Application development platforms for emerging smart environments

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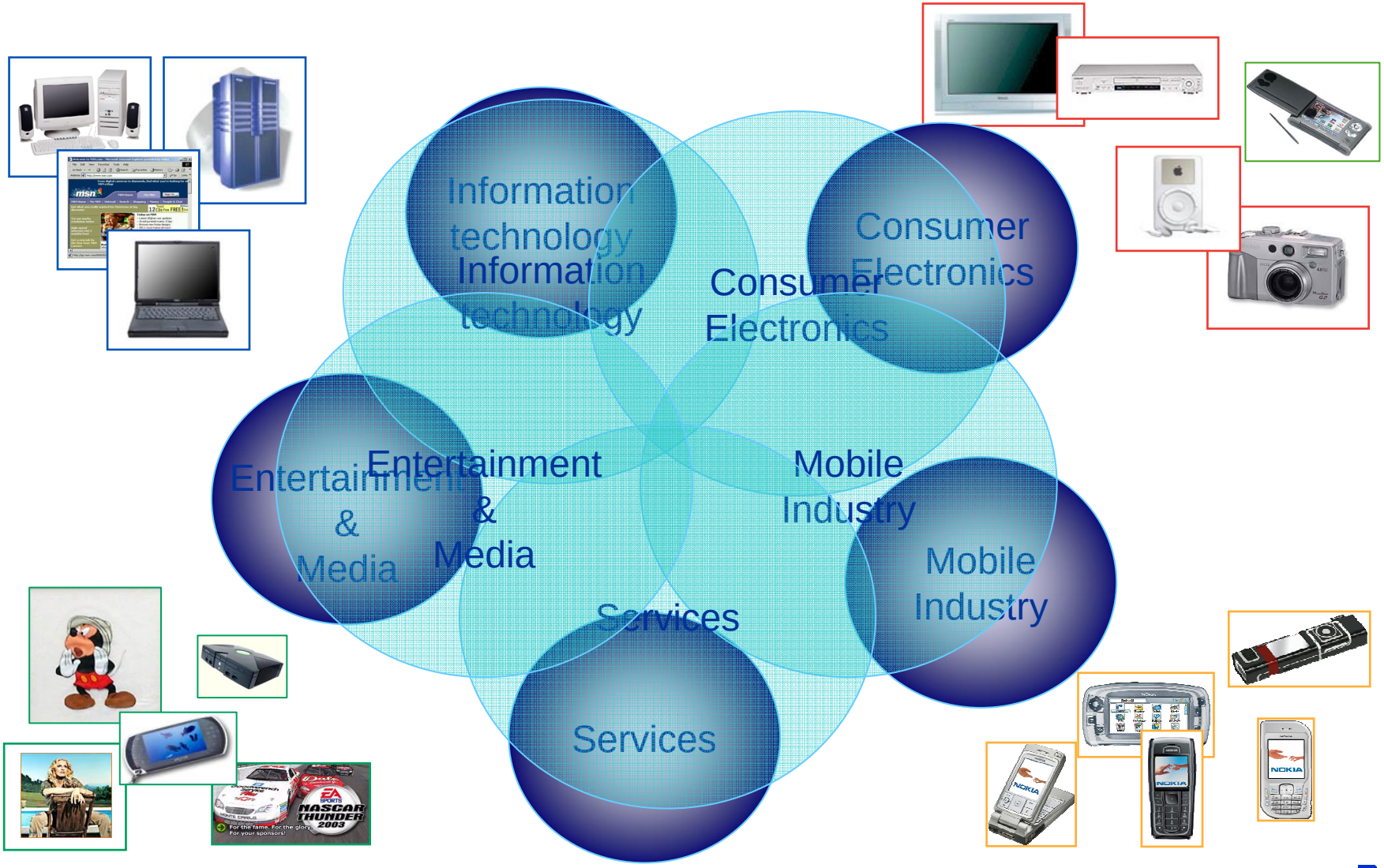
Talk at Mobilware 2009

Petri Liuha

Nokia Research Center

Digital Convergence – mobile terminal centric view



2000 2010

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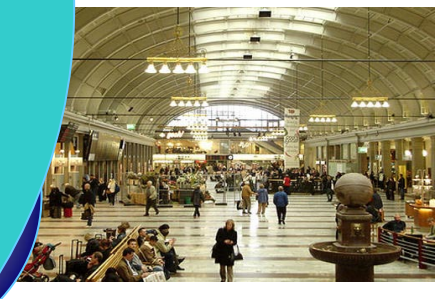
Digital Convergence – ubicom view

Convergence to a single device – NO!
Convergence to single vendor devices and web service – HARDLY!

What then !



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“Ubiquitous systems are embedded systems of tomorrow ”

