COST 605

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Self-Management of Wireless Ad hoc Networks

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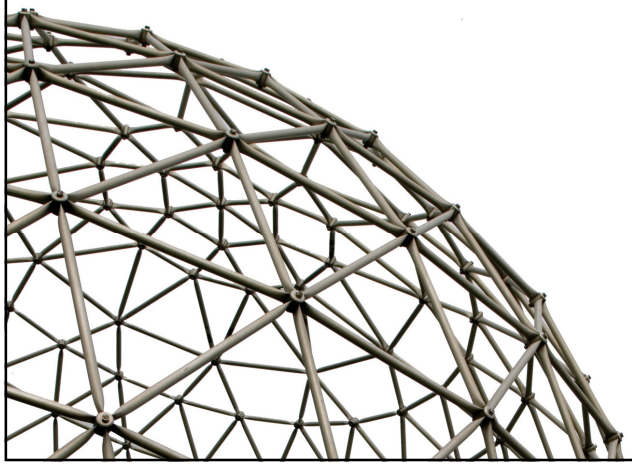

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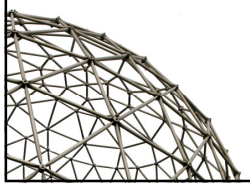
Outline

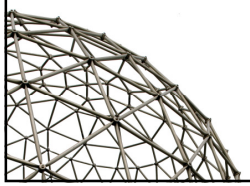
- **Introduction and Background**
- Policy-Based Self-Management Framework for Wireless Ad Hoc Networks
- Summary and Conclusions



Introduction and Background
Overview

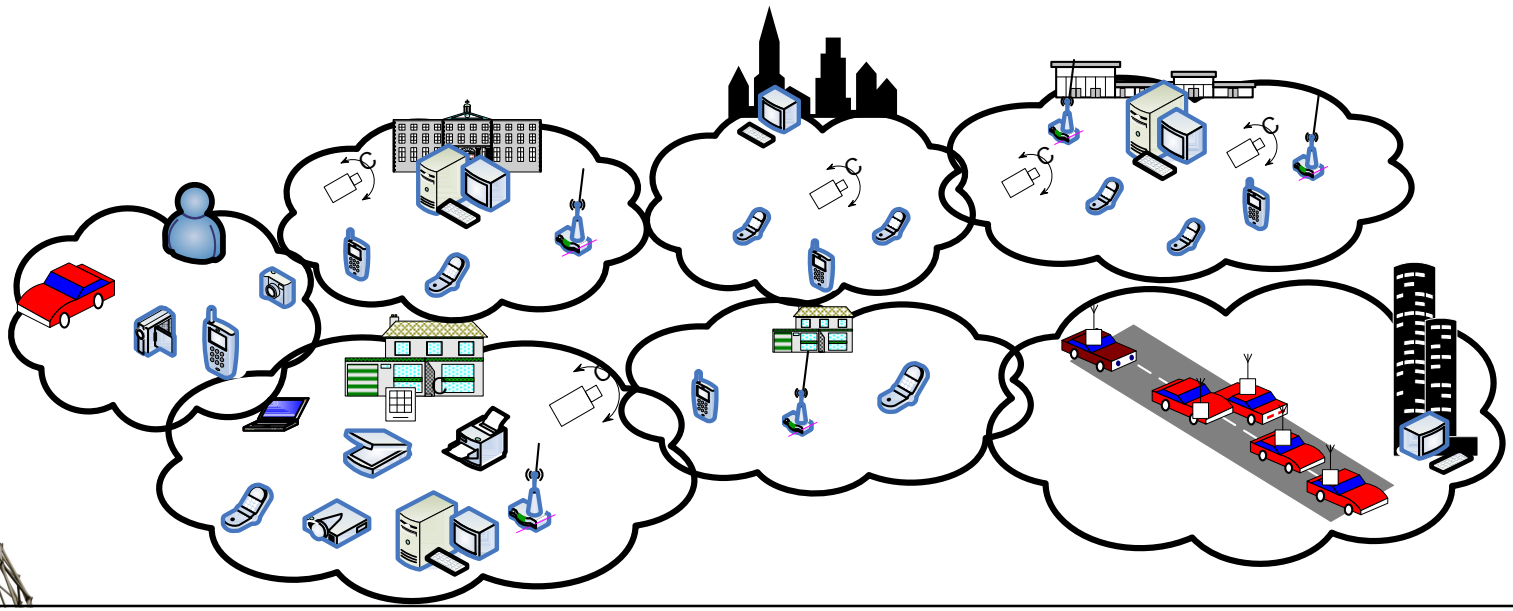
- Research motivation
  - Emanates from the increased penetration of wireless technologies and devices in today's networked environment.
  - A need for a new management framework is identified
    - The deficiencies of current management frameworks in the rapidly evolving wireless landscape
    - The increasing users' demand for unrestricted spontaneous communication

