



Car-2-Car Communication Activities Overview

Sophia Antipolis, 26 February 2007
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CSP Mission

- CSP targets are:
 - **Technology transfer**
 - Information society implementation
 - Through a strong synergy with **Local government, Private** business and **Academic** institutions
- CSP Today
 - Innovation & Research ICT agency devoted to Piedmont system development:
 - Research and technology transfer of innovative services based on a multi-annual projects with **other local government**



- Innovation & Research ICT agency:
 - **Promoting Piedmont competitiveness** in a knowledge-based economy
 - Disseminating best eAdoption practices in the world
 - Building a pervasive open culture keen to use ICT in work, education, social and cultural life
- Research and technology transfer of innovative services based on a multi-annual projects with **other local government**
 - TOSCANA, EMILIA-ROMAGNA and VALLE D’AOSTA Region
 - TRENTO and MANTOVA County
 - Municipality of LUCCA
 - LAZIOMATICA
 - FORMEZ
 - CNIPA (National Center for ICT in Public Bodies)



The International Projects

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Relationship with Universities

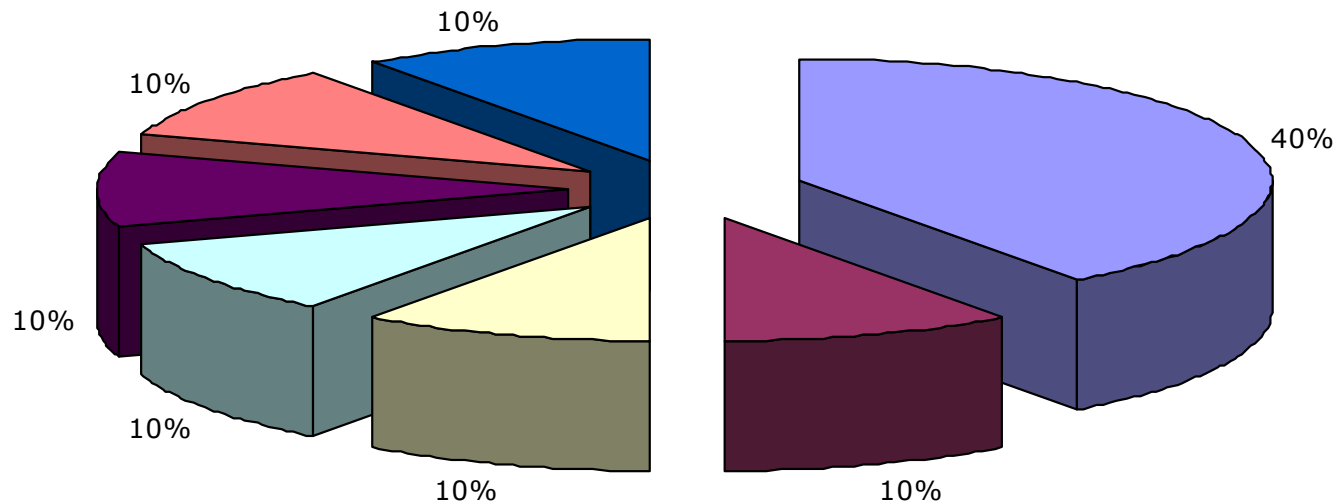
- Relationship with University is based on **technology and scientific exchange**:
 - Annual research plan.
 - Collaboration on specific matters
 - Skills valorization.
- Operational instruments are:
 - Agreements with Politecnico and University of Turin.
 - Agreements with University of Siena, University of Florence and University of Trento.



CSP shareholders

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CSP is a **non-profit ICT Research & Development Agency**, recognized as Research Lab by the Italian Ministry of Education, University and Scientific Research (MIUR), certified **UNI EN ISO 9001:2000**



■ CSI Piemonte	■ Comune di Torino	■ Politecnico di Torino
■ Università agli Studi di Torino	■ Unione Industriale di Torino	■ Confindustria Piemonte
■ AEM		



5 Technology Laboratories

- focused on technological research:
 - **INLab** focused on **Integrated Networks** for voice, vide and data transfer
 - **SECURELab** focused on IT telecommunication **security**
 - **W3Lab** focused on **application architectures**
 - **DTTLab** focused on **Digital Terrestrial Television** technologies study and prototyping
 - **EmSys** focused on **embedded systems** and media center technologies