- Prof. Ken Sakamura

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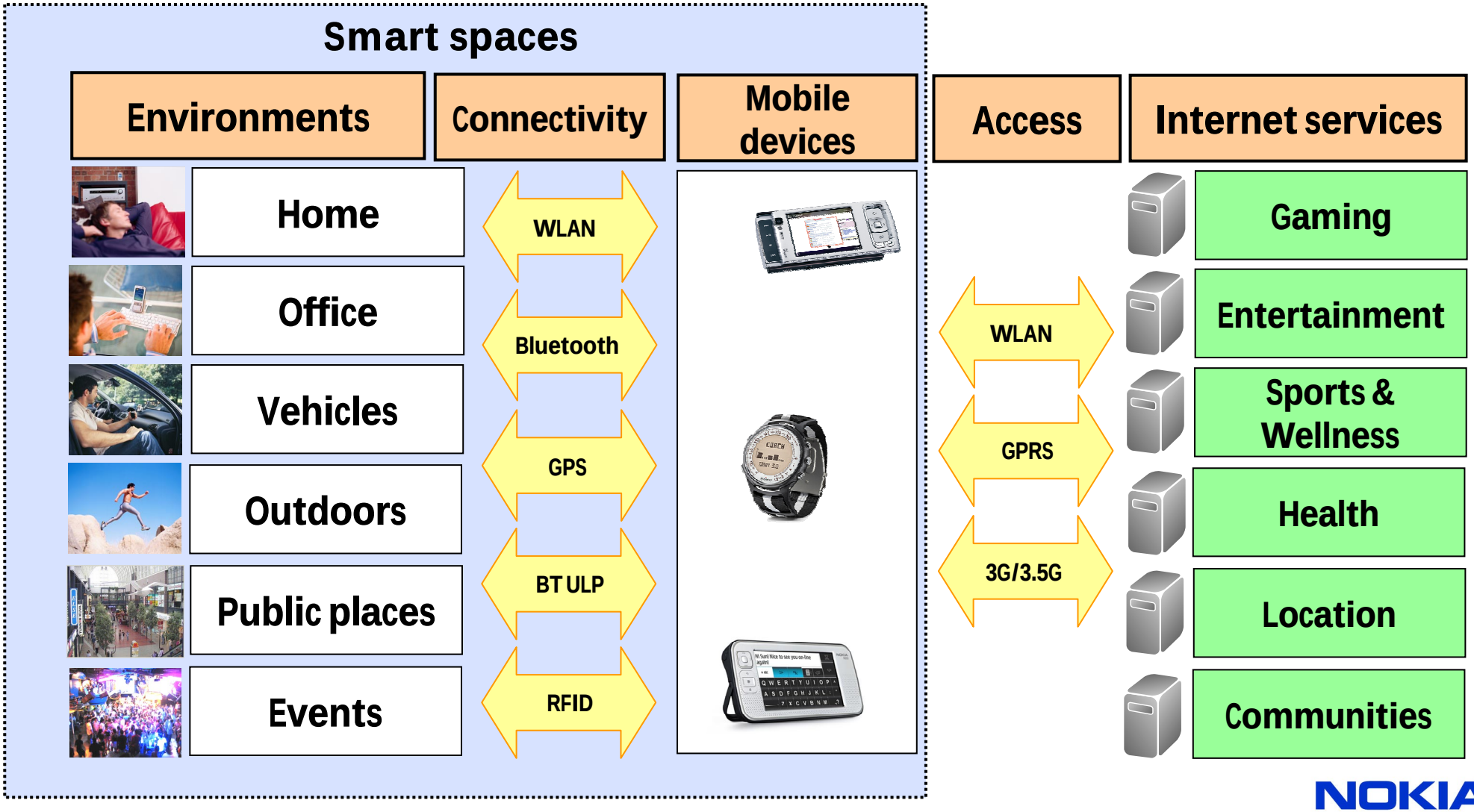
From plain connectivity to Smart Spaces – Mobile devices bridging reality and digital worlds



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Challenges and opportunities for mobile device

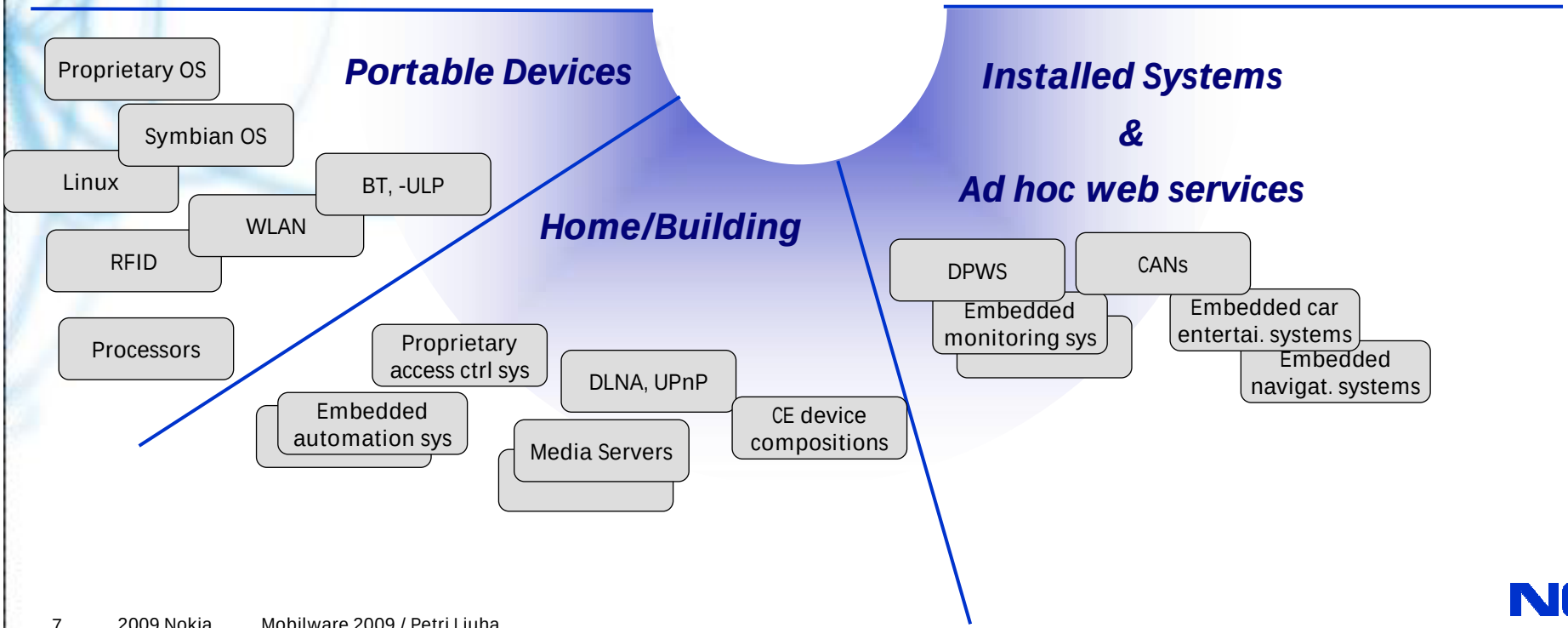
- A nomadic device is present in different environments
- Multitude of existing, embedded information for services
- Shift to Space based computing.

➢How to open and share the embedded information?

➢How to target your application development?

Challenge1: Different legacy – different technologies

- Different development platforms
- Some very closed systems
- Many have deeply embedded approach for development
- Multiple connectivity options