- Research objective
  - To propose a novel specialised management framework that supports wireless ad hoc networking
    - To leverage wireless ad hoc networks' potential as an alternative communication method
    - Allow their integration and coexistence with current and future networks



Introduction and Background
Overview

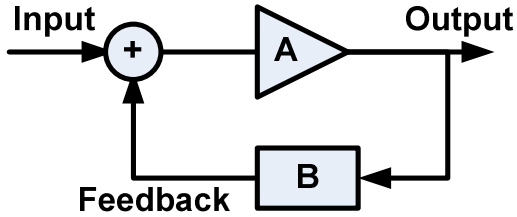
- **Wireless Ad Hoc Networking paradigm**
  - Consisted of a majority of end-user devices, capable of multihop communication and optionally supported by limited infrastructure
  - **Renewed interest, abandoning MANET isolation**
    - Mesh Networks
    - VANET
    - RFID/Sensor Networks
  - **An extension of today's or future's networks**

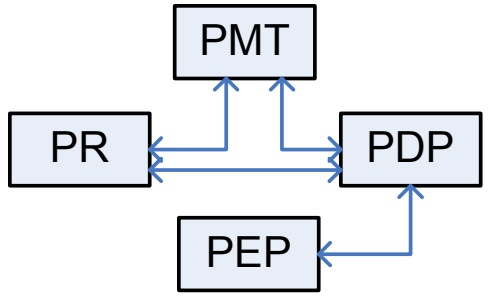


Introduction and Background

Autonomic and Policy-Based Management

- **Autonomic Computing**: a computing environment with the ability to manage itself and dynamically adapt to change in accordance with business policies and objectives [IBM]
  - Self-*
    - Configuration
    - Healing
    - Optimisation
    - Protection





- **The policy-based management (PBM) paradigm**
  - Policies capture the high-level management objectives
  - The means to integrate self-management capabilities
  - PBM offers controlled programmability
  - [IETF] **Policy** : a set of rules to administer, manage and control access to network resources
    - ECA: on *Event* if *Condition* then *Action*

Policy-Based Self-Management Framework

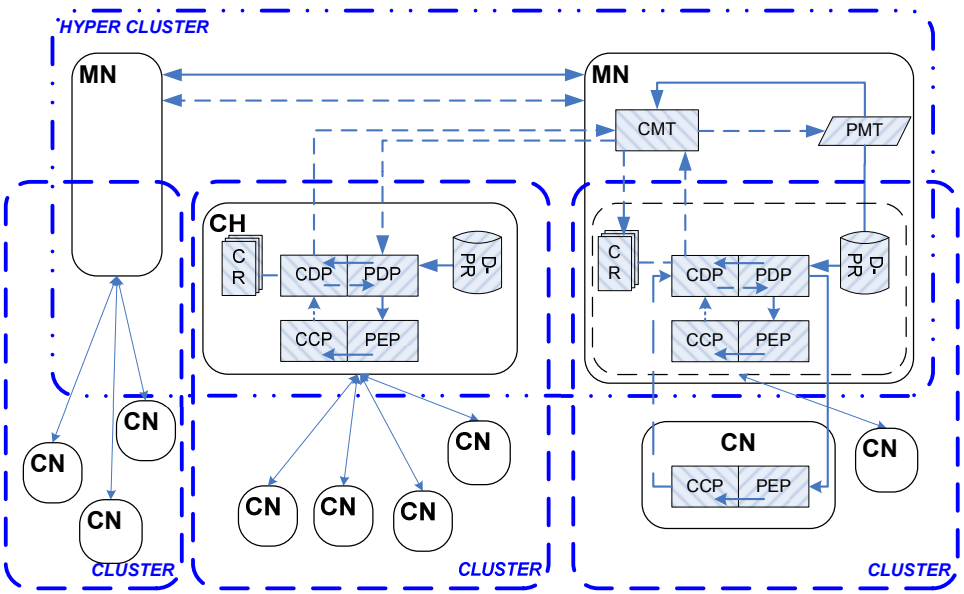
Policy Hierarchy for Wireless Ad Hoc Networks

