

Plug & Manage Heterogeneous Sensing Devices

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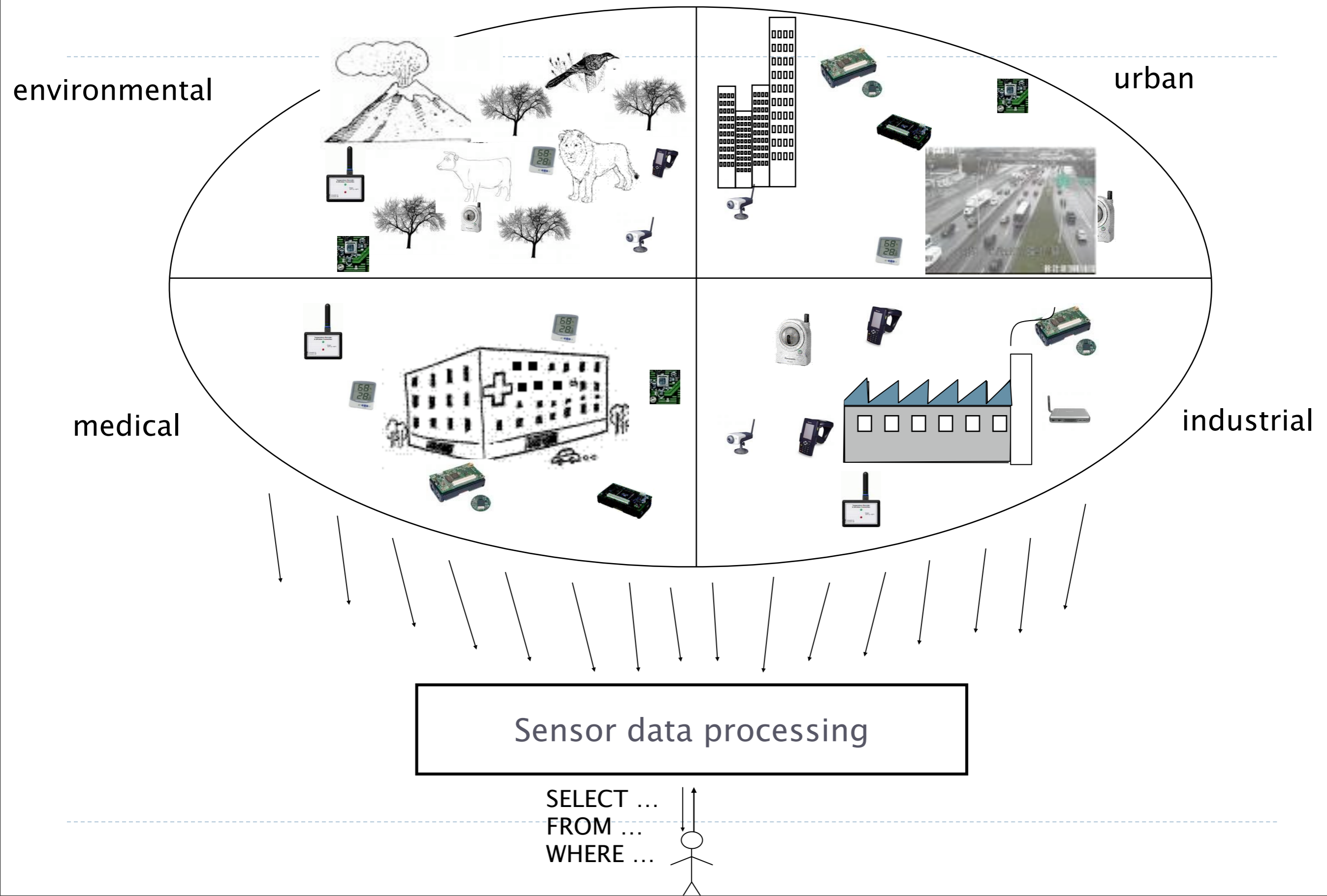
DMSN workshop
in conjunction with VLDB
Lyon, France