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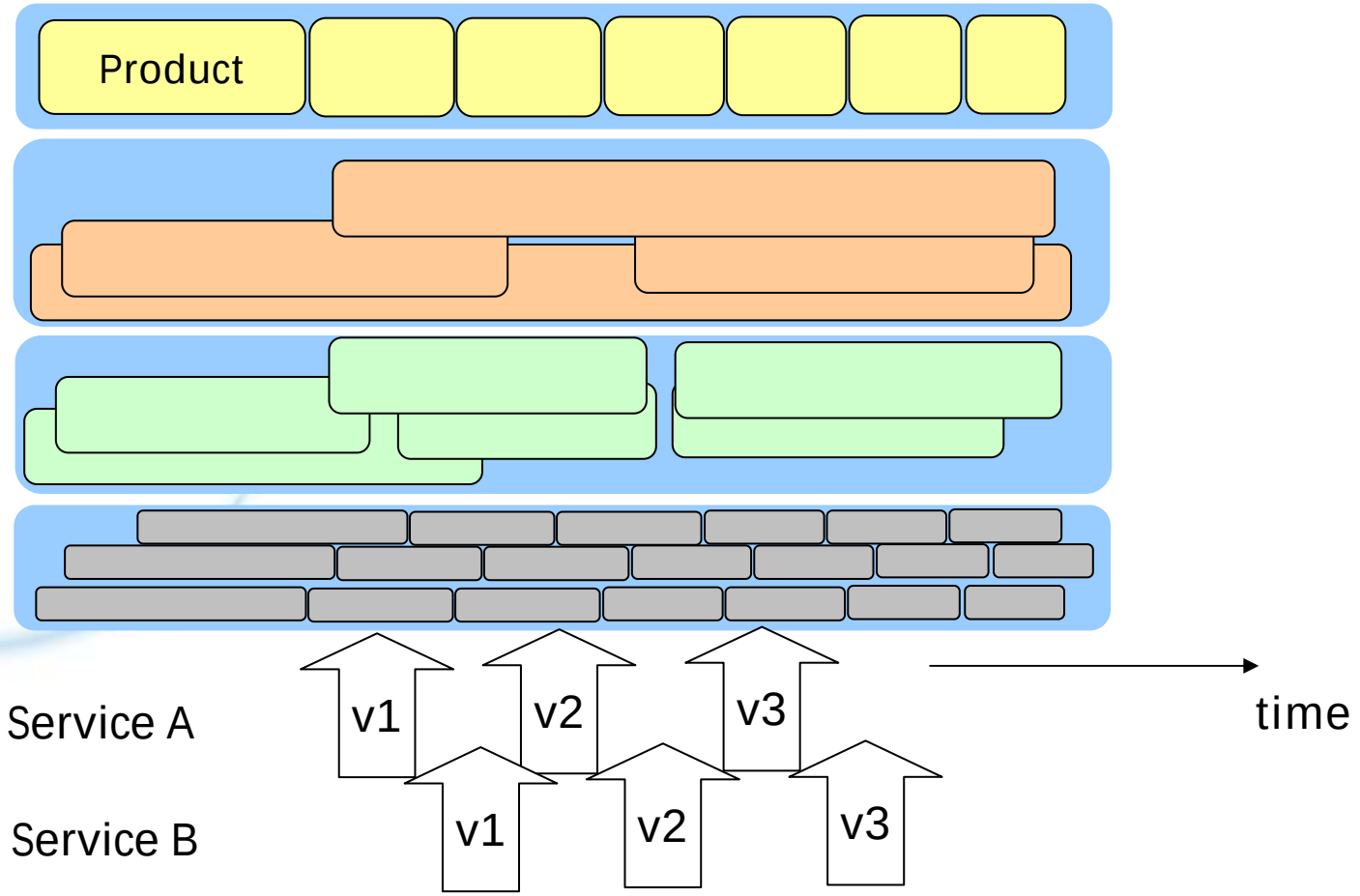
Challenge2: Different lifecycles

Portable Devices

Home/Building

Installed Systems &
Ad hoc web services

Domain X



Where to target my cross-domain applications? Future versions?

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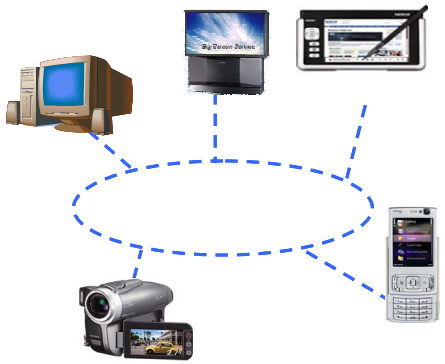
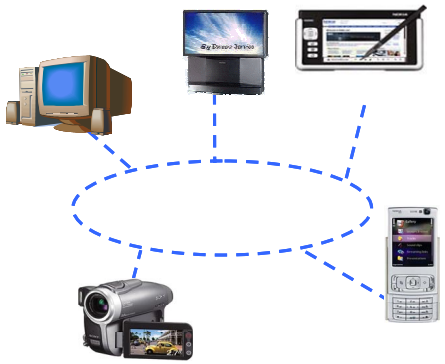
Common challenges for mobile device and other electronics companies in general

- Digital convergence will result in
  - Increased requirements for **multivendor interoperability**
    - For example IP address is not enough but ‘play’ and ‘pause’ commands are defined as well
  - **Dynamic topologies**, i.e. devices and services in a space evolve in time
  - **Scalability,** instead of server farm and PC client, also small battery powered devices needs to be addressed
- Handhelds, computers and consumer electronics devices must interoperate in various environments
  - E.g. lack of interoperability between home automation and multimedia industries.
  - There is no closed car (or other) domain but users want interoperability between cell phones and car electronics





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Possibilities to address the smart space challenges -Nokia's view

	Closed	Open Standard	De facto dominance
Interface	So far it has not been possible to describe accurately a service interface unless there has been an unanimous understanding on the use case behind	+ works with use cases understood similarly -UPnP: slow requires use-case by use standardization - WS* is faster but interfaces have become more & more complex, scalability	-Slows down the innovation +/- profit distribution
Information	Agree on the payload semantics	**M³** approach	

+ easy to come up with point solution, e.g. Nike& Apple music running
-Fragmented
- don't address user needs of seamless interoperability

