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

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AMUSe

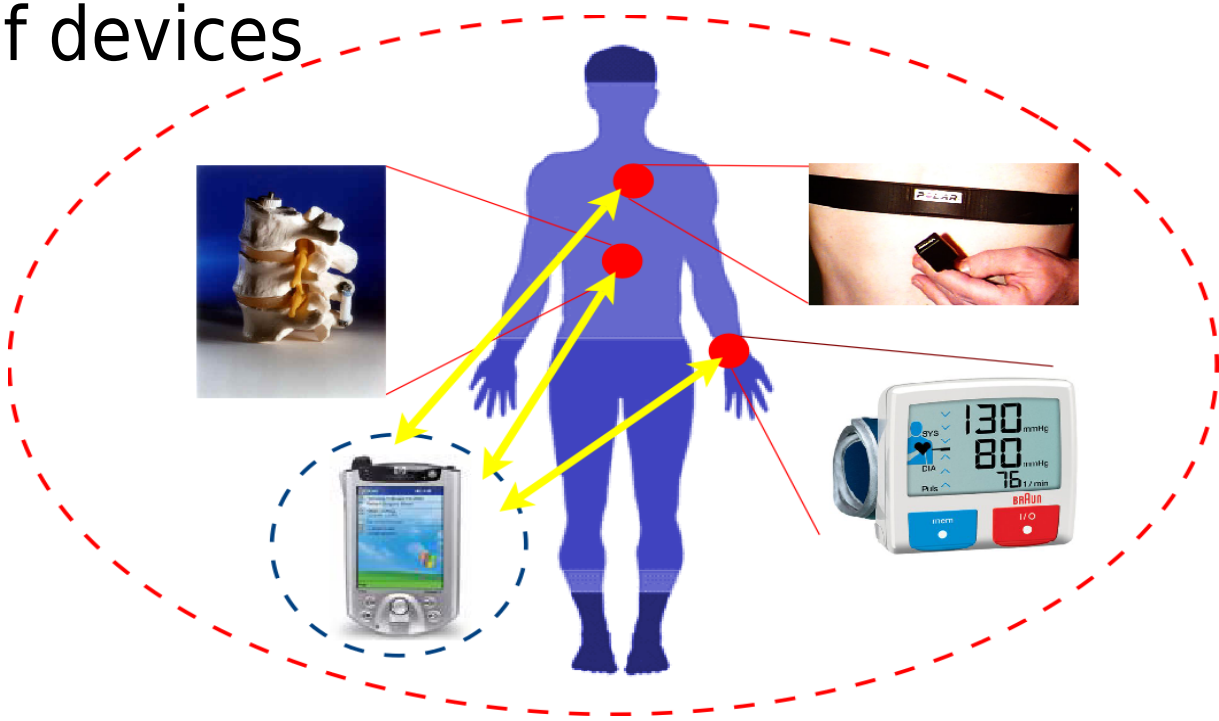
- Autonomic Management of Ubiquitous Systems for e-Health
- Collaborative EPSRC-funded project
  - University of Glasgow
  - Imperial College London