INLAB C2C Activities

- Test beds
 - Protocol analysis and testing
 - Vehicular Networks Analysis & Performance Evaluation
- A C2C oriented framework
 - Store and forward & service discovery nodel
 - WiNoT: Wireless Nomadic Transfer Framework
- Prototypes
 - Mesh Network for Fast Deploying Infrastructures



Test Beds in Turin: on the road experiences

- Test beds finalized in Ad Hoc Networking protocol evaluation and optimization
 - Indoor analysis:
 - Outdoor urban WiFi coverage study
 - Performance measurements in vehicular context
- WiNoT
 - Wireless Nomadic Transfer
 - Software Framework born and designed for “discontinue” network scenario
- Embedded or near-embedd hardware testing



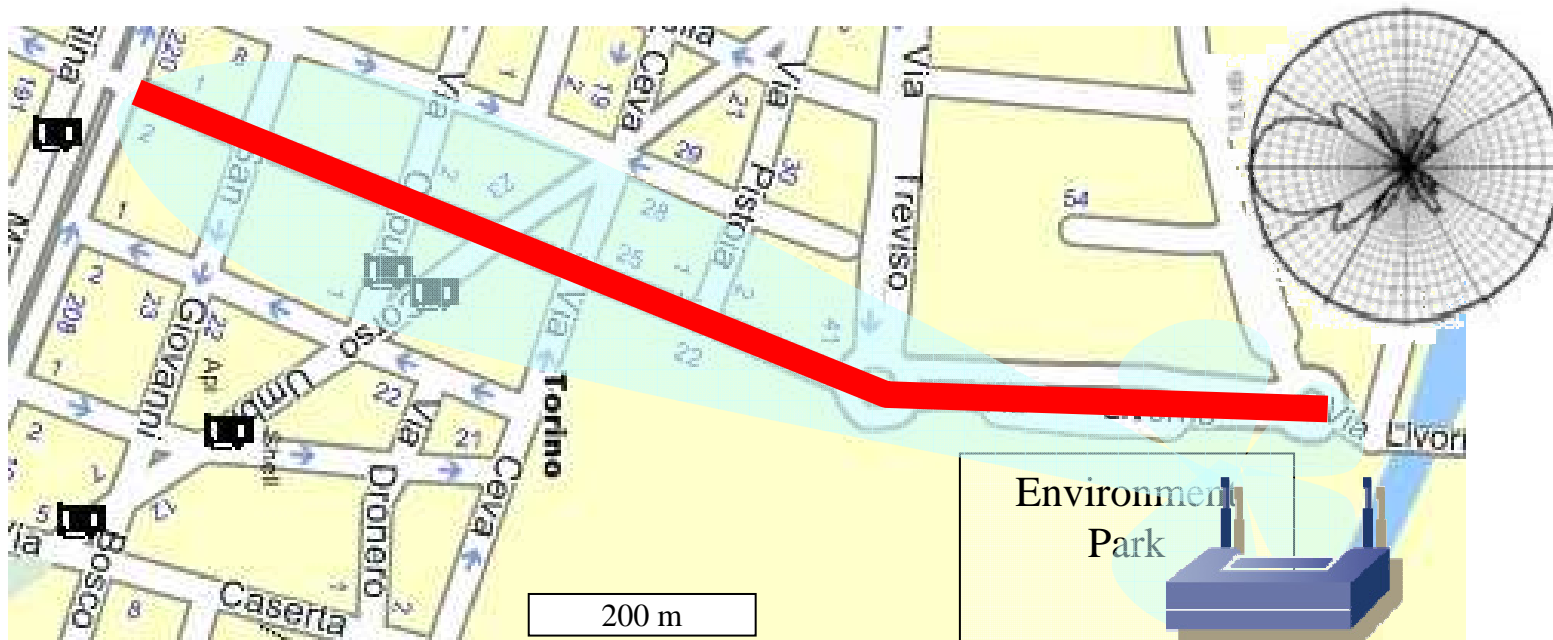
Test Bed

Some steps to work on Ad Hoc Network routing protocol



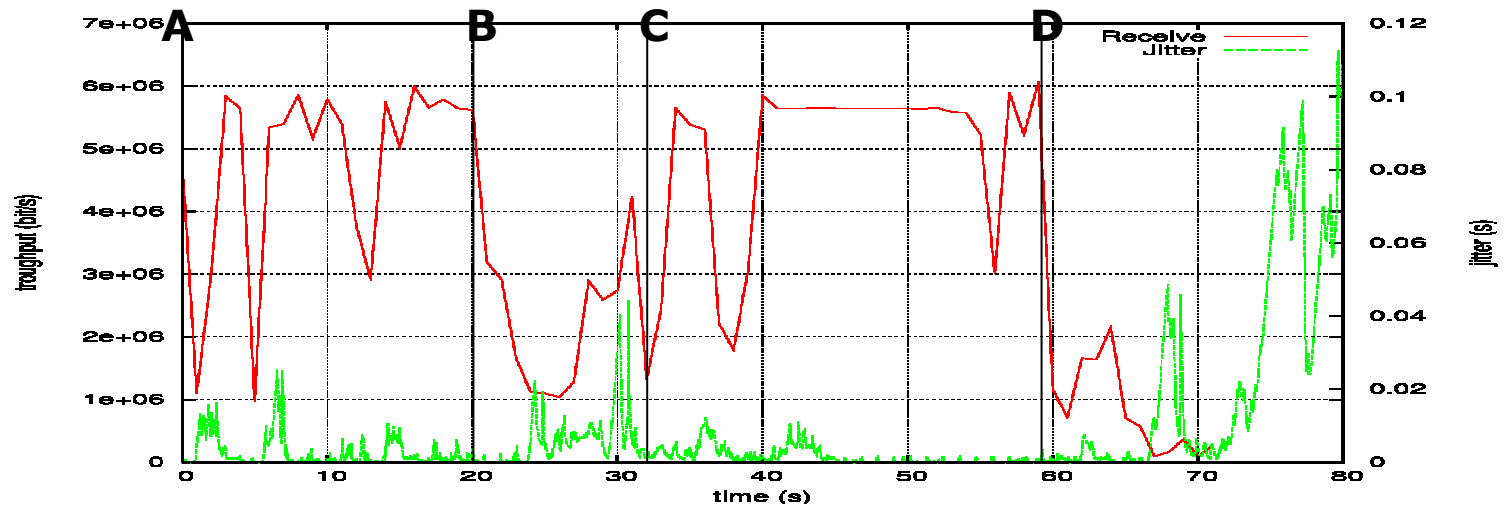
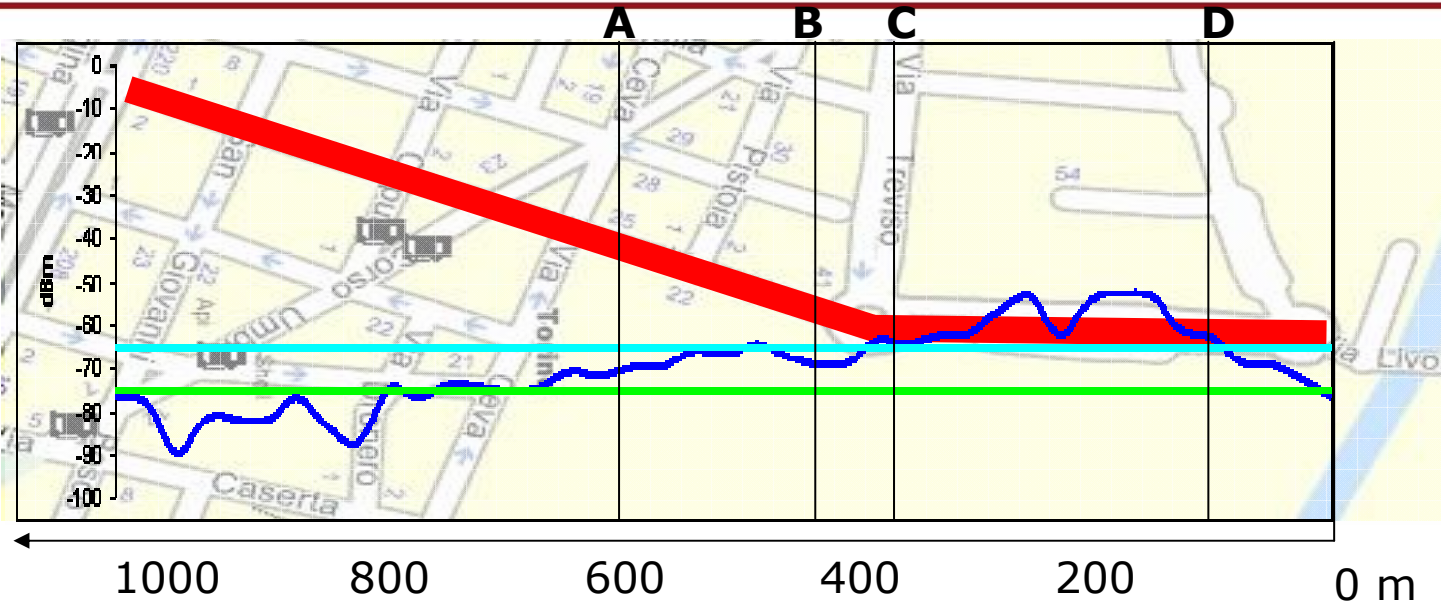
1st step – Urban Radio coverage measurements