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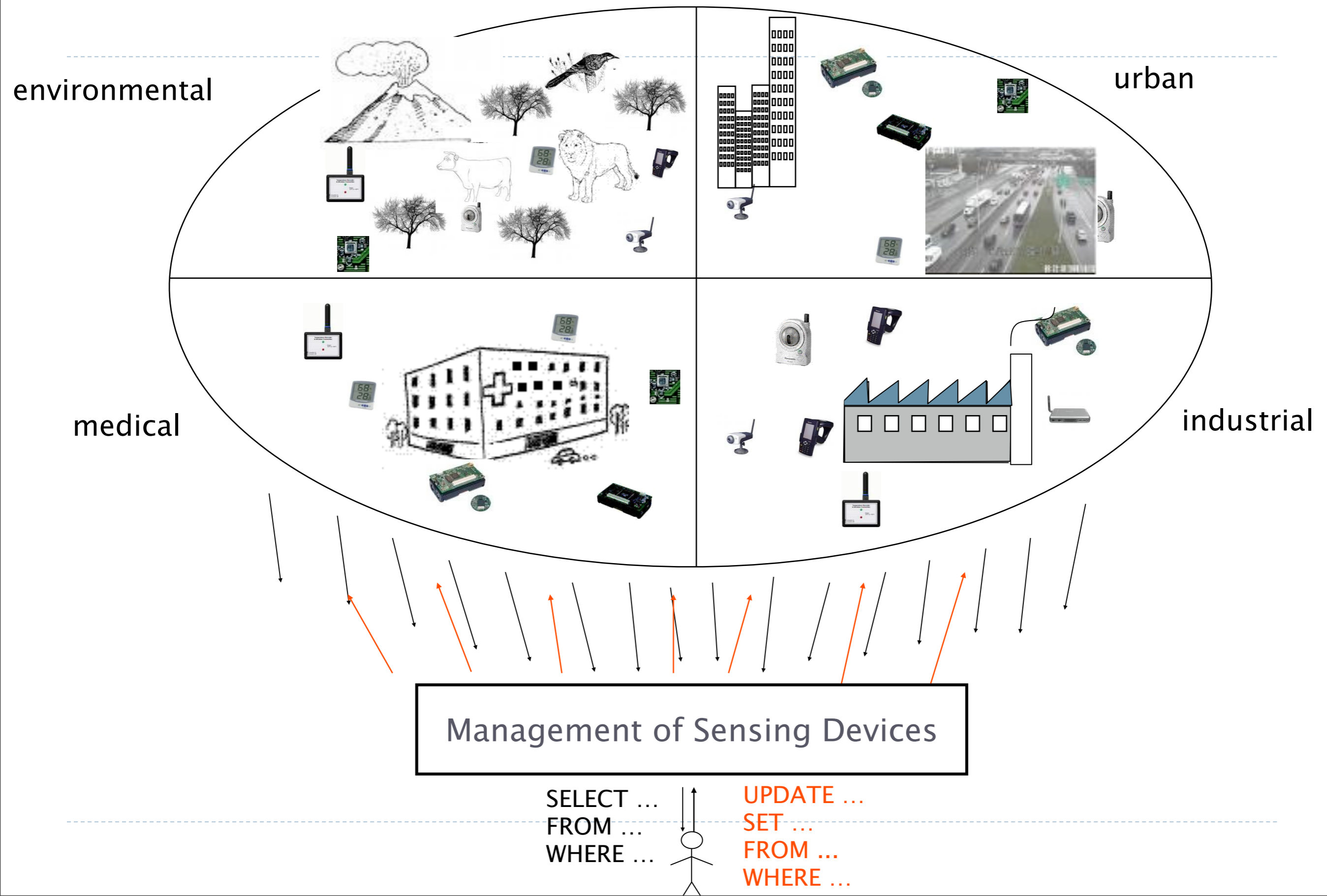
Outline

