

A Platform-as-a-Service for in-situ Development of Wireless Sensor Network Applications

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Motivation

- Facilitating development of WSN applications
 - On-demand *development*
 - On-demand *deployment*
 - On-demand *integration*

- Dinam PaaS for WSN application hosting
 - *Service delivery* architecture for WSNs
 - *QoS, Reliability & Scalability*
 - Enabler for *business integration*

- 1. Dinam Cloud Architecture**
- 2. Dinam PaaS Approach**
- 3. Application Example**
- 4. System Integration Example**
- 5. Discussion**
- 6. Summary and Outlook**

1. **Dinam Cloud Architecture**

2. Dinam PaaS Approach

3. Application Example

4. System Integration Example

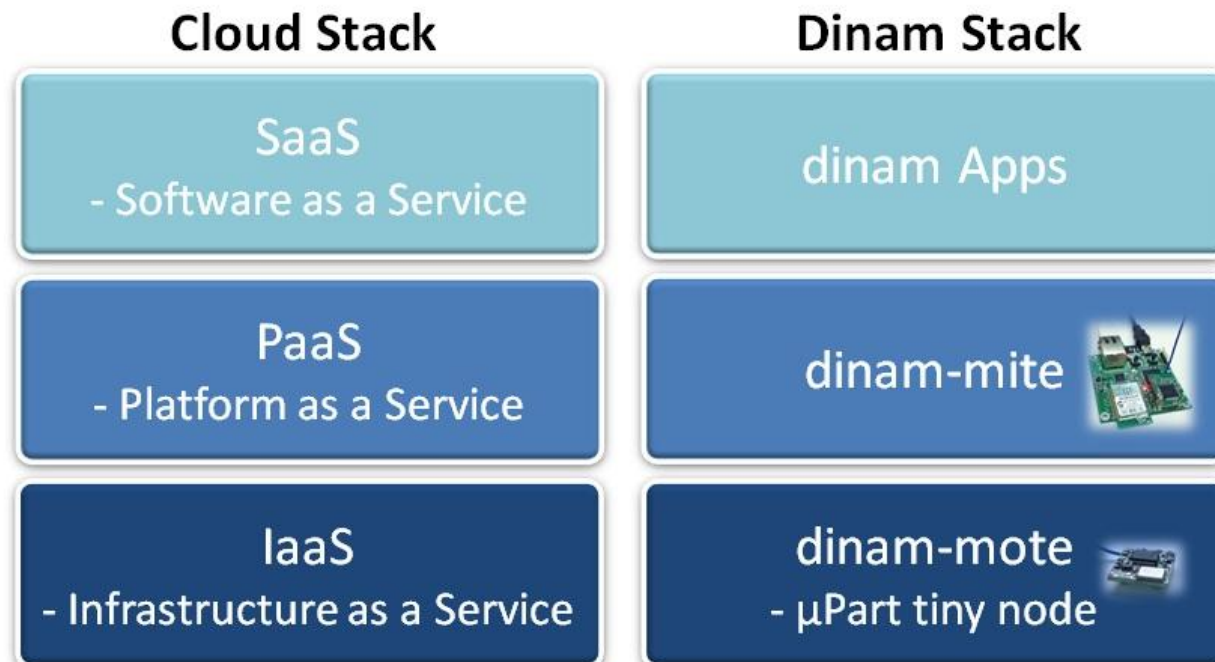
5. Discussion

6. Summary and Outlook

Dinam Cloud Architecture – I

■ Dinam Cloud Stack:

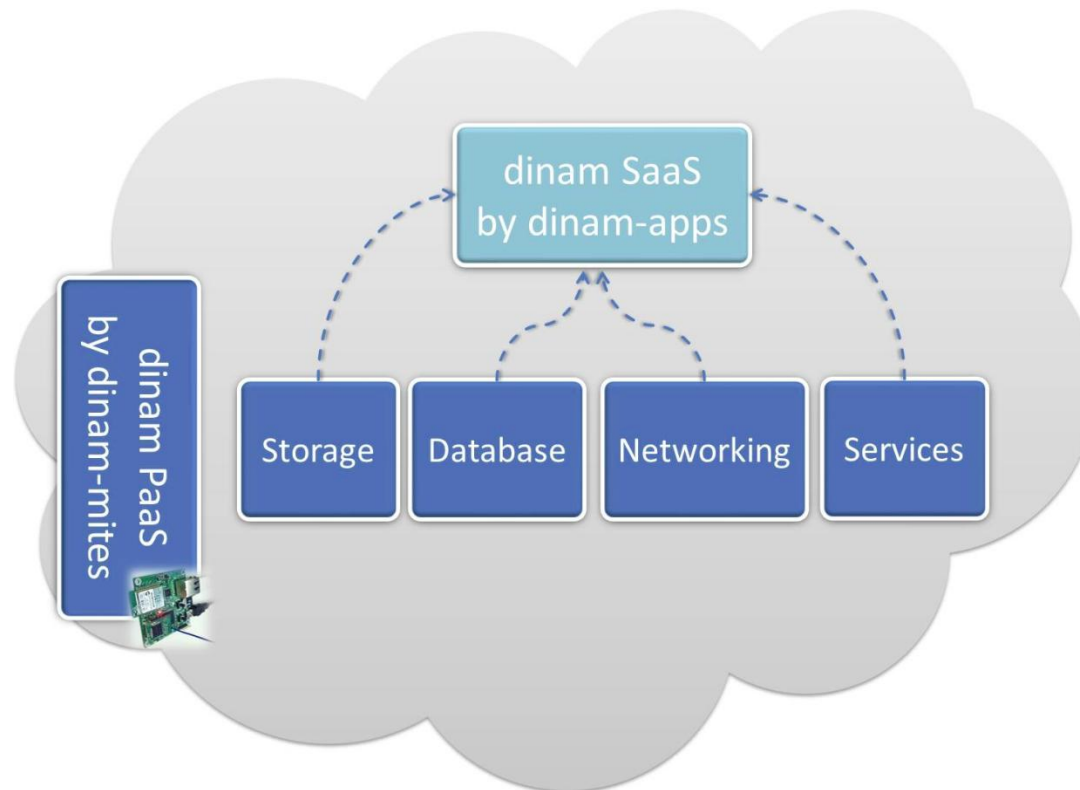
- Dinam *IaaS*:
infrastructure services
- Dinam *PaaS*:
platform services
- Dinam *SaaS*:
software services



Dinam Cloud Architecture – II

■ Dinam *PaaS* Layer

➡ computing platform services for WSN apps



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■ A programming and run-time environment

- Web-based IDE
- Services development
- Services deployment
- Sensing systems
- Business systems



The screenshot shows a web browser window with the URL `http://dinam-mite/ide/index.htm`. The page title is "TecO WebInterface". Below the title, it says "Current location: [IDE](#)". On the left, there is a navigation menu with the following items: Overview, Console, IDE (selected), Logs, Data Visualizer, Admin, and Help. The main content area is titled "IDE" and contains a file management section with "Files: PAAS.BAS" and buttons for "Load", "Delete", "Save", and "Reboot". Below this is a text input field for "Filename: PAAS.BAS". The main area displays a code editor with the following code:

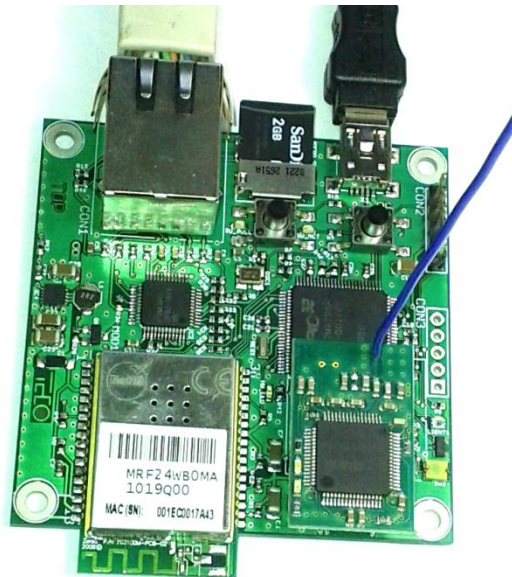
```
1 NumMeas = 0
2 TempSum = 0
3 StartTime=Time()
4 IF upNew() THEN GOTO 5 ELSE GOTO 4
5 TempSum = TempSum + upGetTemp()
6 NumMeas = NumMeas + 1
7 ElapsedTime = Time() - StartTime
8 IF ElapsedTime >= 10 THEN GOTO 9 ELSE GOTO 4
9 LogData("Avg Temp", TempSum / NumMeas)
10 GOTO 1
```

At the bottom of the page, it says "TecO Software Stack (Version: v1.0.0) of the [Telecooperation Office \(TecO\)](#) at the Karlsruhe Institute of Technology (KIT)".