- Tx Power: 33.5dBm
 - Radio equipment: 20dBm
 - Antenna gain: 13.5dBi
- Coverage \sim 500m with long and narrow shape

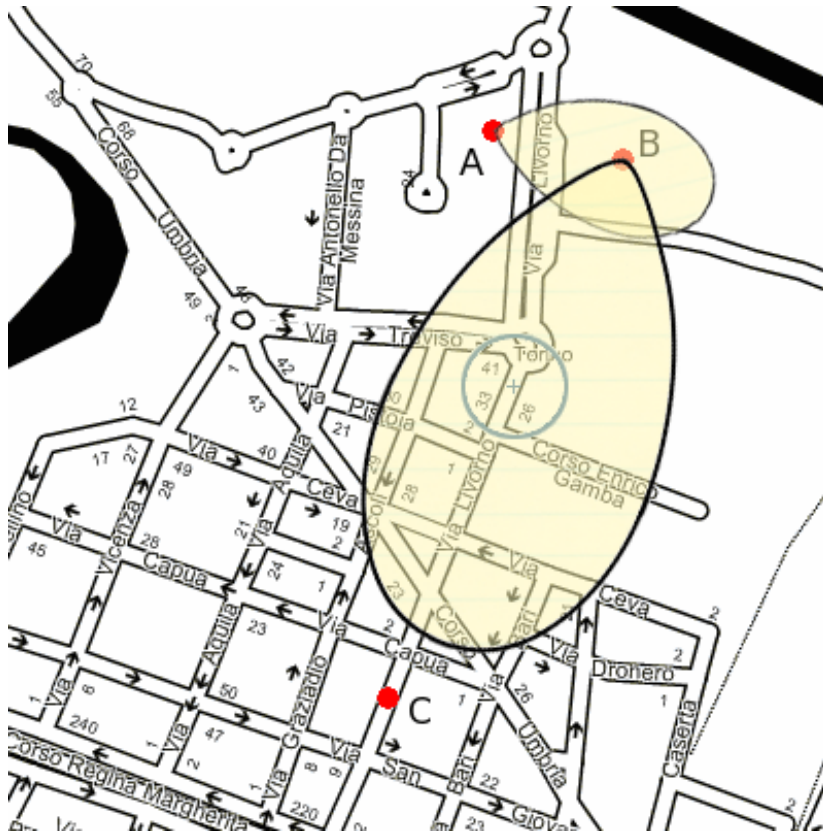


1st step – Data flow results

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2nd step – two fixed node and a mobile one