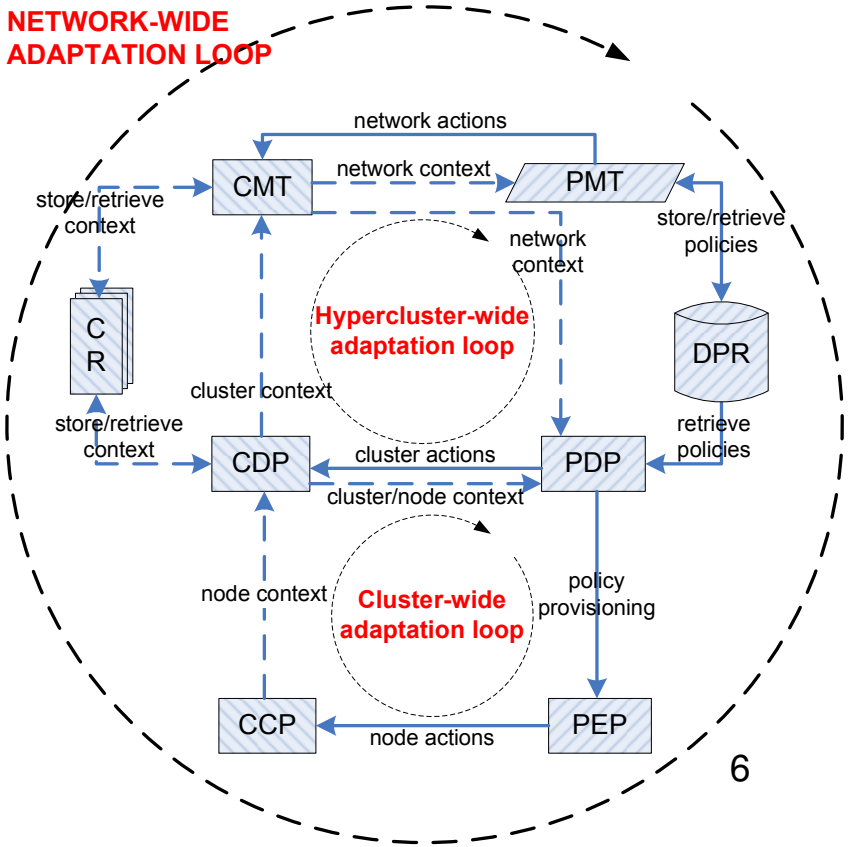
- Hybrid role-based organisation and policy hierarchy
  - **{Roles} [Event] if {Conditions} then {Actions}**
- Policy enforcement scope for closed-loop management

-Cluster-wide (energy conservation)

-Hypercluster-wide (repository repl.)