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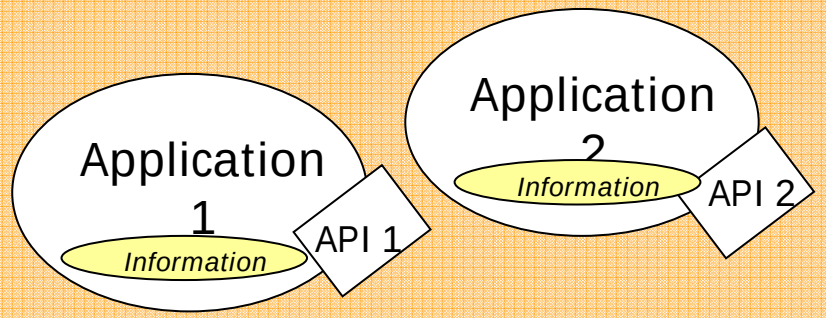
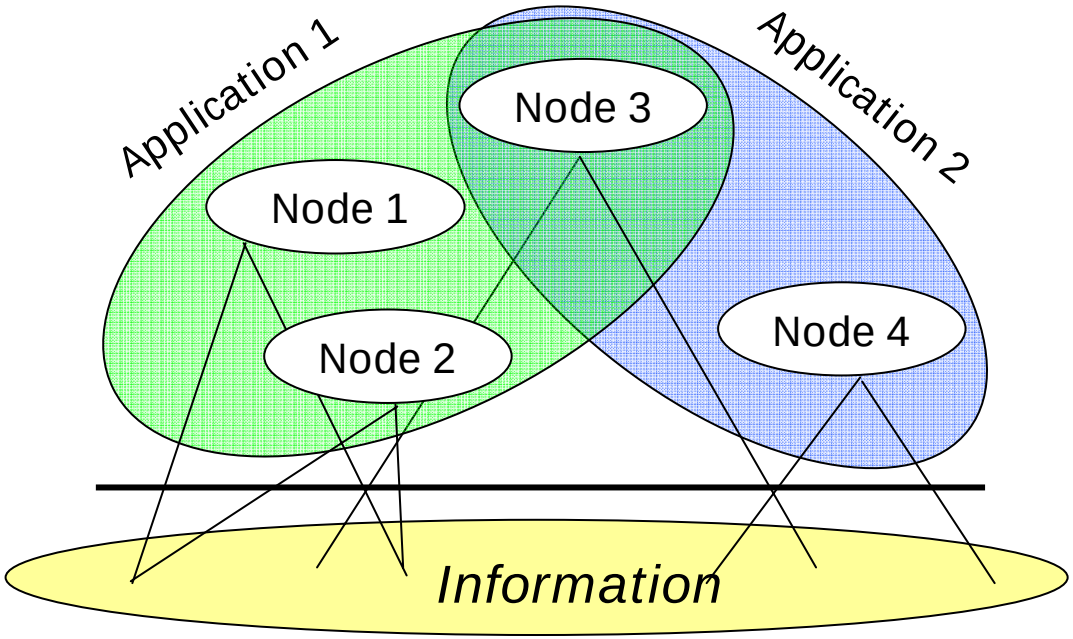
Information based approach

- **Today:**
- Standalone applications
- Interoperability provided by application-specific APIs



- Tomorrow:
- Applications consist of one or more nodes operating on shared information
- The application is not fixed: functionality may change when nodes join and leave the smart environment



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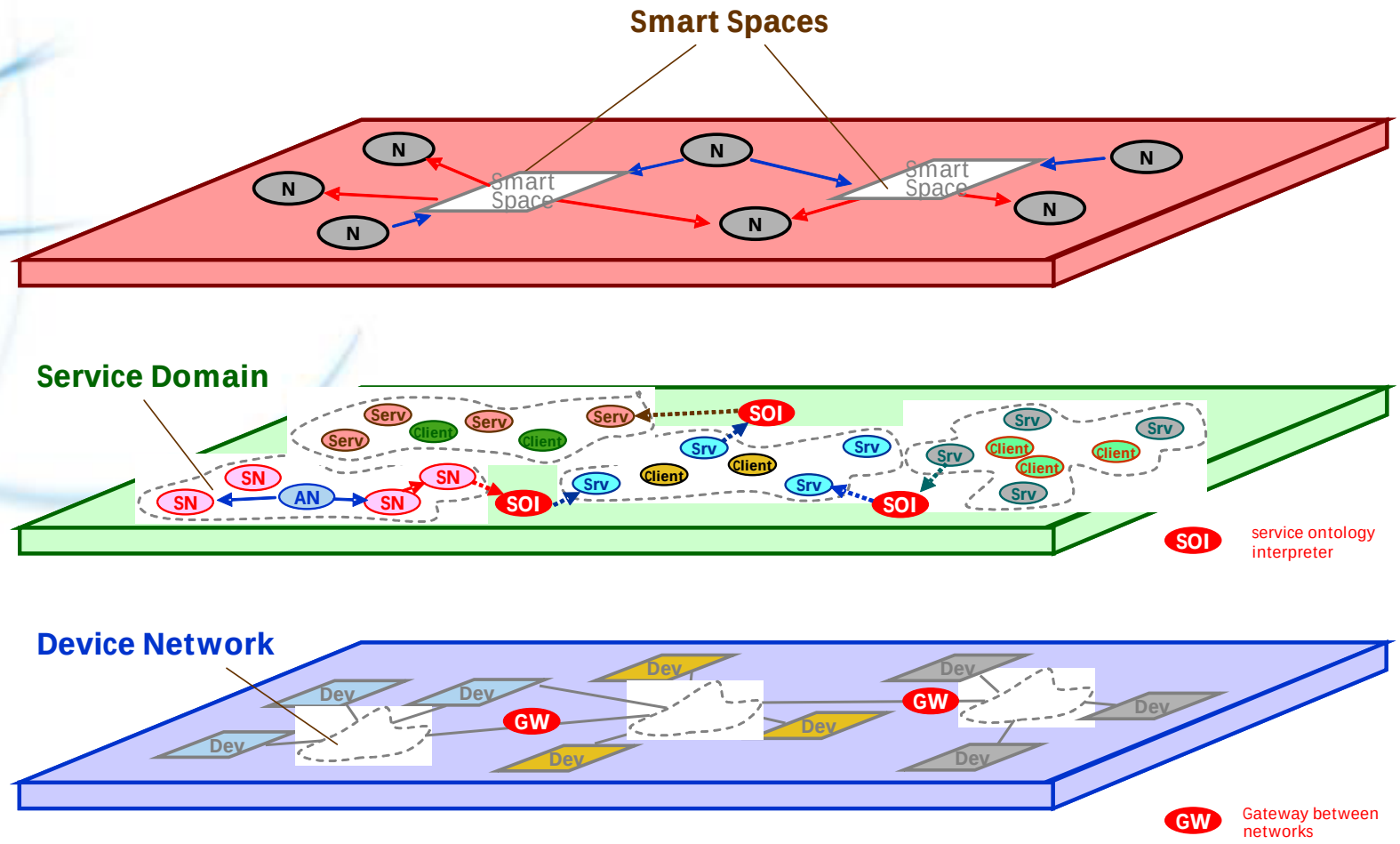
Technical view - Levels of interoperability