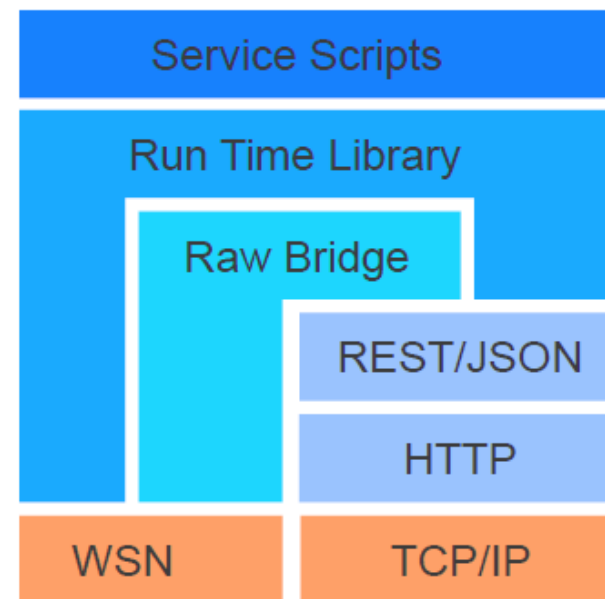
Dinam PaaS Approach – II

■ Dinam PaaS Reference Implementation

- Physical networking interfaces
- Services for integration of WSNs and business systems
- Services in BASIC using bridging framework



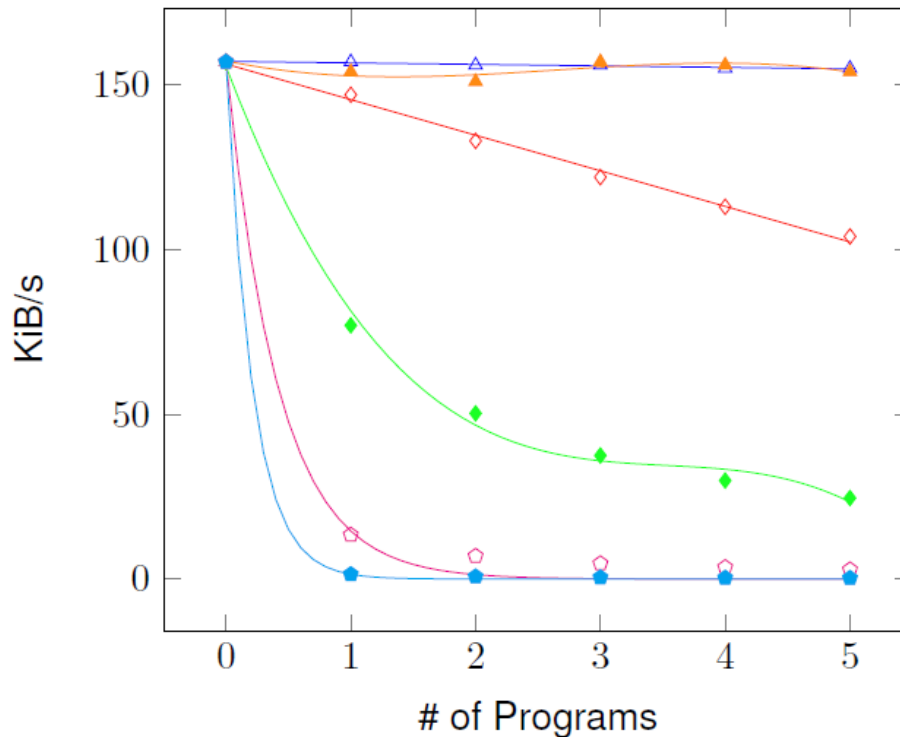
HW platform



SW platform

Dinam PaaS Approach – III

■ Performance Evaluation



- Test routine in 6 iterations
- Trade-off between BASIC program performance (budget) and the number of scripts
- ✓ Towards Monitoring
 - ✓ ... for QoS
 - ✓ ... for rapid elasticity