- ▶ **Context and motivation**
 - ▶ **Related Work**
 - ▶ Device Management
 - ▶ Management of Sensor Networks
 - ▶ **Management of Sensing Devices**
 - ▶ Integrated management framework
 - ▶ Implementation
 - ▶ **Conclusion and future work**
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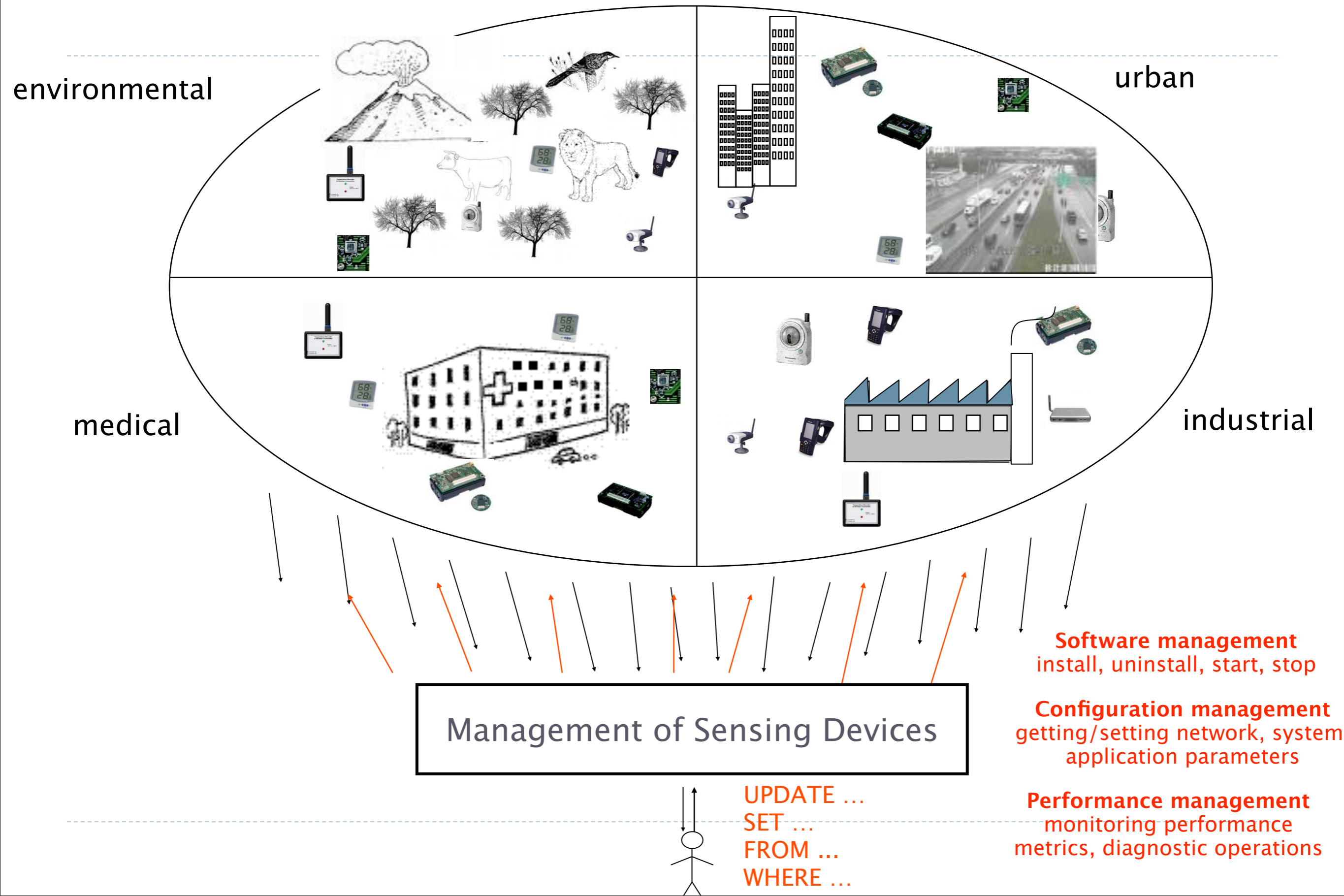
Extensive research on processing sensor data



What about managing sensors ?



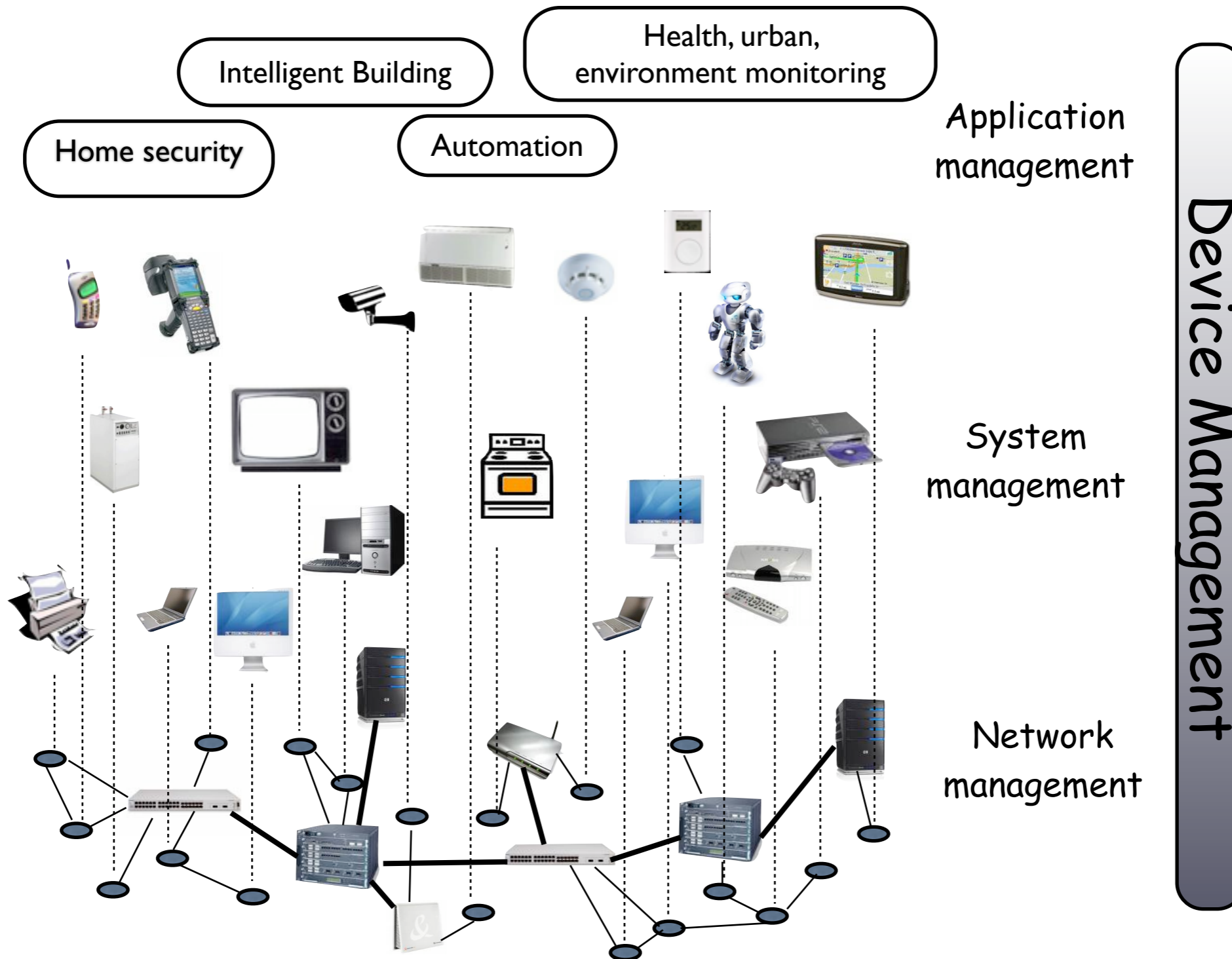
What about managing sensors ?