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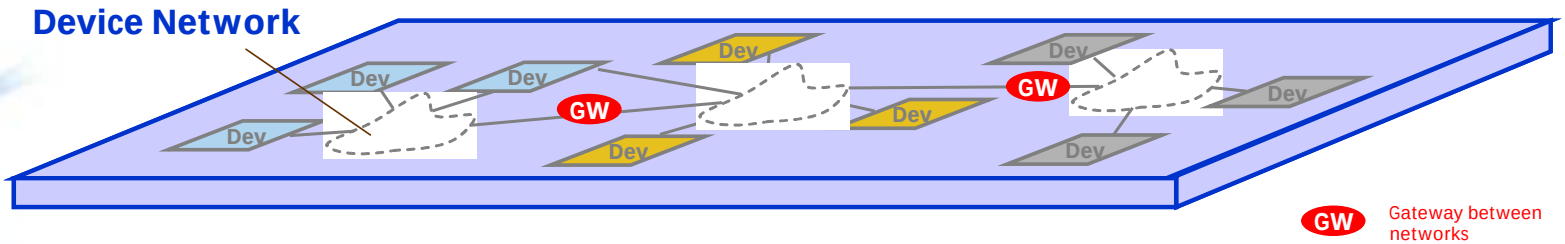
“Device world”



- Bona fide standardized air interfaces
- No use case specific radios
- Utilization of IP technologies
- Bluetooth LE
- Other focused technologies, TCP/IP, WLAN, Bluetooth and USB

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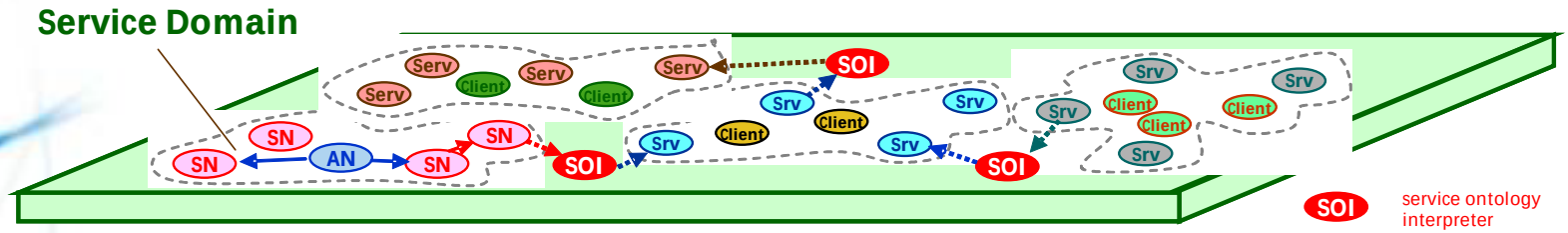
“Service world”



- **Many industry domains have/will have their “favorite” Service Oriented Architecture(s)**
- A nomadic device needs to be compatible with the important Service paradigms: WebServices, DLNA, …. More will emerge
- Need to compatible with multiple SOA styles
- Nokia has developed NoTA technology to allow rapid introduction of new technology and solution to Nokia platform http://www.notaworld.org/
- The differences between Internet mash-up model and the ad-hoc & scalability requirements indicate that the service level is not sufficient.

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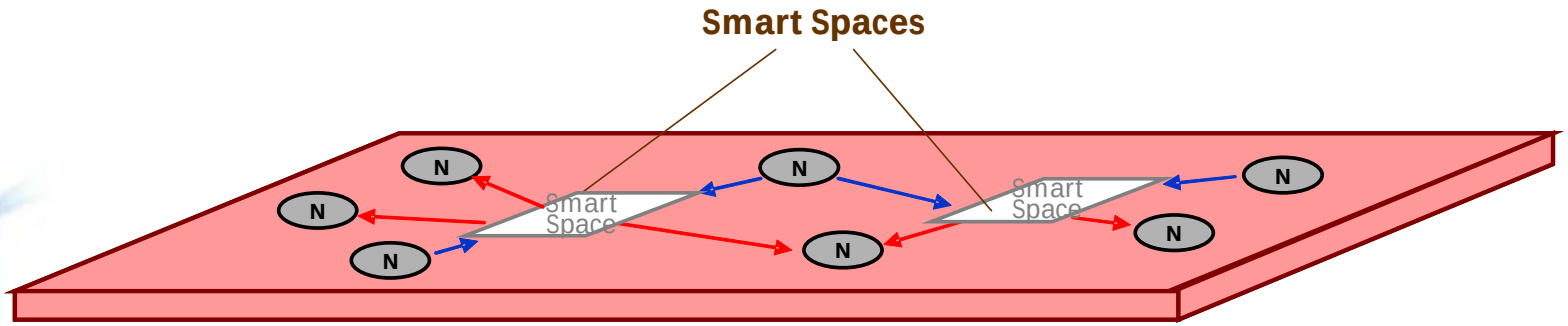
“Smart world”



- **Smart space level key issue – A nomadic device in multiple environments**
- Ad- hoc nature of the multi device collaboration – cross-domain
- New user interaction paradigm - Instead of “play” and “pause” command channel
  - Users’ nomadic applications can access and understand the information of the environment
  - Users contribute information to the environment
- Implementation through service level architectures, e.g DLNA, NoTa

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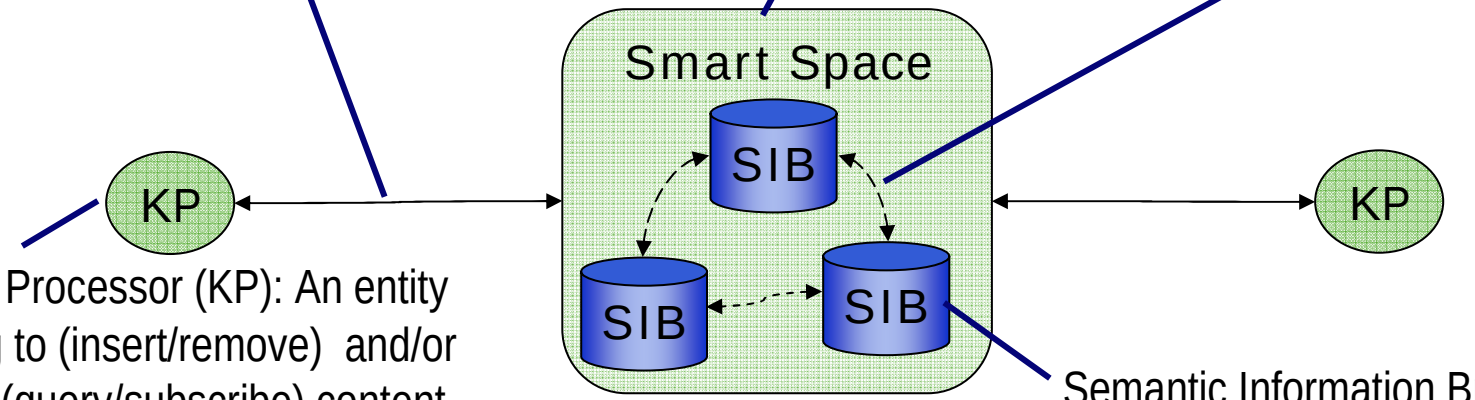
M3: Solution for Smart World interoperability

Triple governance transactions using Smart Space Access Protocol (SSAP): e.g. join, leave, insert, remove, update, query, subscribe, unsubscribe

Smart Space: a named search extent of information

Physical distribution of a Smart Space



Knowledge Processor (KP): An entity contributing to (insert/remove) and/or consuming (query/subscribe) content according to ontology relevant to its defined functionality. A KP needs one or more partner KPs for useful sharing of content, implying an agreed semantics for the used ontology

Semantic Information Broker (SIB): An entity performing triple governance in possible co-operation with other SIBs for one Smart Space. A SIB may be a concrete or virtual entity.