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Application Example – I

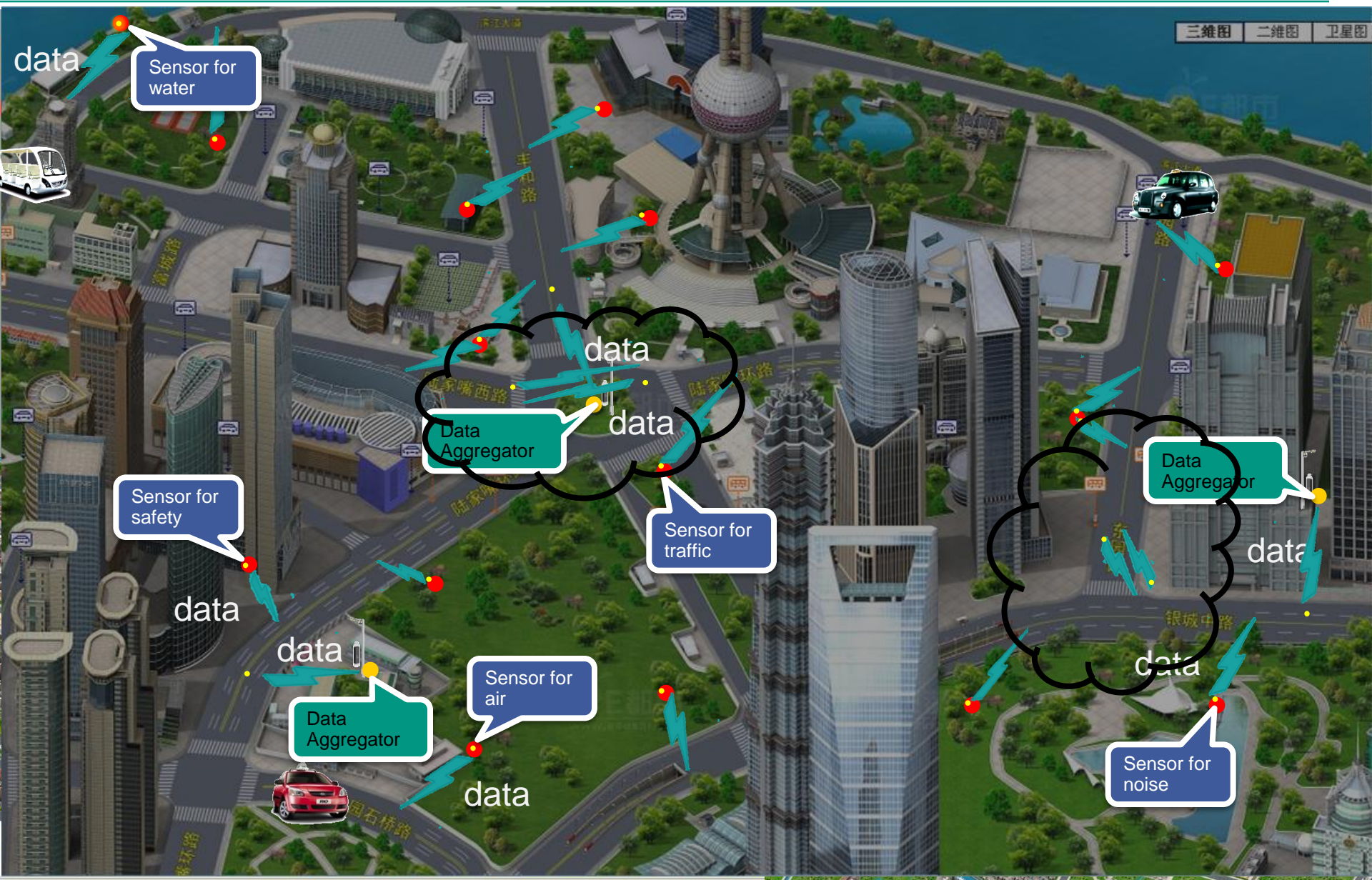
■ Sensing System – *MASON*

- Fine-grained environmental data within the city of Beijing
- A mobile vehicular network of Tsinghua University
- GPS, temperature, humidity, carbon-monoxide, and 3-axis accelerometer.