Related Work

Device Management

- Remote management of end-user devices (e.g. domotic).
- Integrated management of network, system and application related functions
- Emerging standards: TR-069 of Broadband Forum, DM of OMA, DM of UPnP, ...



Management in Sensor Networks

- **Network management**
 - Energy efficient topology management [1], adaptive routing [2] and reconfiguration [3]
- **System management**
 - System software update on sensors [4], dynamic reconfiguration[5], performance monitoring [6]
- **Application management**
 - scripts on virtual machines [7], software bundles on modular environment [8] and mobile agents on middleware [9].

Management in Sensor Networks

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Solutions are sensor and domain specific

No generic integrated management mechanism

Management of Sensing Devices

Management in sensors' context

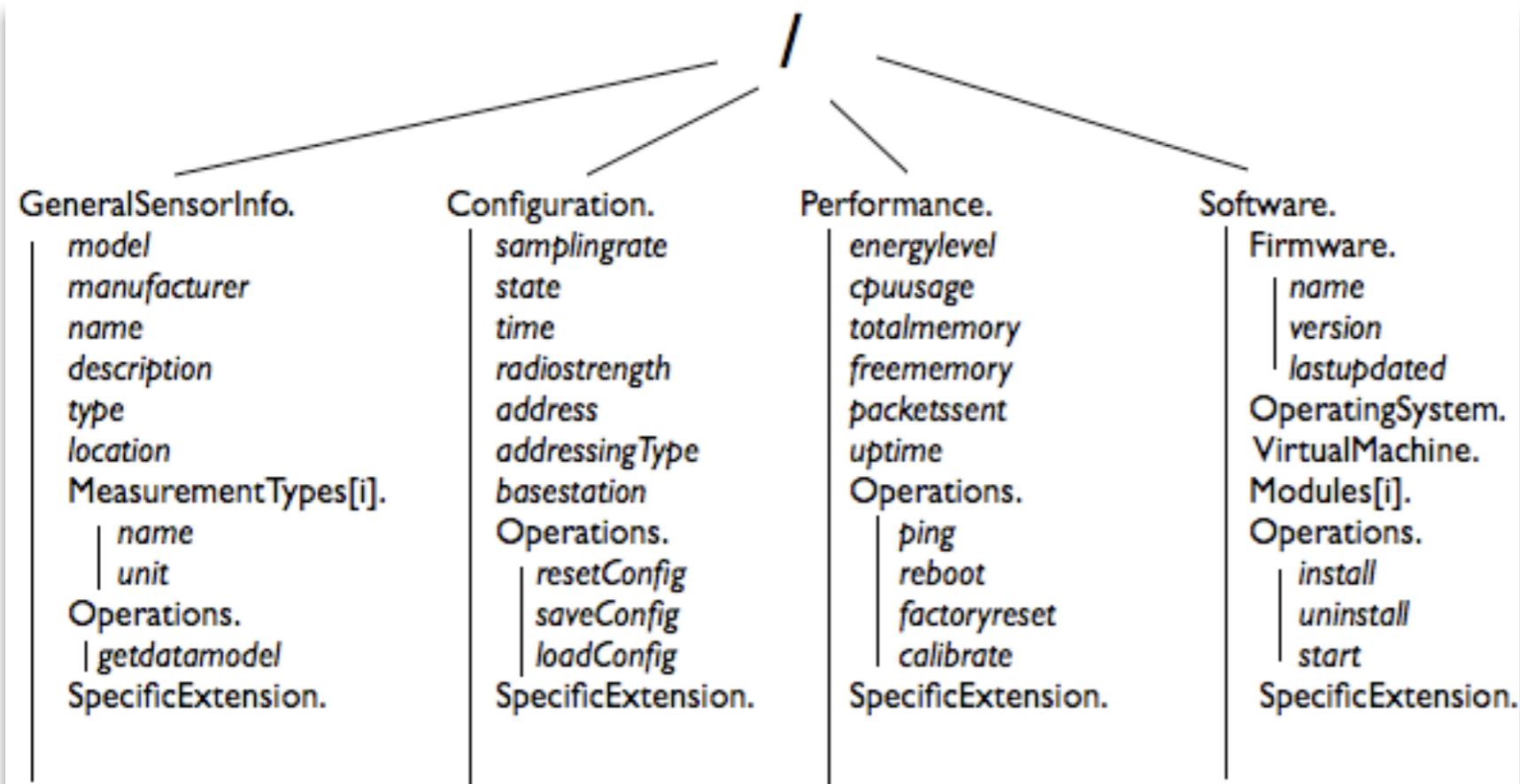
- Sensors more and more present in critical applications (e.g., industrial, domotic, medical)
- Efficient management necessary for better quality of service, reliability, security and integrity.
- Existing work deals with either network, system or application management.