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Applying M3 to enhanced context awareness

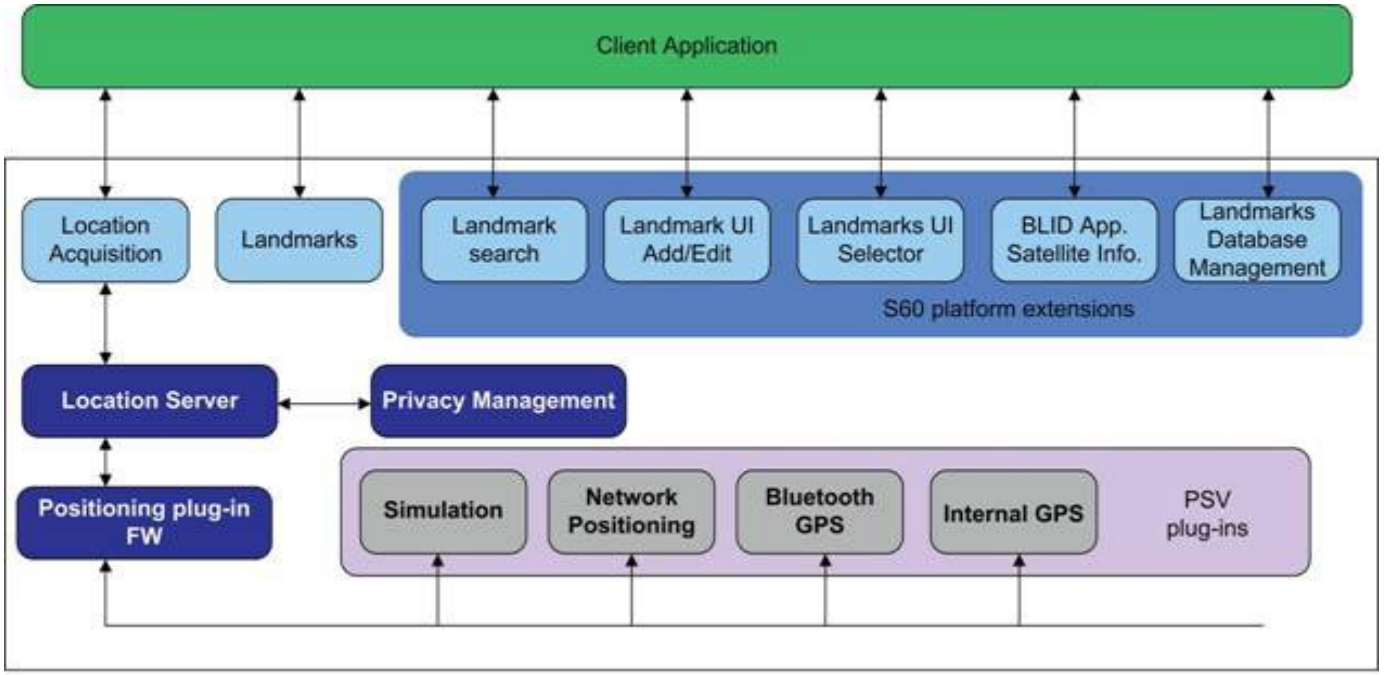
Rationale

What comes to personal smart environments, location and its derivatives is the hottest context information family today

Mobile devices already have quite sophisticated context (location as example) management frameworks, including privacy

Let's take S60

as an example



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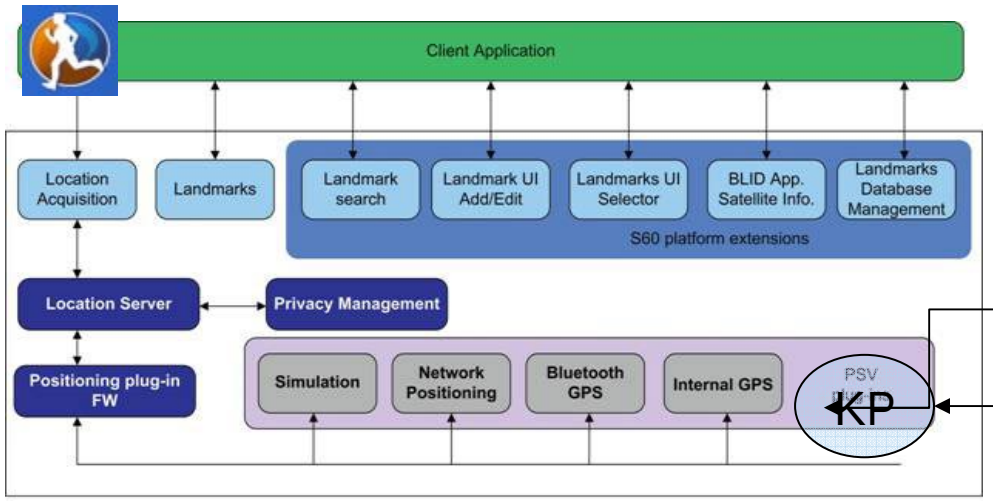
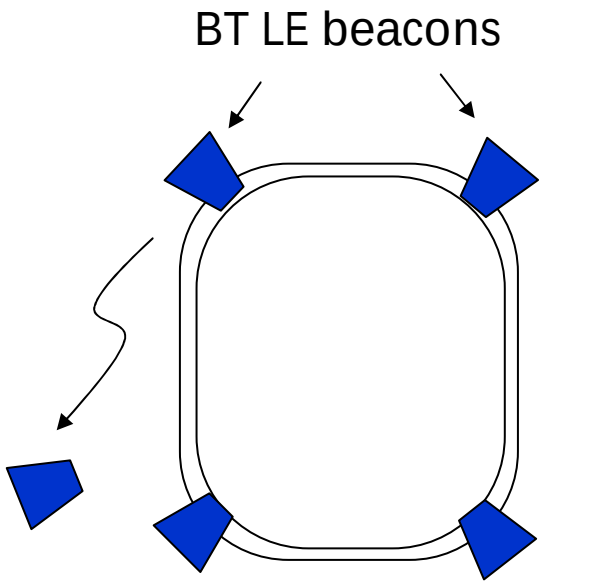
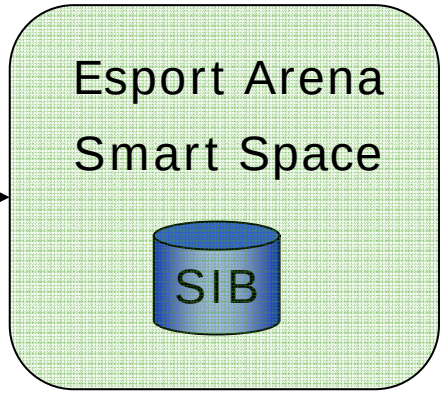
How should we include indoor context information using M3

