Using delay-tolerant networking to knit together self-managed computing cells

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AMUS e

- Autonomic Management of Ubiquitous Systems for e-Health
- Collaborative EPSRC-funded project
  - University of Glasgow
  - Imperial College London
Ubiquitous e-Health

• “Healthcare everywhere”
• Wearable sensors, implanted sensors, ingestible sensors, smart clothing
• Automated, continuous monitoring
  – Monitor effectiveness of treatment over time
  – Allows monitoring during recovery in familiar environs
  – Mass data & analysis
  – Emergency feedback or response
Self-Managed Cell – Body Area Network

- Self-Managed Cell (SMC) forms an administrative domain capable of functioning autonomously
  - Pre-defined set of core software services
  - Configurable set of devices
Self-Managed Cell – Generic

- Core software services are:
  - Policy service
    - management
  - Discovery service
    - device location & group membership
  - Event bus
    - event routing
Self-Managed Cell

• Scales:
  – Patient
  – Home
  – GP/doctor
  – Surgery
  – Hospital
  – Geographic region, etc...
Self-Managed Cell – Scaling up

• Core services exist in all SMCs
• Semantics may differ
  – e.g., discovery service, event bus
SMC Interactions

- SMCs are autonomous, but obviously must interact...
  - Peer-to-peer interaction
    - eg, patient – GP
  - Composition interaction
    - e.g., patient – monitoring hardware

- SMCs will present to each other an interface based on the type of the remote SMC.
SMC Interactions

• Discovery...
  – newSMC event...
  – Policy service interaction

• Missions
e-Health Scenario

- We define a scenario whereby:
  - An asthma sufferer carries an inhaler designed to log usage statistics
    - e.g., basic count, frequency, dosage, geographic location...
  - Inhaler set up to periodically bundle data and transmit back to GP surgery
- Characters include: patient, patient's home, GP surgery, hospitals, and ambulances.
e-Health Scenario
DTN in Context

- Scenario describes a DTN problem
- Mobile nodes moving around a fixed hierarchy of nodes
  - Maps neatly onto regions
DTN in Context
DTN in Context

• DTN used to shift user data between intermittently connected regions
  – In particular, provides an easy way of transmitting data only through *trusted* regions, a particular concern of healthcare information...

• In our example world, custody transfer semantics are good enough
  – Network consists of trusted components
Emulation

- “Emulated” a network with multiple mobile nodes generating data, a mobile node capable of carrying data, and a fixed hierarchy of nodes.
Outcomes

- Prototype implementation has demonstrated that the SMC pattern can be applied to e-Health applications
- Event bus provides sufficient performance, modularity, and scale to adequately address e-Health management traffic
- The SMC concept can be extended to larger scale environments
- DTN is an ideal mode of transport for non-critical data
Questions?

• Infos at:
  – http://www.dcs.gla.ac.uk/amuse/