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*

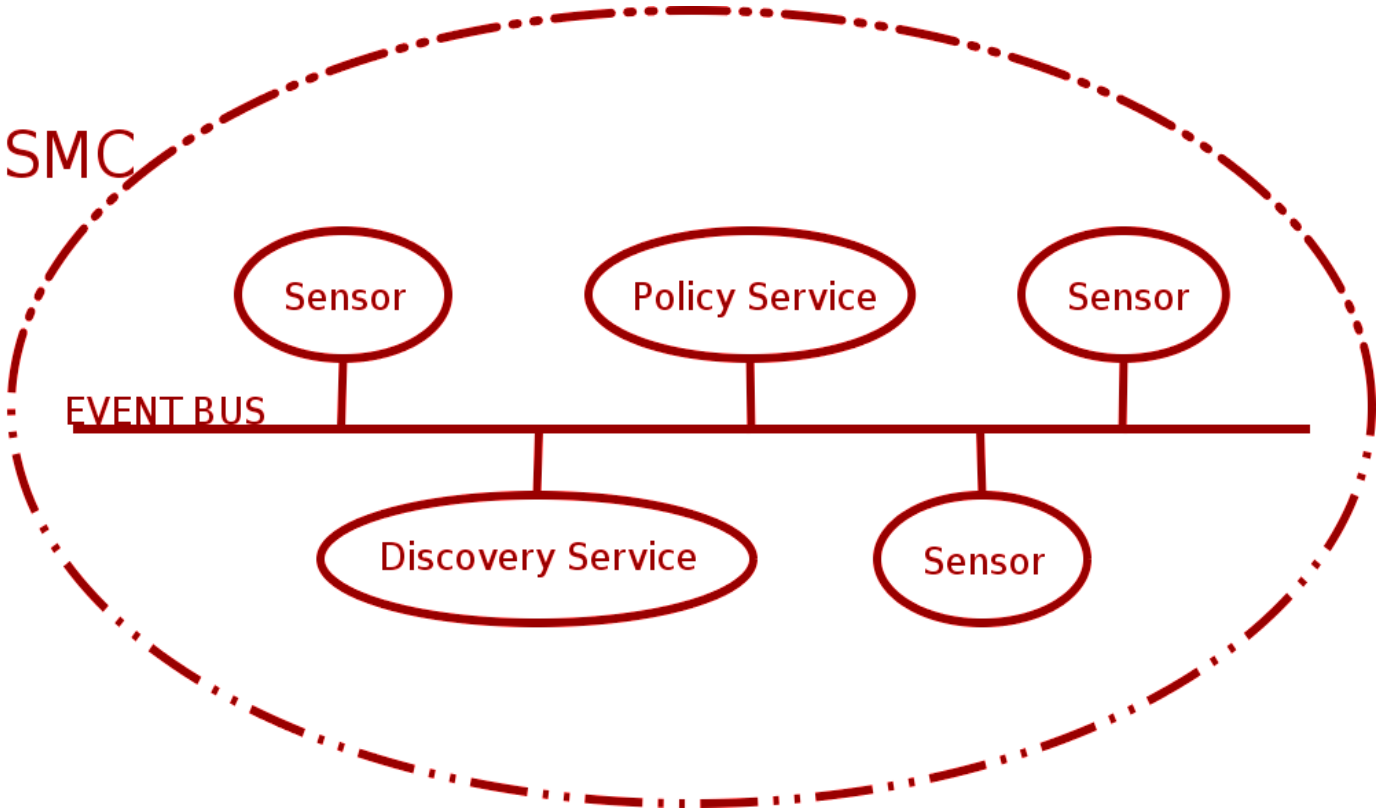
Self-Managed Cell – Body Area Network

- 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.