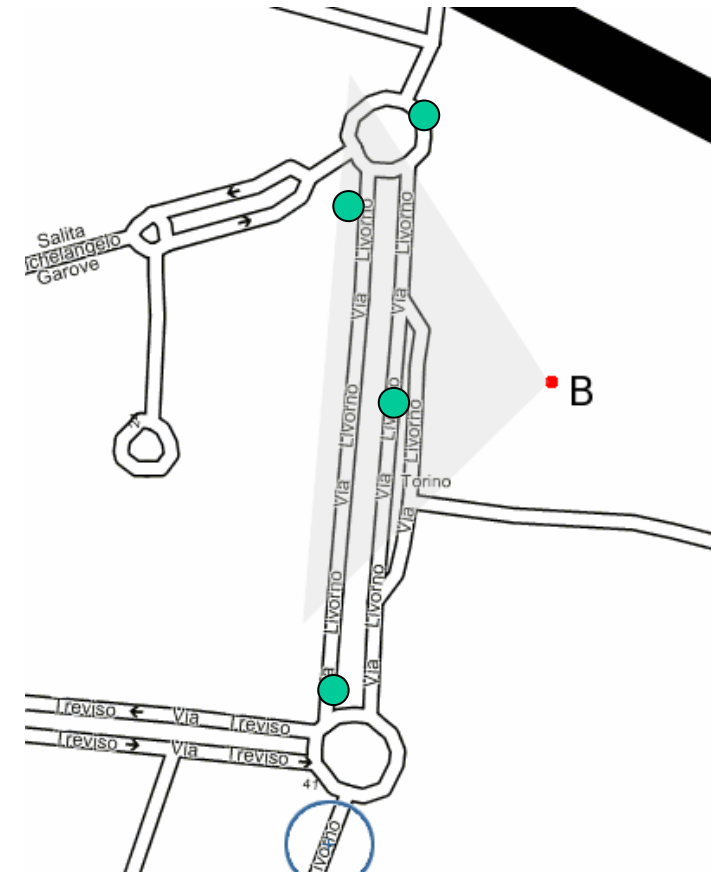


- A e B are fixed with an overlap area
- C is a car moving through the coverage area
- UDP Flows
 - From B to C



3rd step – cars following each other

- A fixed node
 - Gateway to Internet
- 2-4 cars following on a “loop” lane
 - Fixed node (B) covers a part of the lane;
 - Urban speed (20-50km/h);
 - Variable mobile node inter-distances
- Test Objective
 - Routing protocol study optimization
 - Network convergence and stability