- Phase 1: No change in Client application







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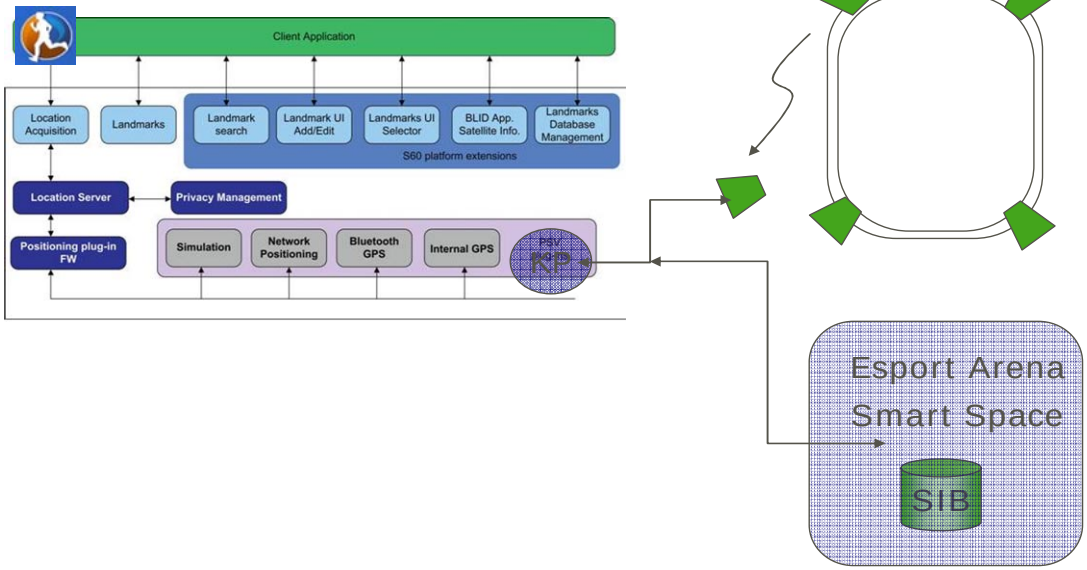