We propose a management mechanism having

- 3 main functions: software management, configuration and performance monitoring
 - a hierarchical architecture based on the *manager-agent* model
 - a simple and extensible data model, and a set of generic management operations
-

Data model and management operations

- A simple Management Information Base (MIB)
 - Hierarchical extensible data model
- Generic Management Operations
 - get, set, act, notify



```
get("/GeneralInfo/MeasurementType")
```

Get all measurement types of the sensor

```
set("/Configuration/SamplingRate", "1000")
```

Set the sampling rate of the sensor to 1000 ms.

```
act("install", "SoftwareURI")
```

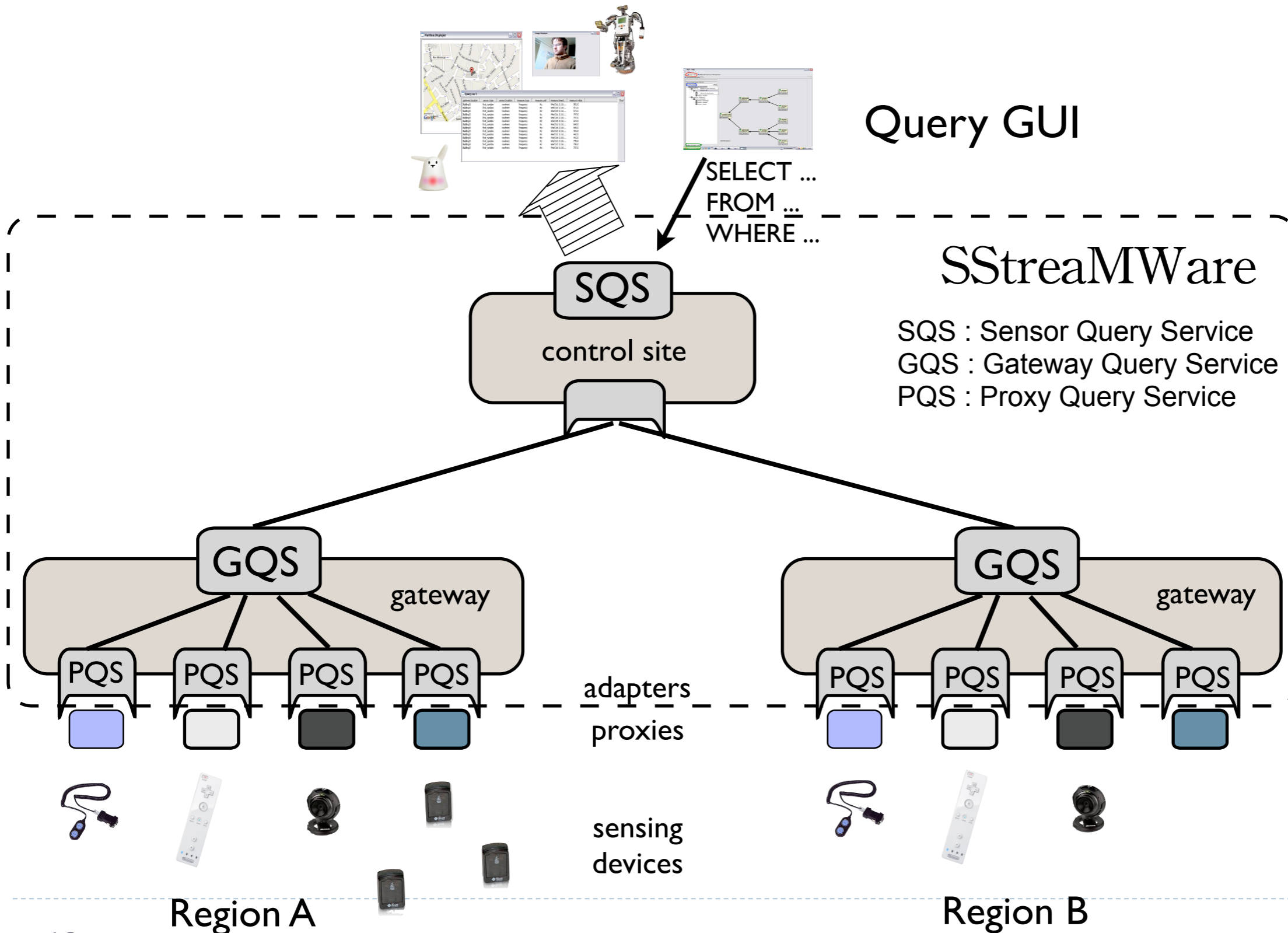
Install a software module from the given URI

```
notify("/Software/OS/Version")
```