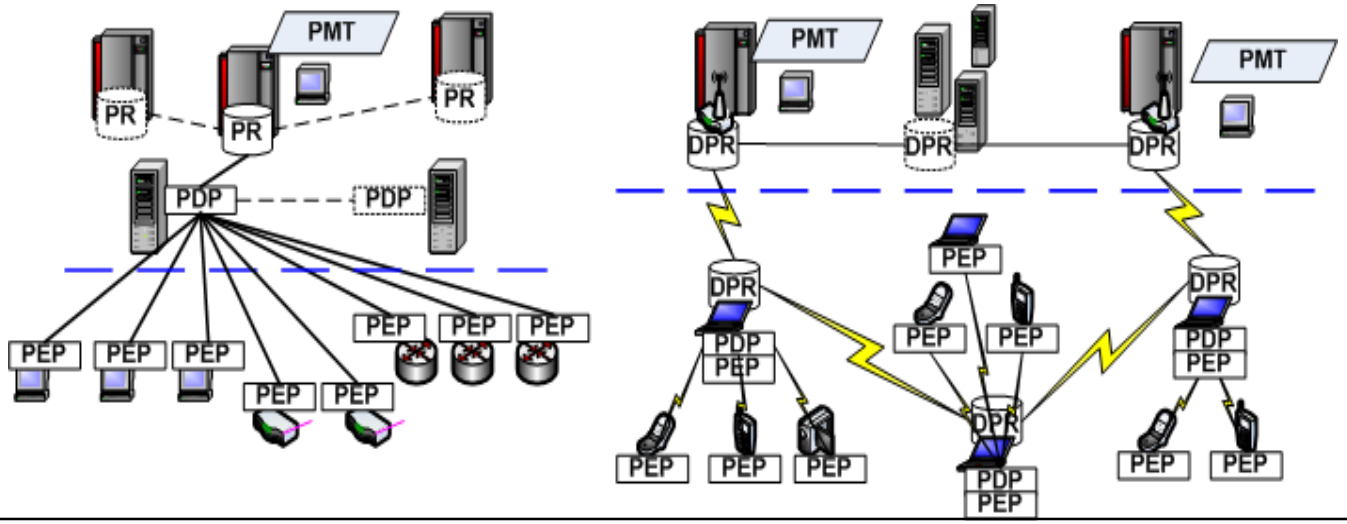
-Network-wide (routing adaptation)





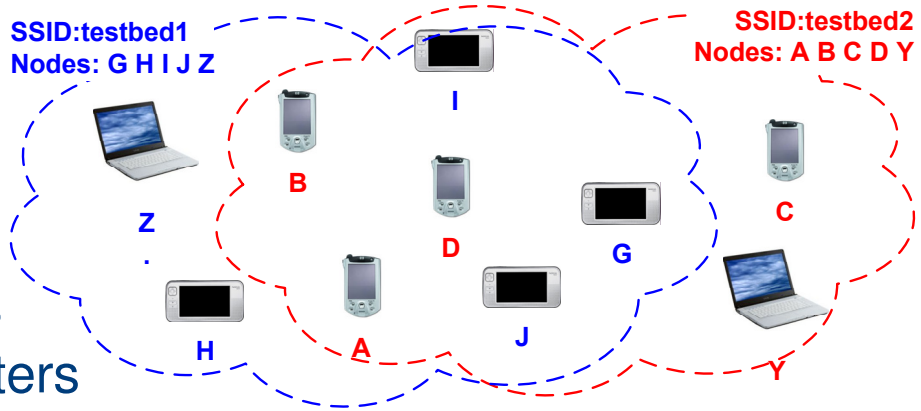
Policy-Based Self-Management Framework
Distributed-Hybrid Model and DPR

- Centralised-Hierarchical Vs Distributed-Hybrid Model
  - Dynamic/Static cluster creation
    - Adapted version of the CDS creation algorithm
- Distributed Policy Repository (DPR)
  - a physically distributed set of interconnected directories hosted on selected hypercluster nodes.
  - DPR design glues together the distributed nodes responsible for collaborative management.



Policy-Based Self-Management Framework
Implementation of Self-* Capabilities

- Testbed setup
  - 10 wireless nodes
  - 802.11b/g Wi-Fi
  - IBSS (ad hoc/p2p mode)
- Setup in two ad hoc clusters
  - Ad hoc file transfer within clusters
- Inter-layer communication (MAC-APP)
  - Cluster Head can monitor and assess wireless interface
  - Open source packet capturer (airodump-ng)
  - Channel selection algorithm
    - Reported Inter-layer metrics: missed frames, avg.pps etc.