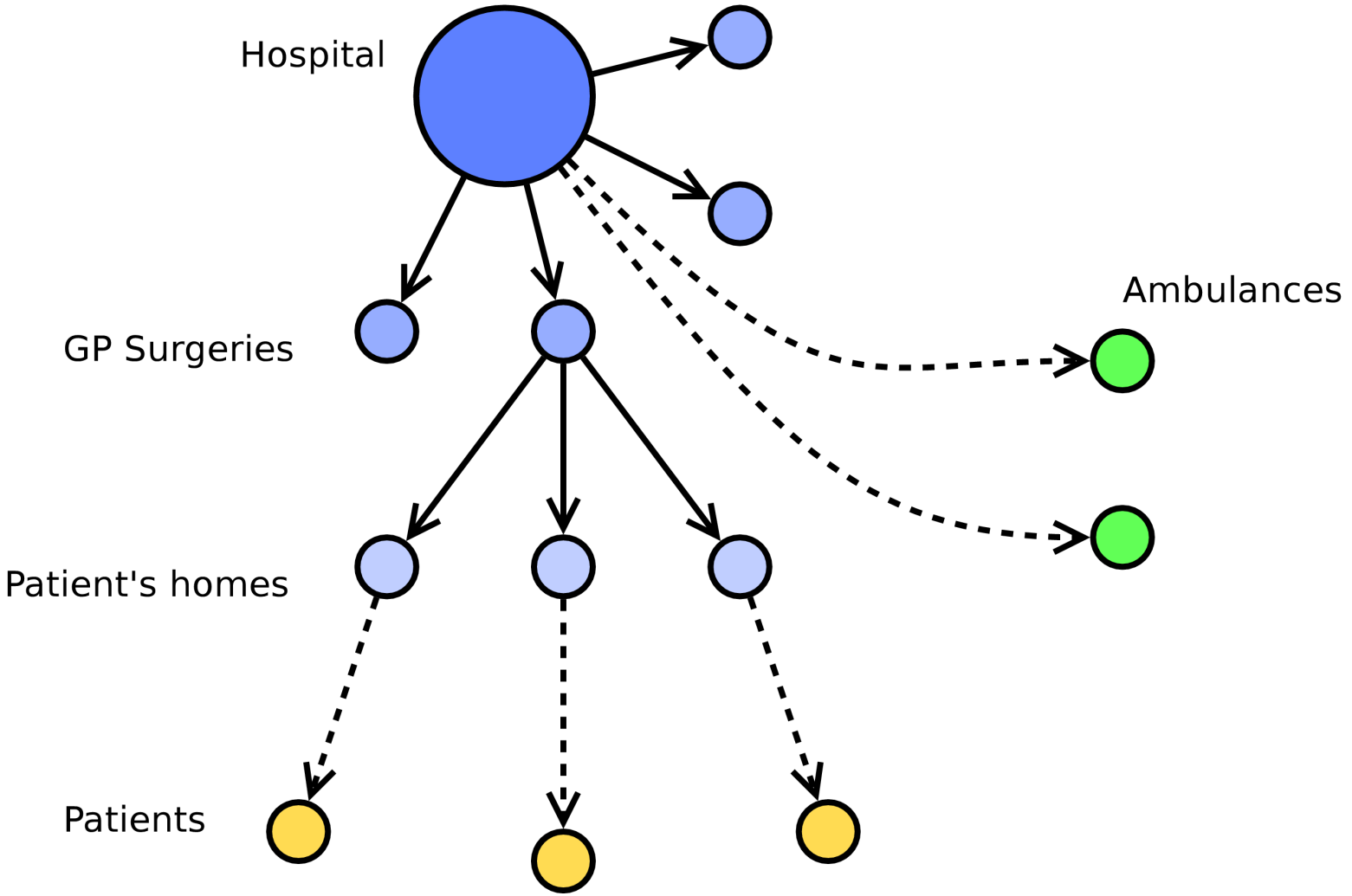
SMC Interactions

- 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.

