Technical Report

From Sensor Networks to Internet of Things: - A Paradigm for Empowering an Infrastructure Technology

Vikram Gupta

Eduardo Tovar

Nuno Pereira

Raj Rajkumar

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Vikram Gupta, Eduardo Tovar, Nuno Pereira, Raj Rajkumar

IPP-HURRAY!

Polytechnic Institute of Porto (ISEP-IPP)

Rua Dr. António Bernardino de Almeida, 431

4200-072 Porto

Portugal

Tel.: +351.22.8340509, Fax: +351.22.8340509

E-mail: vigup@isep.ipp.pt, emt@isep.ipp.pt, nap@isep.ipp.pt,

http://www.hurray.isep.ipp.pt

Abstract

NA

From Sensor Networks to *Internet of Things:*

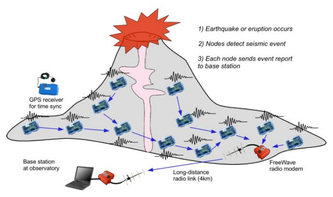
-A Paradigm for Empowering an Infrastructure Technology

CISTER - Research Center in
Real-Time & Embedded Computing Systems

Vikram Gupta, Eduardo Tovar, Nuno Pereira, Raj Rajkumar (CMU)

Empowering Sensors as an Infrastructure Technology

Wireless Sensor Networks are limited to dedicated test-beds

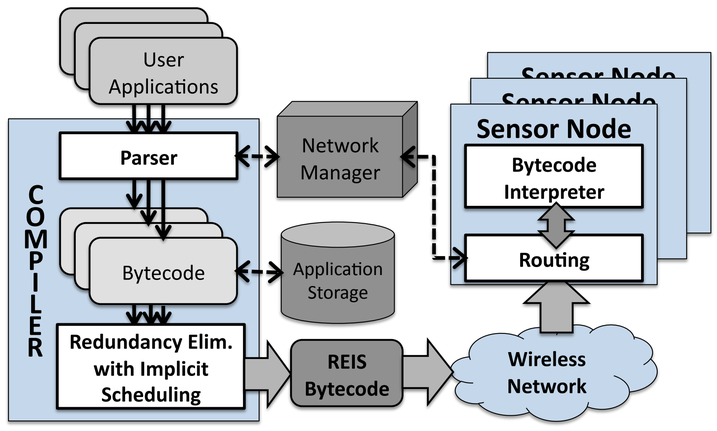


The goal is to enable them to be an infrastructure technology, for independent users

Support for Multiple Applications from Independent Users

Multiple applications on Networked Embedded System require ground-up building of software architecture

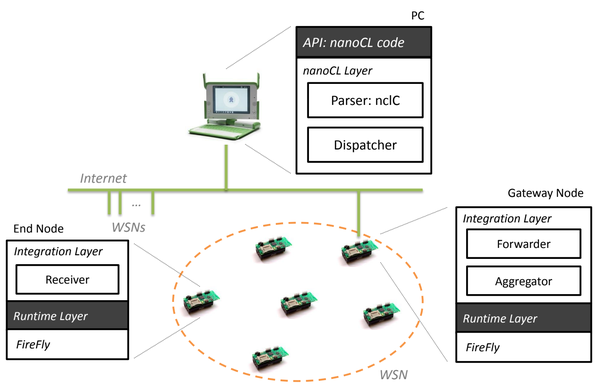
- A network level compiler
- Over the air programming support
- Network manager
- Network and node-level Application Manager

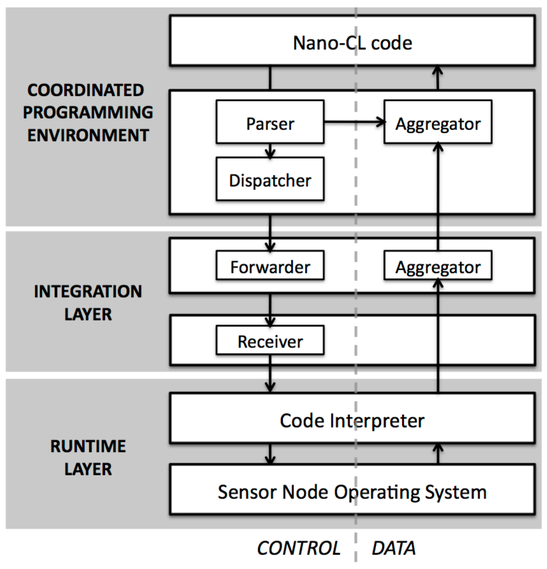


Programming Framework

Multi-layered Software Infrastructure to support multiple independent applications

- Independent layers to conduct various responsibilities





Programming Abstraction

Map Functionality to devices

```
1 smap(service_name, list_of_nodes, period){
2   for each node in list_of_nodes
3     temp_value = gets(TEMP);
4     smap_emit(temp_value, node_id);
5   end
```

(a) sMap Function

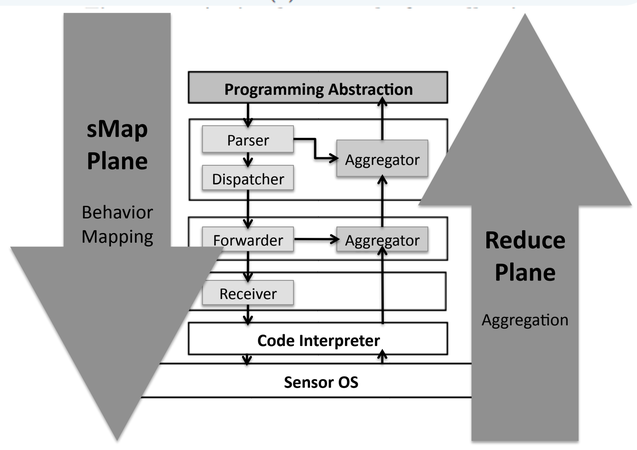
Aggregate data through the network

```
1 reduce(data, list_of_nodes){
2   for each node in INNER.list_of_nodes
3     sum += data.temp_value; //AGGREGATION
4   end
5   return sum;
6 }
```

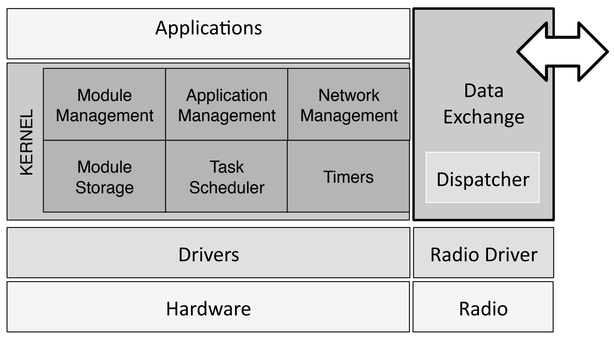
(b) Reduce Function

Intuitive Programming Abstraction

- Split job assignment and data collection
- Selective filtering of nodes participating in an application
- Explicit control over the aggregation strategies



From an Operating System to a Co-operating System



Traditional operating systems like TinyOS, NanoRK were built for individual devices

- A new paradigm of OS is required to inherently support **networked** devices
- The delegation of applications, network management is distributed
- Modular design of OS for adding functionalities at the runtime

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CISTER Research Centre/INESC-TEC
ISEP, Polytechnic Institute of Porto
Rua Dr. Antº Bernardino de Almeida, 431
4200-072 PORTO Portugal
tel: +351-228340502
fax: +351-228340509
http://www.cister.isep.ipp.pt
cister-info@isep.ipp.pt