■ Business Process – *Energy Demand Prediction*

- The majority is based on long-term statistics
- Urban information is an effective support for accurate prediction
- New approach takes environmental factors into account

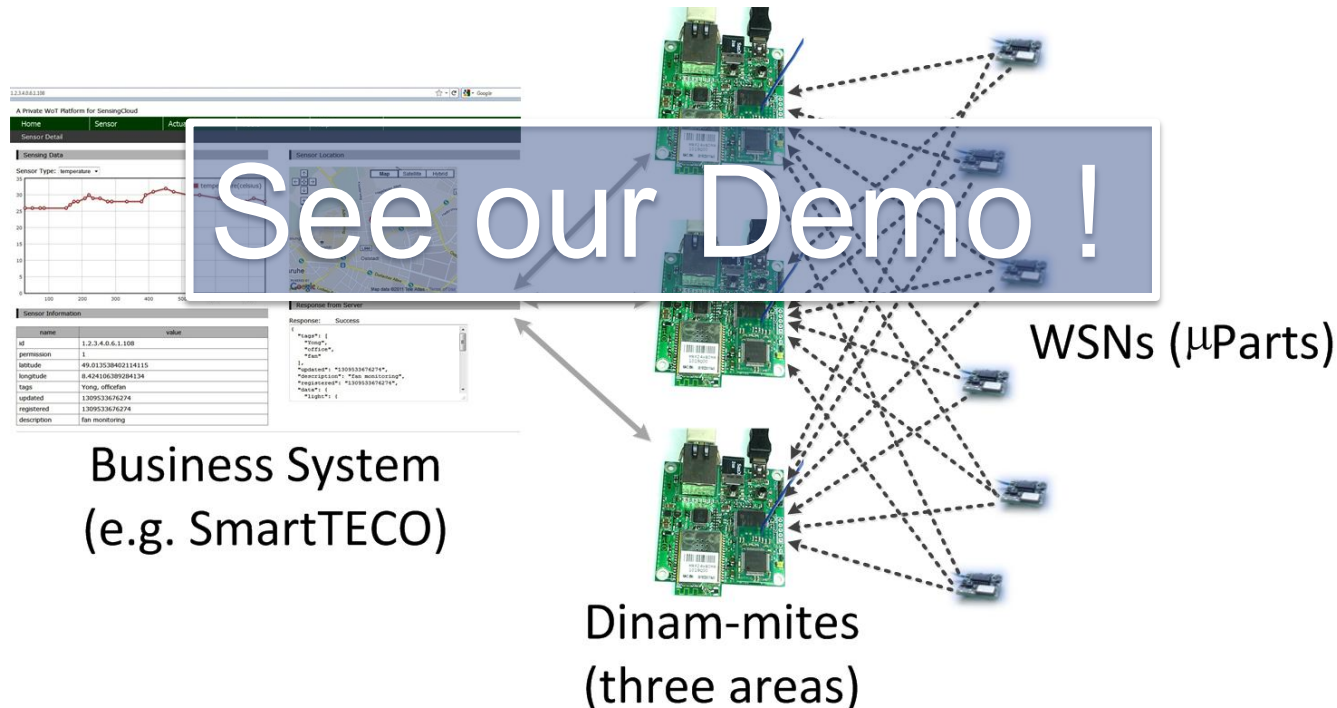
Application Example – II



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System Integration Example

- *PaaS development interface*
- *PaaS platform* for hosting services
- *Business integration* using web services



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Five Essential Characteristics

- On-demand self-service
 - *Automatically provisioning of computing resources*
- Broad network access
 - *Networking interfaces (for WSNs and IP-based)*
- Resource pooling
 - *N BASIC scripts to 1 dinam-mite node*
- Rapid elasticity
 - *N dinam-mites to 1 computing platform*
- Measured service
 - *Monitoring of running apps on a dinam-mite node*

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Conclusions

- Concept of an embedded PaaS
 - for in-situ development of WSN apps
 - for WSN integration into business system
- Dinam-mite concept and implementation ...
- A real world scenario for WSN system integration
- The dinam PaaS provides ...
 - *QoS*
 - *Reliability*
 - *Scalability*

■ *Thank You!*
■ *Questions?*