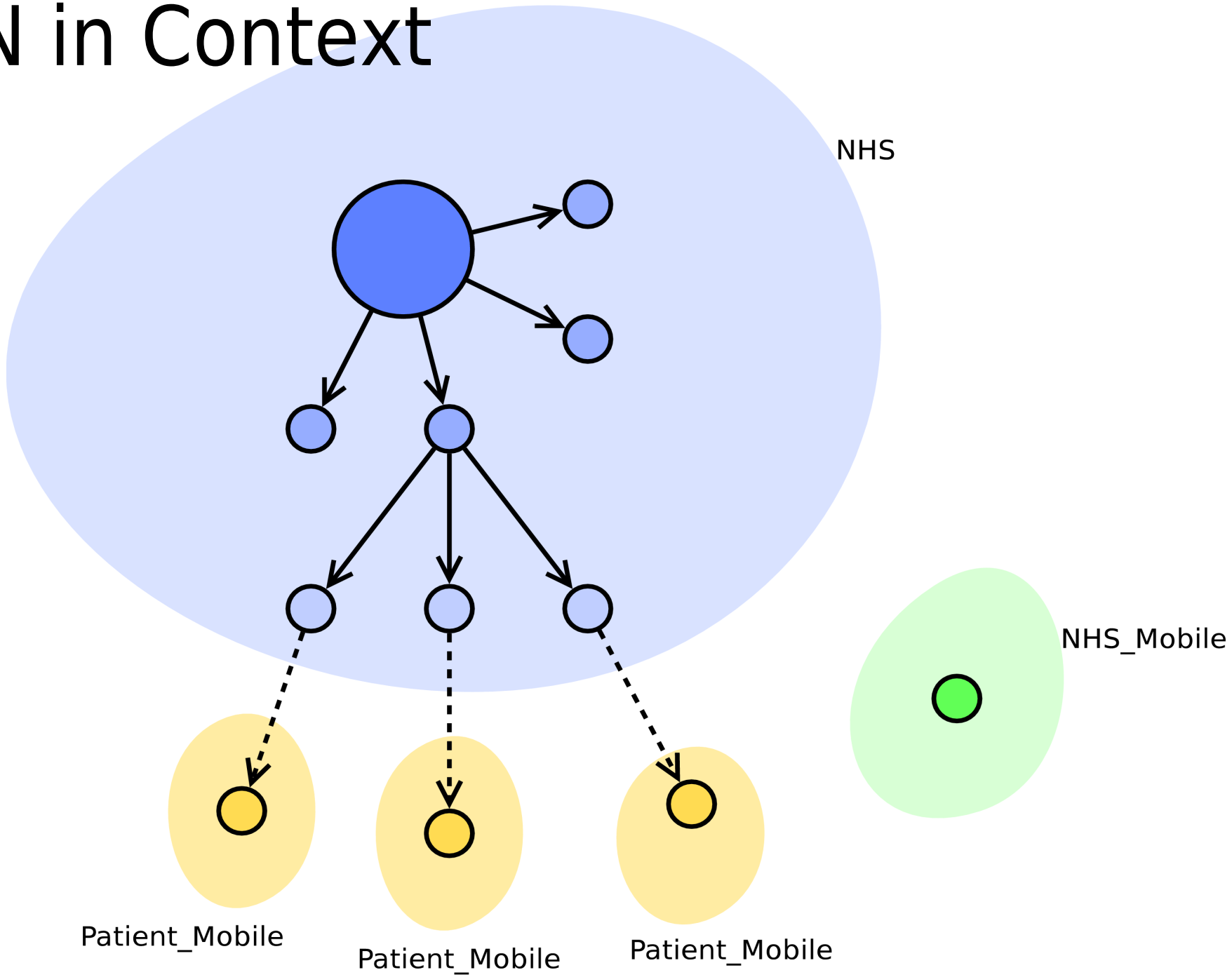
e-Health Scenario



DTN in Context

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

DTN in Context

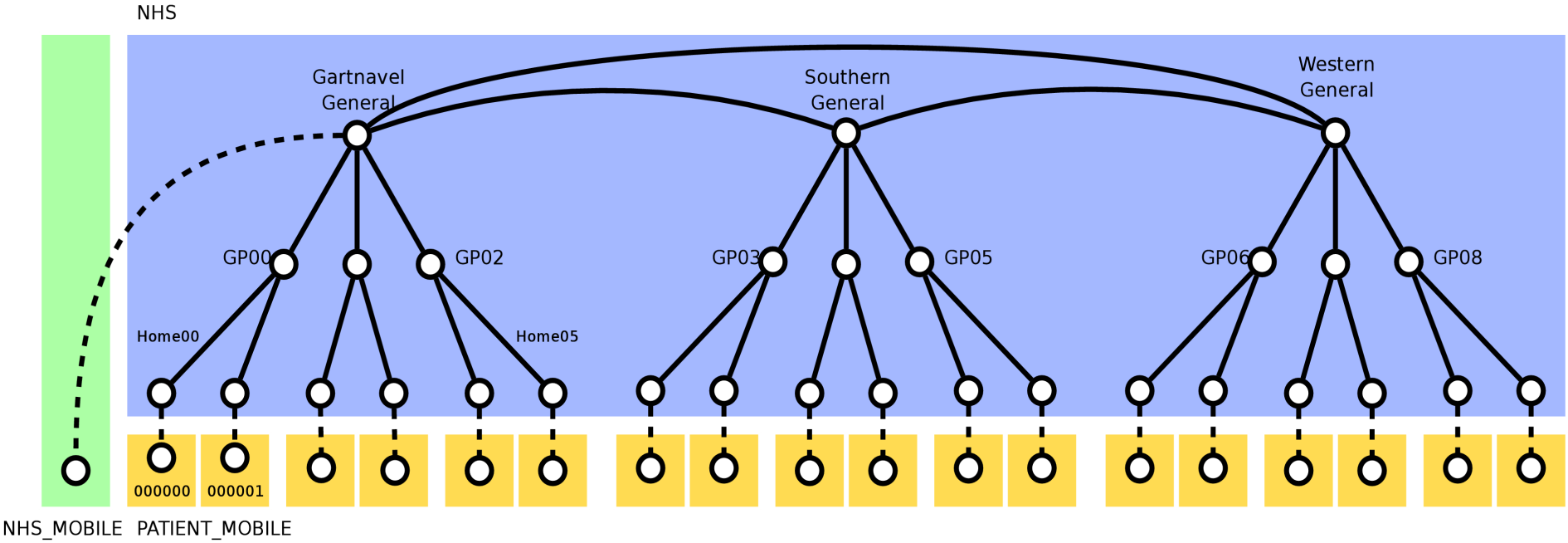


DTN in Context

- 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/