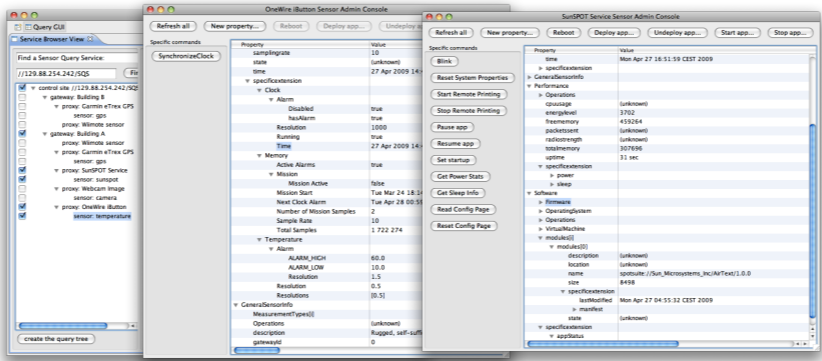
Notify when the OS version is modified

Implementation

- Prototype implemented on the top of SStreamWare [10], a service oriented middleware for sensor data management middleware:

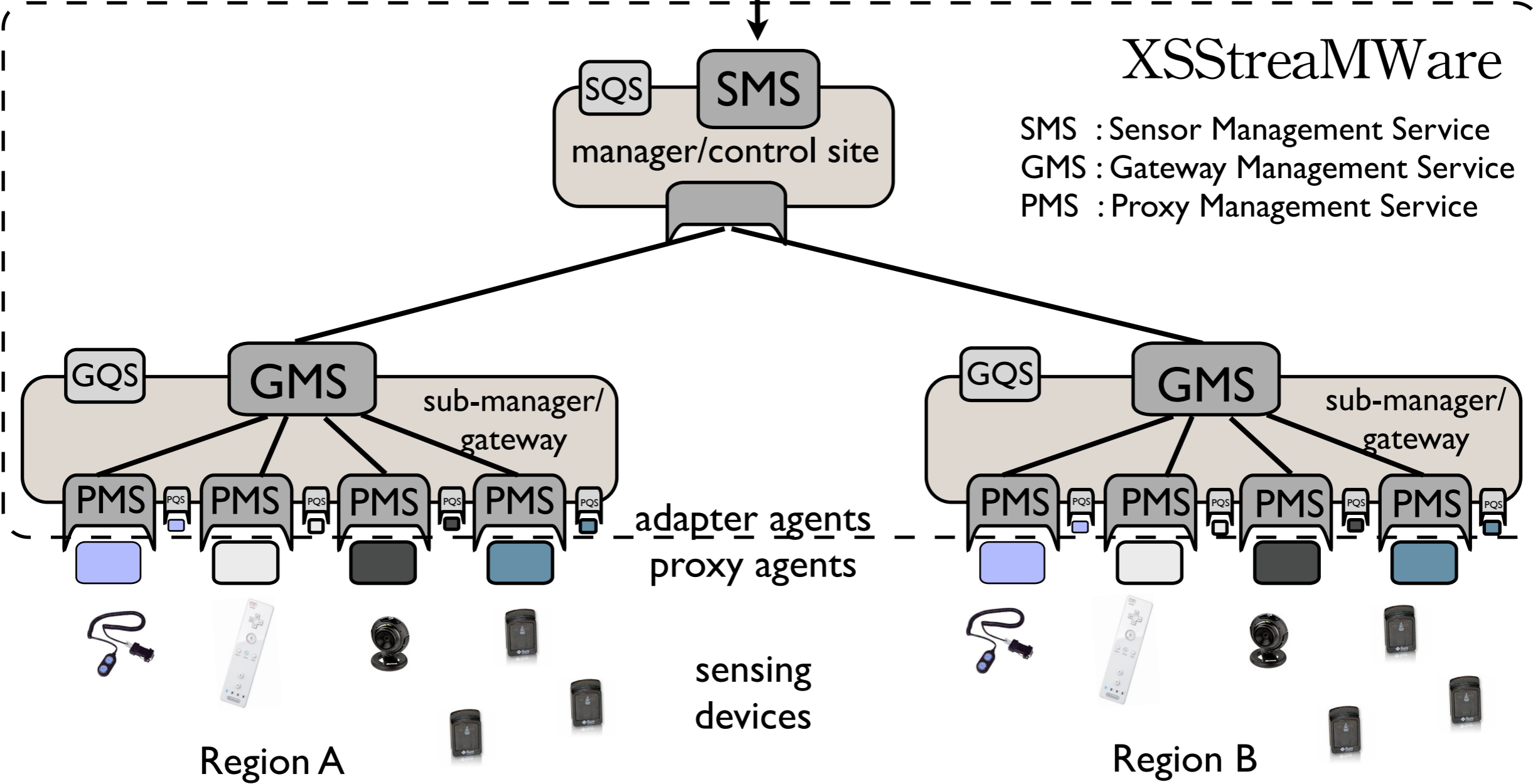


XSStreaMWare: eXtending SStreaMWare for management



Management GUI

get, set, act, notify



Conclusion

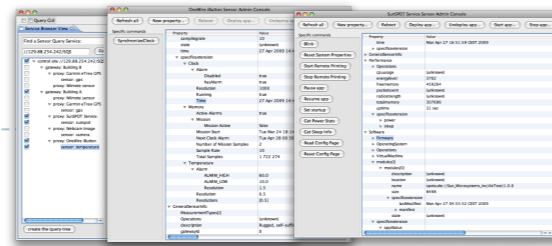
- Sensors more and more numerous and heterogenous in various applications requiring quality of service
 - They should be efficiently managed
 - A simple, extensible, scalable management mechanism is needed