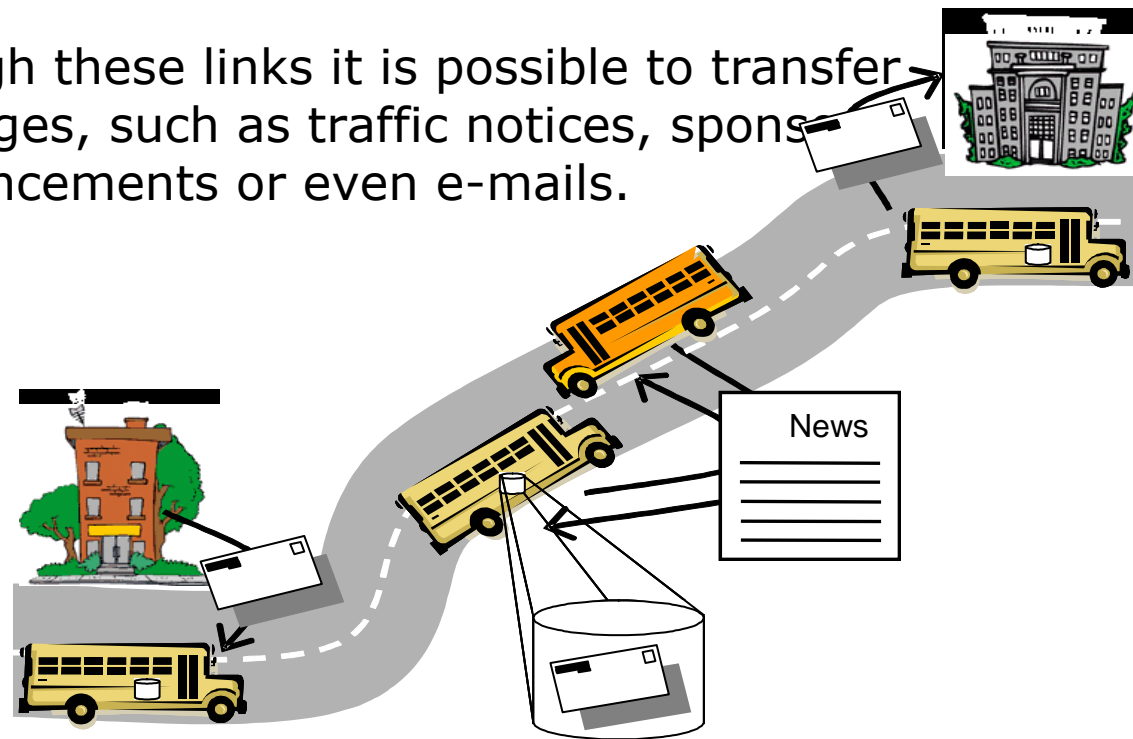
WiNoT

A Software Framework for ad hoc networks started in
2005



WiNoT Over Mobile Ad Hoc Networks

- Wireless Nomadic Transfer (WiNoT) is based on the idea that it is possible to transfer data by mobile vehicles using wireless sporadic networking;
- Mobile vehicles along their journey can create ad hoc networks with other WiNoT nodes and transfer data;
- Through these links it is possible to transfer messages, such as traffic notices, spons announcements or even e-mails.

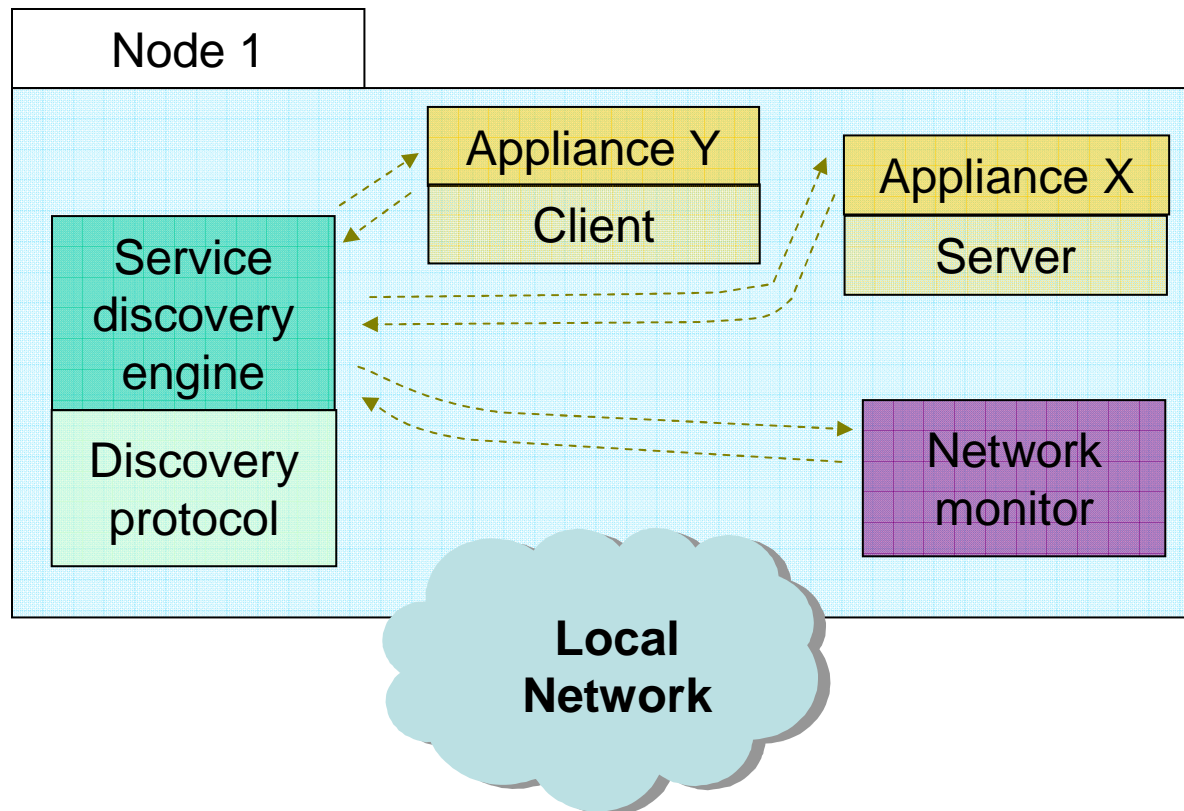


- WiNoT sums up different logical components:
 - Service discovery engine;
 - UDP data transfer with support to:
 - Fragmentation/ reassembly;
 - Lost frame retransmission;
 - Acknowledgement.
 - Network monitoring service
 - Service discovery triggering on network topology events.



