Mobile Computing

General introduction

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BRICS

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- Better refer to *process algebras* or *process calculi*
- Mobility = any formalism able to describe concurrent, distributed and dynamically-reconfigurable systems
- In fact, two notions:
  - Mobility of names, *labile* systems
  - Mobility of processes, *motile* systems

In the old times

First process calculi emerged from automata theory:

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  process synchronization, asynchronous events, concurrent operations, and conflicts or resource sharing

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  process synchronization, asynchronous events, concurrent operations, and conflicts or resource sharing
- CSP (Hoare, 1978), CCS (Milner, 1980):
  parallel and independent processes, synchronizing over *channels*, through *channel names*:

$$\bar{a}.P \mid a.Q \quad \longrightarrow \quad P \mid Q$$

The π-calculus

Milner, Parrow, Walker, 1989

- Adds the possibility of *communication*:

$$\bar{a}b.P \mid a(x).Q \quad \rightarrow \quad P \mid Q\{x \mapsto b\}$$

- the possibility of passing previously unknown names allows to *dynamically reconfigure* systems

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- Many many variants: synchronous/asynchronous, choice, matching, linear π, fusion calculus (Parrow, Walker), join-calculus (Fournet, Gonthier), blue-calculus (Boudol)...

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- Extensive formal developments (semantics, types, equivalences...)
- Still an active research area
- Implementations: Pict (Turner, 1995), Nomadic Pict, Blue, TyCo, JoCaml
- Used in industry: Microsoft's BizTalk

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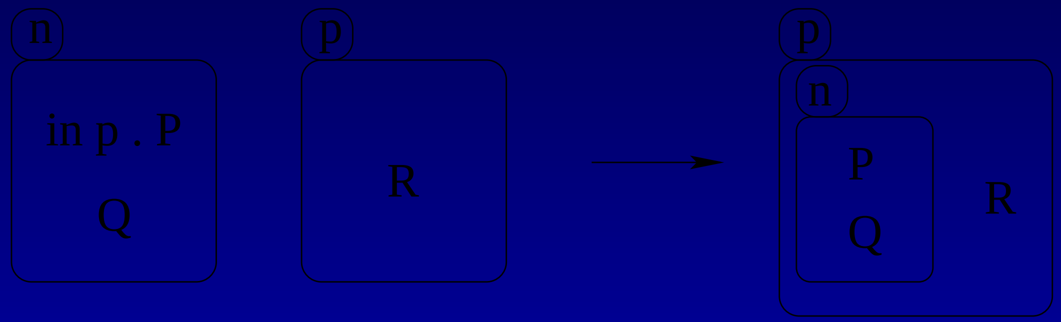
- π_1 (Amadio, Prasad), Dpi (Hennessy, Riely), join-calculus, etc...
- Often *higher-order* communication (i.e. migration of processes or *agents*)

Mobile ambients

Cardelli, Gordon 1998

- Real “physical” mobility:



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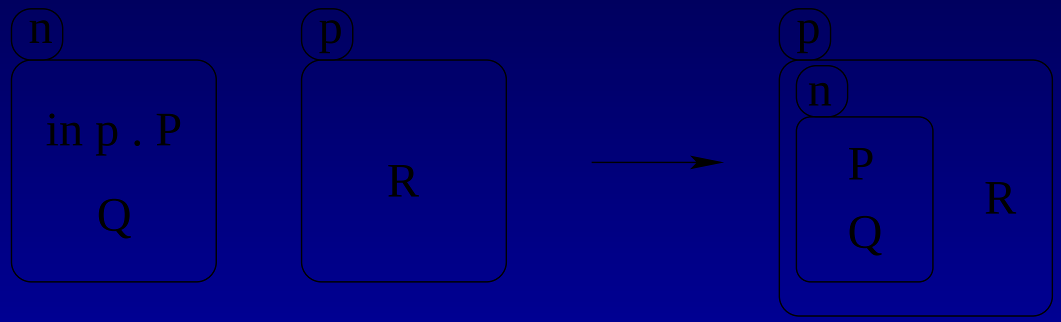

- In fact, two notions:
  - Mobile computation: mobile code moving between different execution devices (agents...)
  - Mobile computing: computation in mobile devices (laptop, crossing of firewall...)

Mobile ambients

- Many variants: safe ambients, robust ambients, controlled ambients, boxed ambients, Seal...
- Related formal tools: type systems, equational theory, logics, expressiveness results...

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- Brane calculi (Cardelli 2003):
  interaction of biological membranes, inspired from ambients, providing new formal tools for biologists

Types

- Static analysis of terms, in order to ensure some properties, w.r.t. some set of *typing rules*
- Examples:
  - Types of arguments for functions in C
  - Topic of conversation on a channel in π
  - Immobility of ambients
  - ...

Equational theory

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- Why is it important ?
- Examples: bisimilarity, strong/weak bisimilarity, trace equivalence, ...

That's enough.

Show me something concrete now !