 - XStreamWare: eXtending StreamWare for management
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Conclusion and Future work

- Sensors more and more numerous and heterogenous in various applications requiring quality of service
 - They should be efficiently managed
 - A simple, extensible, scalable management mechanism is needed
 - XStreaMWare: eXtending SStreaMWare for management

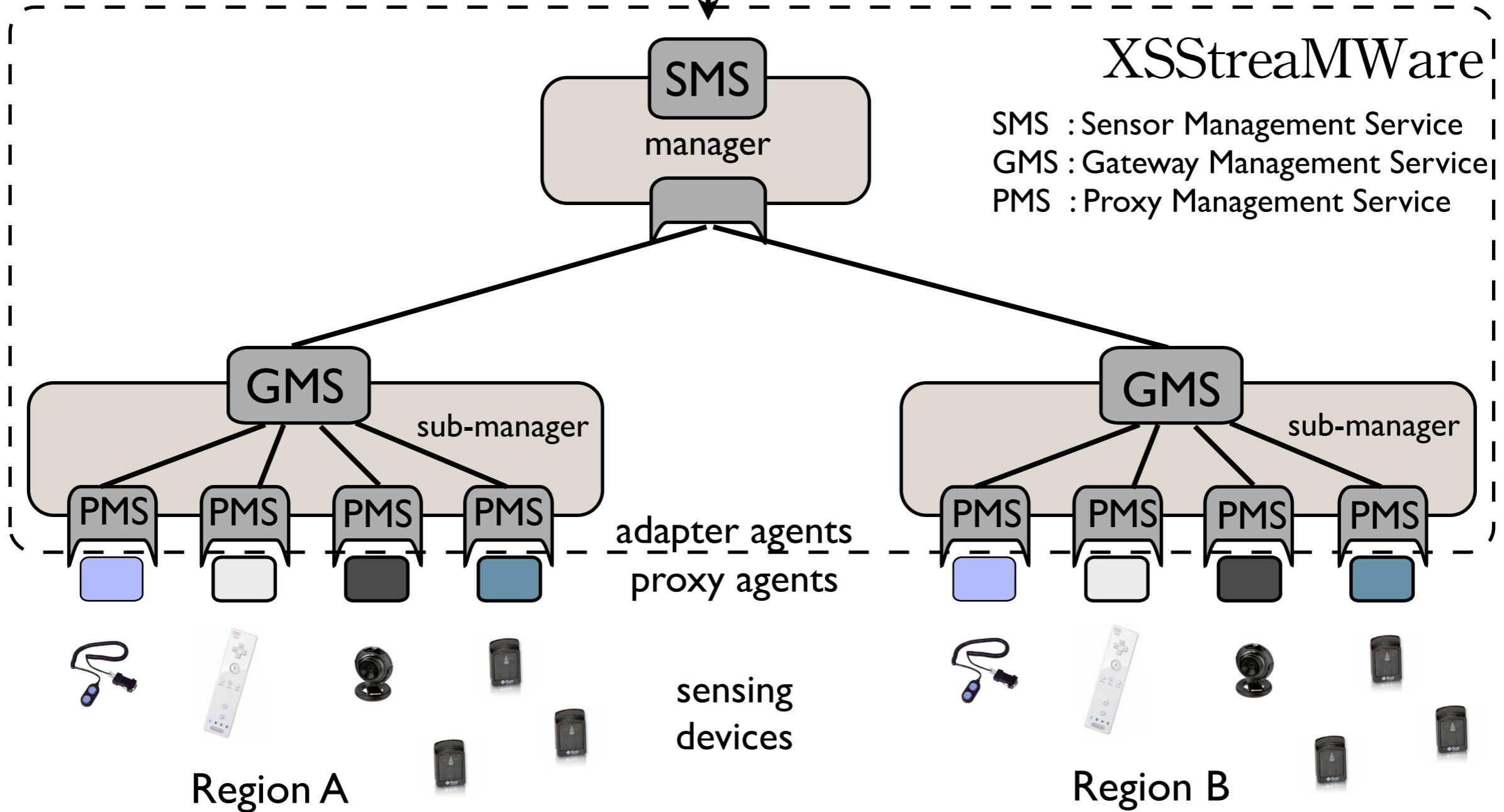
 - Integrating more sensing devices
 - Dealing with non-functional properties
 - ▶ security, reliability, transactional integrity...?
 - Autonomic management
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Thanks!