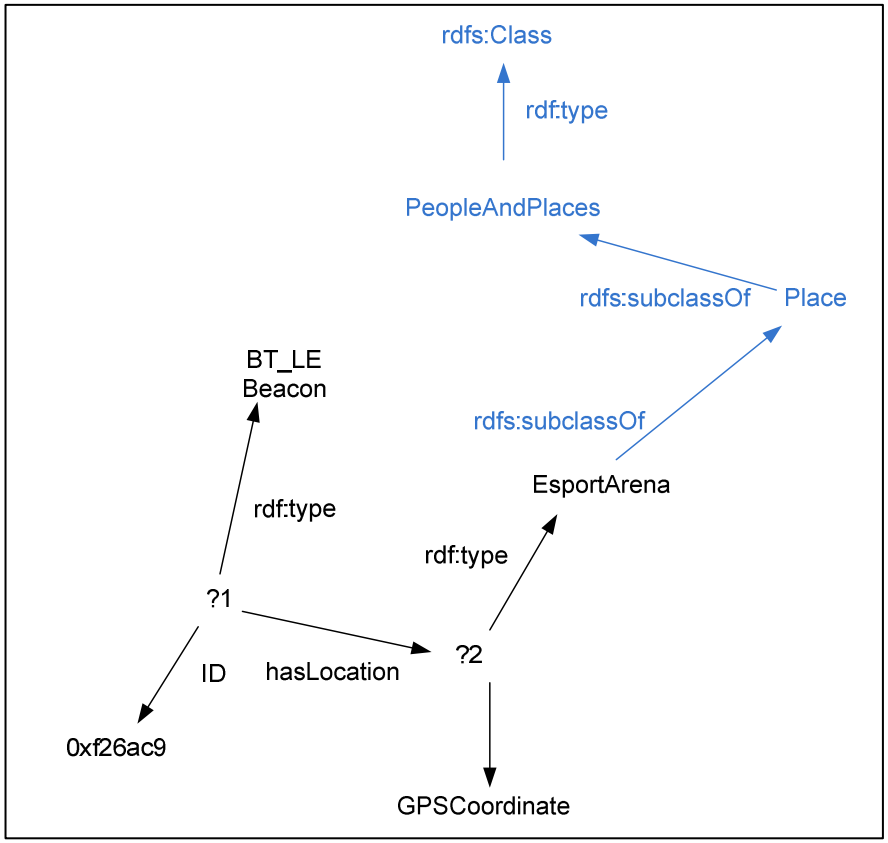

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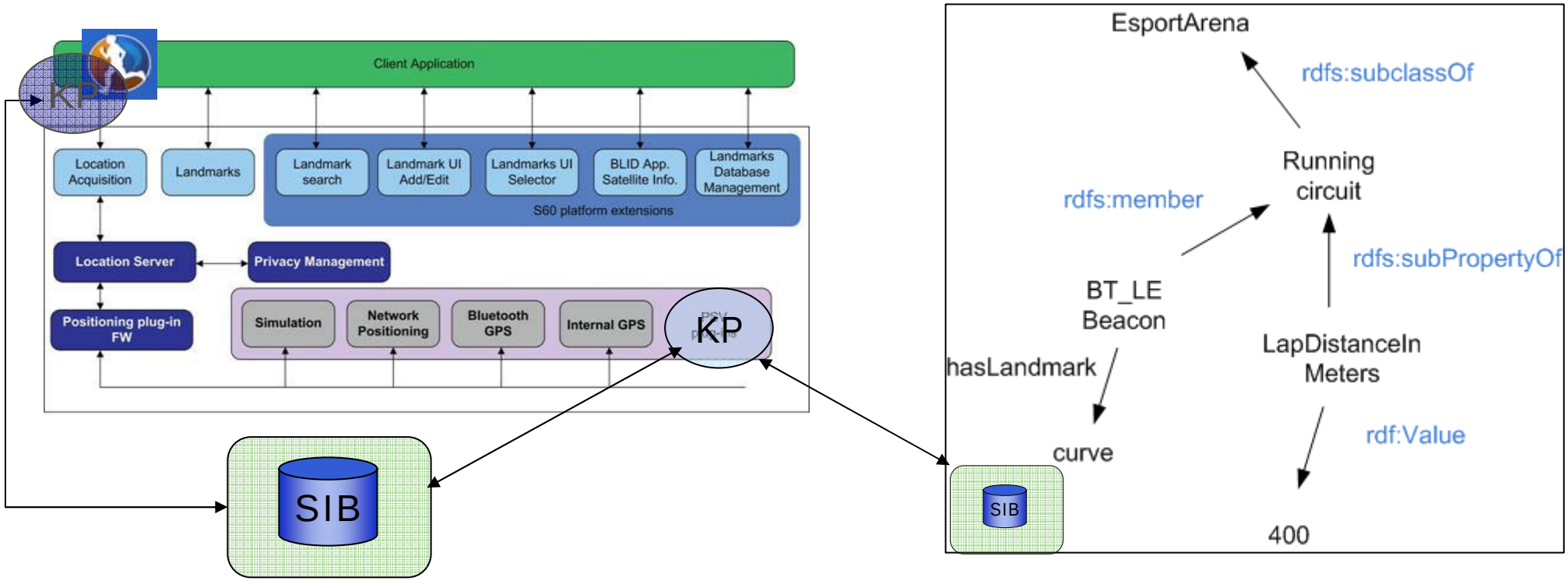
How should we include indoor context information using M3

- Phase 2: Additional information provided for client application



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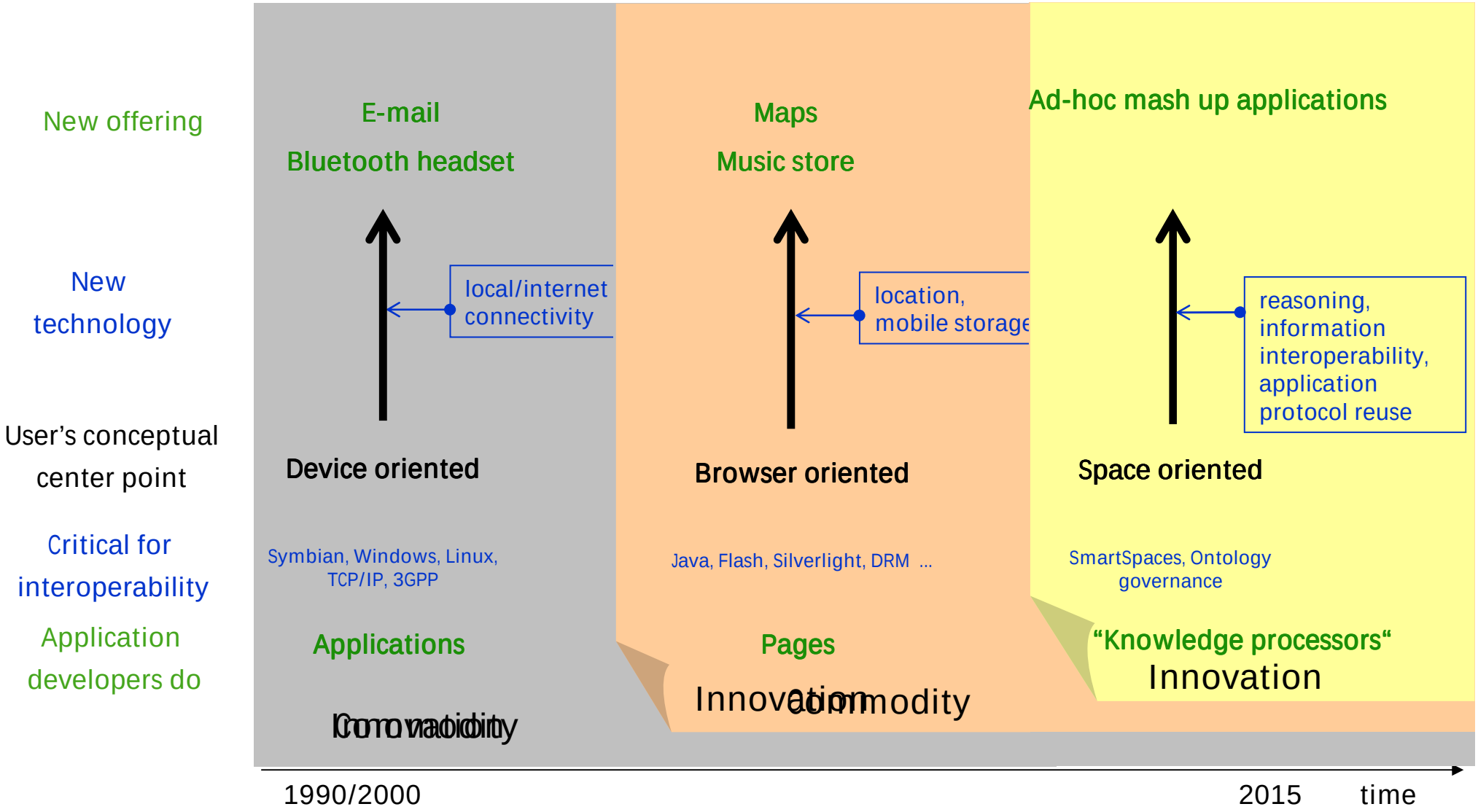
Long-term advancement from mobile point of view



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Conclusions

- **Heterogeneous systems, strong legacy, life-cycle differences drive a solution with minimum impact to existing investment.**
- **Information level approach seems feasible to attack the challenge.**
- **Three big challenges in the commercialization of the information level interoperability**

1. How to get the information of the embedded domains available for the web domain tools
2. How to establish ontology governance process that omits use case standardization but is concrete enough for scalable “on top of the platform” business ecosystem
3. How to reason information having different owner, business model, volatility & data format.

1. Localization to existing embedded domains. E.g. NoTA to provide transport independency.
2. Localization to existing domains, RDF/Semantic web, limiting the search extend and ontology governance by introducing Smart Space instead of GGG (Giant-Global-Graph)
3. SIB distribution, privacy & security, distributed deductive closure.

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Thank you
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