The architecture (1)

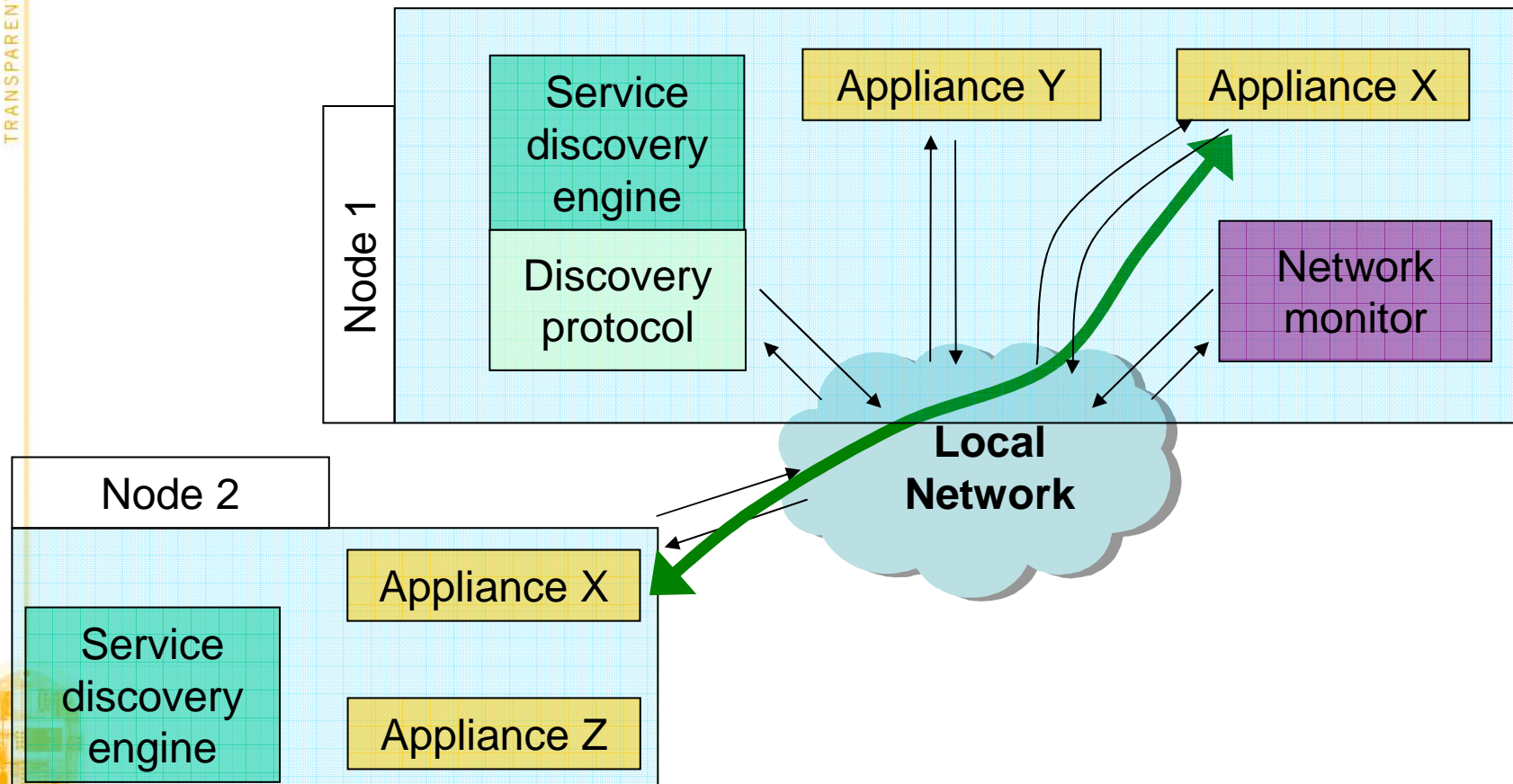
- Each node can be build using any working combination of the implemented elements;



The architecture (2)

- After Discovery two appliances interacts directly

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A couple of sample implementation

- WiNoT SMTP Proxy – a C2C store-and-forward e-mail transfer
 - E-mail is sent using a “standard” client (such like Outlook);
 - WiNoT SMTP proxy nodes transfer the e-mail via UDP transactions.
 - A gateway node send the e-mail to a public SMTP server
- Missing component:
 - Dissemination logic should be added!
- WiNoT Message Push
 - A client enabled to receive
 - A message push server:
 - Looking for a enabled client via service discover engine;
 - Sending lists of messages;
 - Sending messages that client will accept.