Management GUI

↓ get, set, act, notify



Questions?

References

- [1] L. B. Ruiz, J. M. Nogueira, and A. A. F. Loureiro. Manna: a management architecture for wireless sensor networks. *Communications Magazine, IEEE*, 41(2):116-125, 2003.
- [2] Chien chung Shen, Chaiporn Jaikaeo, Chavalit Srisathapornphat, and Zhuochuan Huang. An adaptive management architecture for ad hoc networks. *IEEE Communications Magazine*, 41:108-115, 2003.
- [3] Alberto Cerpa and Deborah Estrin. Ascent: Adaptive self-configuring sensor networks topologies. *IEEE Transactions on Mobile Computing*, 3(3):272-285, 2004.
- [5] Pedro Jos Marrn, Andreas Lachenmann, Daniel Minder, Matthias Gauger, Olga Saukh, and Kurt Rothermel. Management and configuration issues for sensor networks. *International Journal of Network Management*, 15:235-253, 2005.
- [6] Sachin Kogekar, Sandeep Neema, Brandon Eames, Xenofon Koutsoukos, Akos Ledeczi, and Miklos Maroti. Constraint-guided dynamic reconfiguration in sensor networks. In *IPSN '04: Proceedings of the 3rd international symposium on Information processing in sensor networks*, pages 379-387. ACM, 2004.
- [6] Ji-Hye Bae, Kyung-Oh Lee, and Yoon-Young Park. Moneta: an embedded monitoring system for ubiquitous network environments. *Consumer Electronics, IEEE Transactions on*, 52(2):414-420, May 2006.
- [7] Philip Levis and David Culler. Mate: a tiny virtual machine for sensor networks. In *ASPLOS-X: Proceedings of the 10th international conference on Architectural support for programming languages and operating systems*, pages 85-95, New York, NY, USA, 2002. ACM.
- [8] Ting Liu and Margaret Martonosi. Impala: A middleware system for managing autonomic, parallel sensor systems. In *PPoPP 03: Proceedings of the 9th ACM SIGPLAN symposium on Principles and practice of parallel programming*, pages 107-118. ACM Press, 2003.
- [9] Chien-Liang Fok, Gruia-Catalin Roman, and Chenyang Lu. Rapid development and flexible deployment of adaptive wireless sensor network applications. In *Proceedings of the 25th IEEE International Conference on Distributed Computing Systems*, pages 653-662, Washington, DC, USA, 2005. IEEE Computer Society
- [10] Levent Gurgun, Claudia Roncancio, Cyril Labbe, Andre Bottaro, and Vincent Olive. SStreaMWare: a service oriented middleware for heterogeneous sensor data management. In *Proceedings of the 5th international conference on Pervasive services, ICPS '08*, pages 121-130, New York, NY, USA, 2008. ACM.