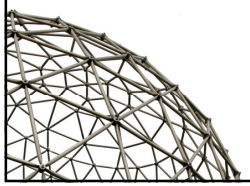


	Operat.System (Kernel)	*Processor*	*Ram (MB)*	*Wifi support*
(2x)Sony Z1XMP	**Debian R4.0 (2.6.18)**	**1500 - Intel**	**512**	**802.11bg**
(4x)HP iPAQ H5550	**Familiar v0.8.4 (2.4.19)**	**400 - ARM**	**128**	**802.11b**
(4x)Nokia N800	**IT OS2007 (2.6.18)**	**330 - ARM**	**128**	**802.11bg**

Policy-Based Self-Management Framework
Implementation of Self-* Capabilities

- Self-Configuration for initial channel assignment
  - 20.4% increase of average goodput compared to default settings
  - Up to 33.3% increase for random channel assignment
  - Worst performance for consecutive channels
  - File download duration is accordingly improved

- Self-Optimisation for dynamic channel switch
  - Peak increase of 33.5%
  - Average goodput increase by 20.3%
    - from 413.54 KB/s to 518.79KB/s
  - Download time reduced
    - from 116sec to 50sec for a 46MB file
  - Scenario in two phases



Policy-Based Self-Management Framework
Implementation of Self-* Capabilities

- Self-Optimisation Scenario

Ph.1: file transfer Z→J

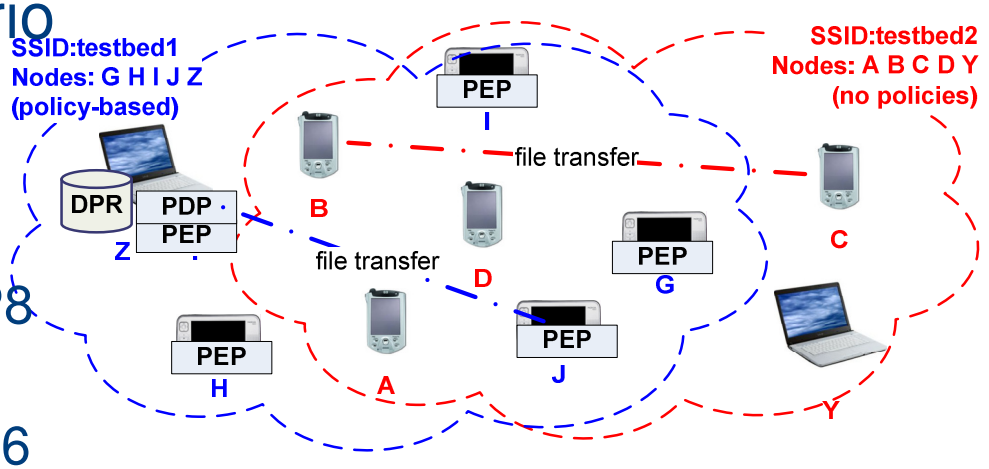
Ph.2: file transfer B→C

