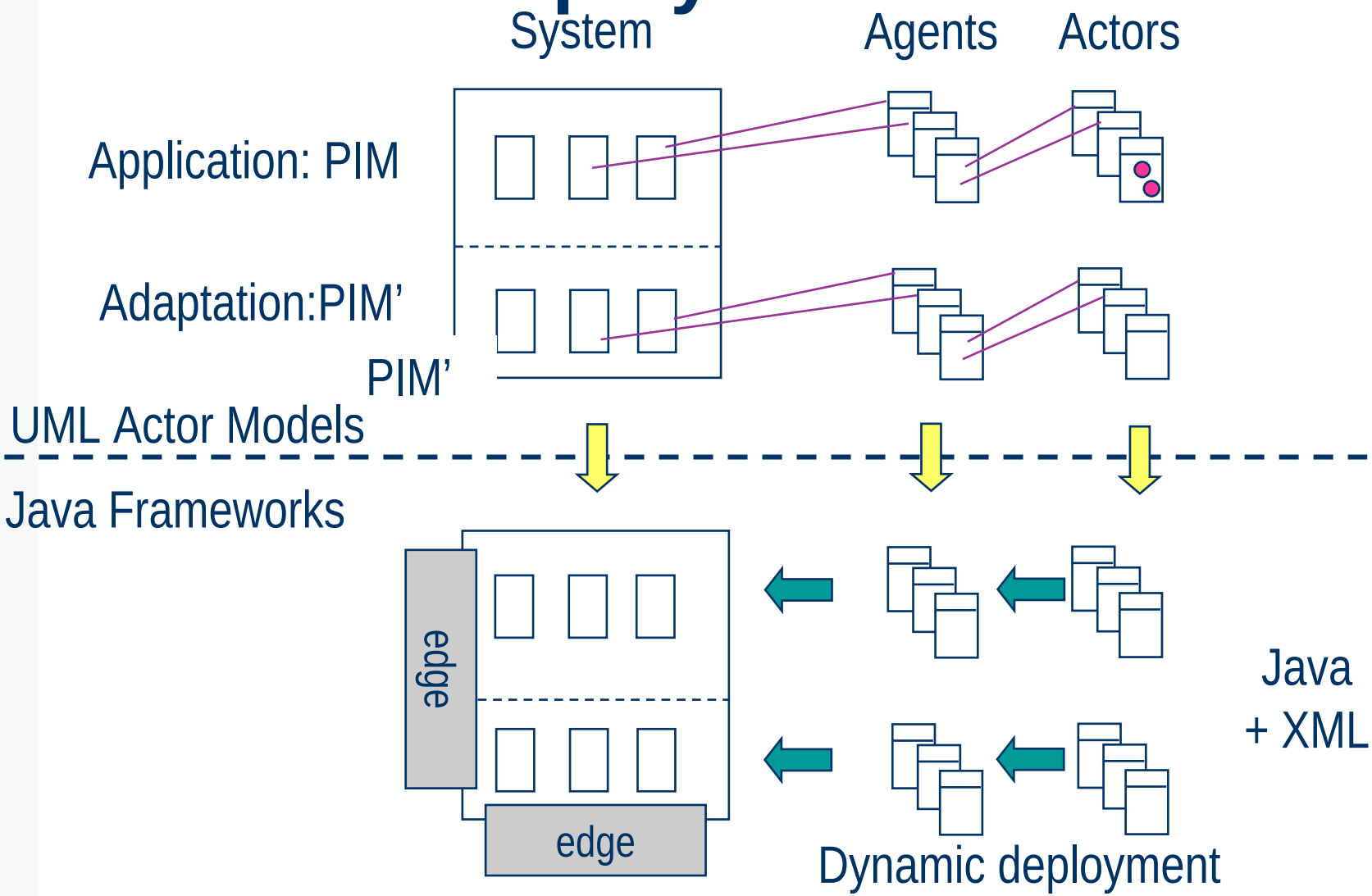
ActorFrame: towards a convergent framework



RAM – Service and Actor Modelling



RAM – implementation and deployment



Conclusions

- Yes, there are fundamental domain properties that shape applications and platforms
- Asynchronous communication at the application level needed as basis
- With invocation based communication as supplement
- Will application programmers accept it?
- Can they awoid it?
- Mixed modelling using UML is possible, with care
- An architectural framework helps
- Dynamic composition becoming more important