An interesting Prototype

Mesh Control, a way to control RS232 equipment
via mesh network



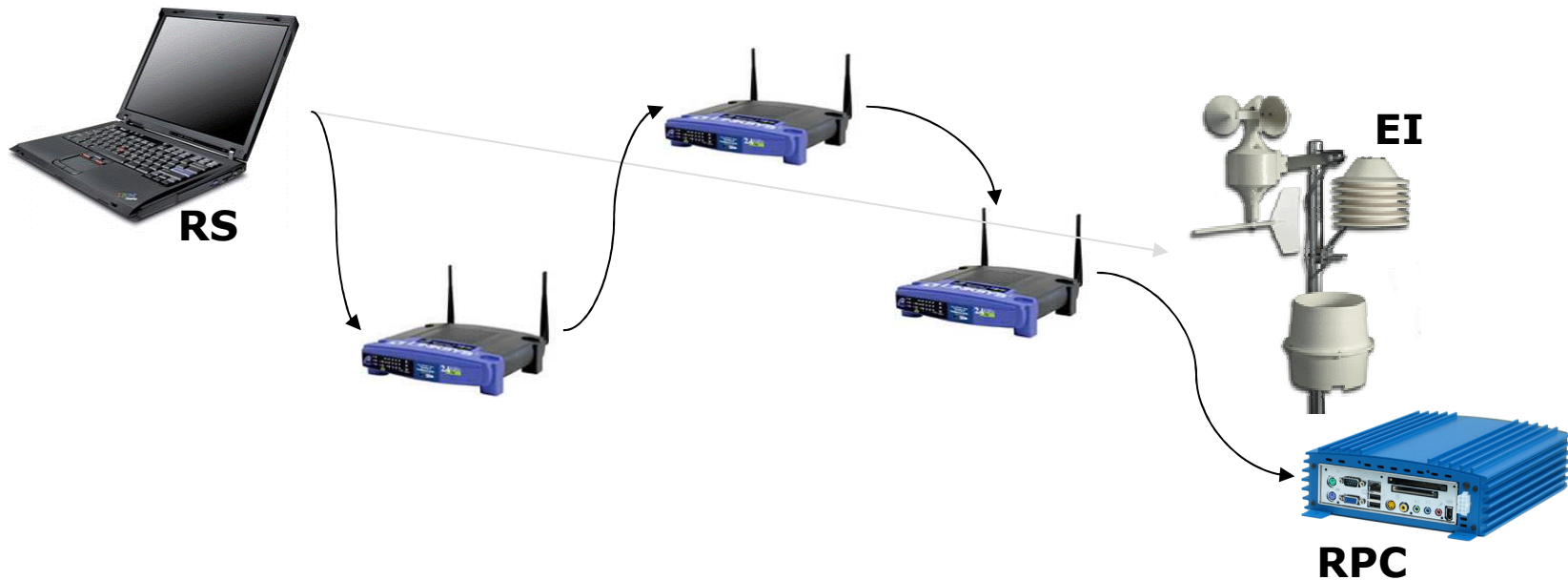
An interesting Prototype

- A Piedmont Small Enterprise pointed out a need:
 - Control of electronic instrument (EI) by a remote station (RS)
 - distinctive aspects:
 - EI doesn't have any network support, just RS232 or similar;
 - EI can explore dangerous place for human health, so RS must be at a certain distance.



Real implementation

- The proposal
 - Connect EI to a rugged PC (RPC)
 - This PC talks with a remote station across an appropriate wireless network
- The solution
 - A remote desktop application (for instance)
 - A wireless mesh network in ad hoc mode



HW and SW details

- Hardware
 - Mini-ITX
 - Small overall dimensions
 - Low electricity waste
 - Linksys WRT54GL wireless router
 - Cisco Aironet omni directional antenna 5.2 dBi gain
- Software
 - OpenWRT: third-party linux-based open source firmware
 - OLSRD (OLSR Daemon): an implementation of Optimized Link State Routing Protocol
- Network stability
 - Power measurements (Positioning tool)
 - Protocol features (Link Quality extension)



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