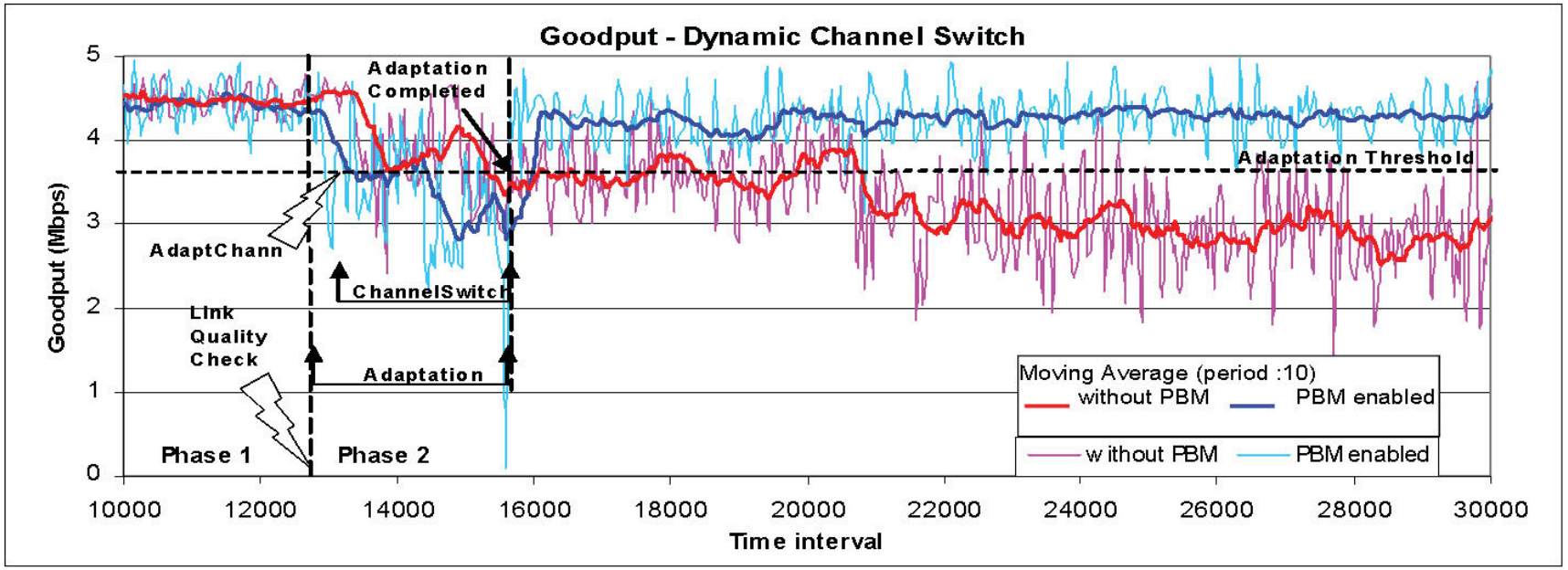
P6: LinkQuality: thr_a <50% ➔P7

P7: Goodput: thr_b <3.67MBps ➔P8

P8(AdaptChannel):algorithm

➔channelSwitch: from ch.1→ch.6





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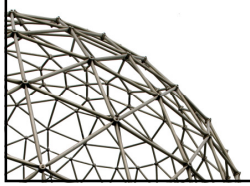
Summary and Conclusions
Overview & Future Research Directions

- Focus on the design and implementation of a policy-based self-management framework:
  - Emerging wireless ad hoc networks can fully integrate and coexist with current and future networks
  - The integrated framework is able to leverage the potential of wireless ad hoc networks

- Future Research Directions
  - Autonomic Management for Future Wireless Networks
    - Future work on self-protection & self-healing
  - Applicability and Integration with Mesh Networks
    - Mesh networks closely resemble wireless ad hoc networks, i.e. multihop communication with limited infrastructure support
  - Wireless Peer-to-Peer Networks for Ad Hoc Inter-Car Communication (Vehicular Ad Hoc Networks)



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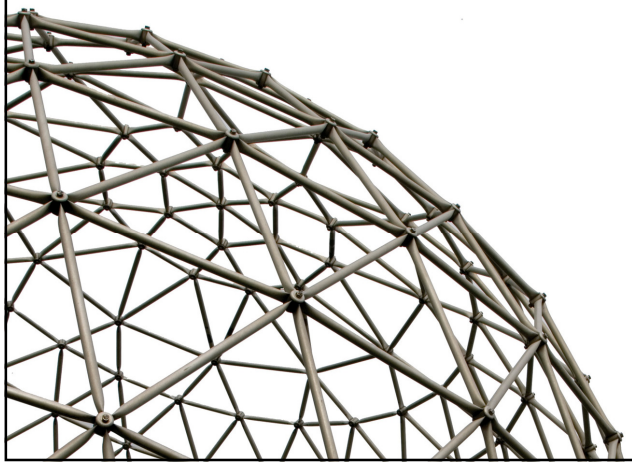

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