

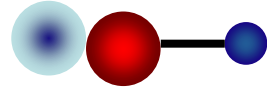
# PROTON

## Policy based solution for 4G mobile Systems

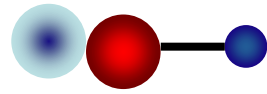
**Pablo Vidales and Andy Hopper**

*Laboratory for Communication Engineering*

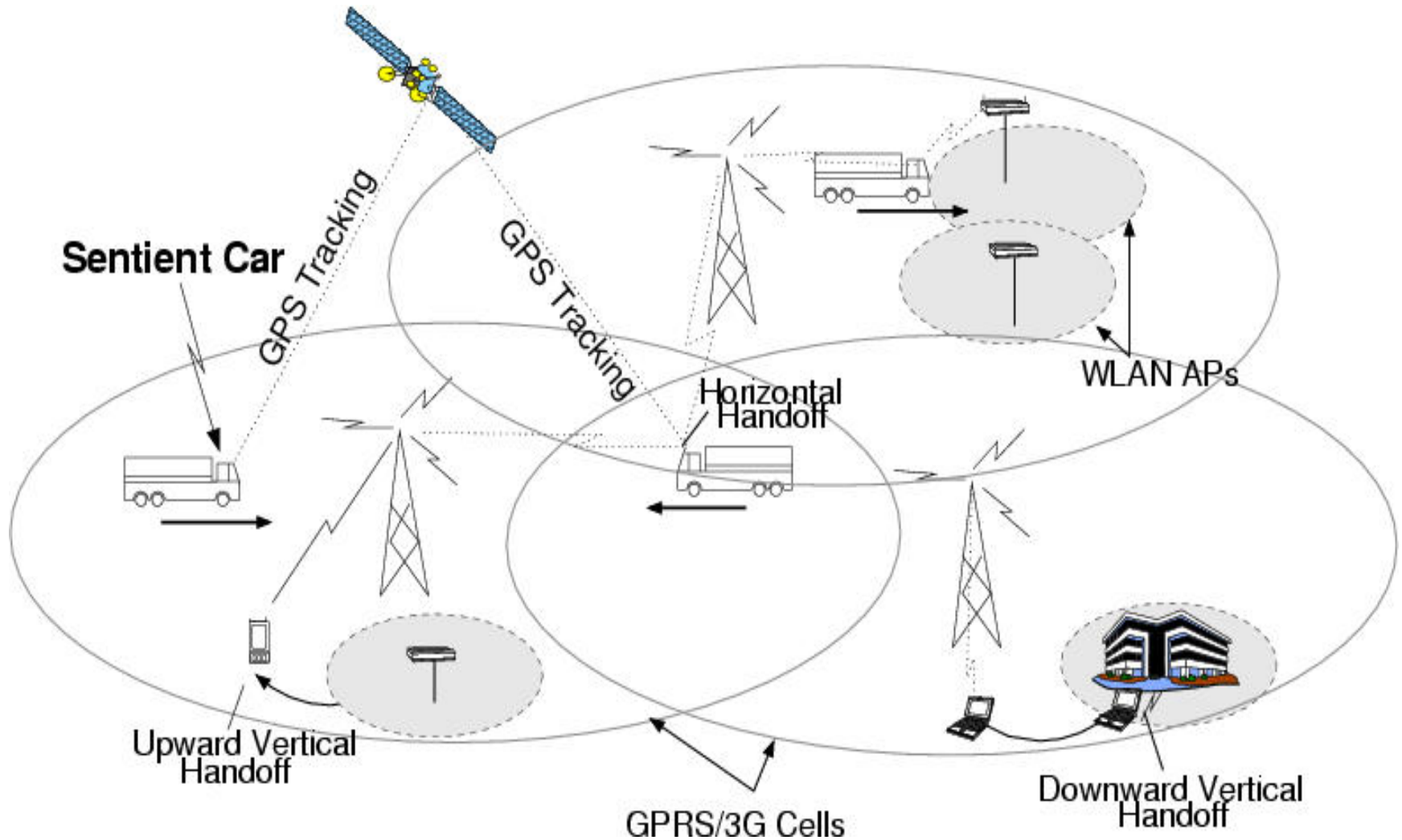
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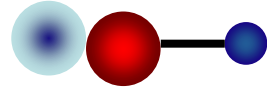


- 4G mobile system
- Motivation
- Key concepts
- Related work
- Architecture
- Context management
- Policy management
- Enforcement
- Conclusions

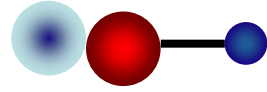


# 4G mobile systems?

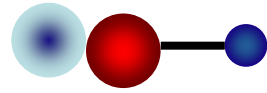




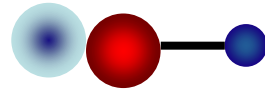
- Seamless roaming and connectivity to highly integrated and heterogeneous networks, is the key idea that springs from the 4G vision. Handover complexity will increase, creating the need for augmented knowledge about context, as well as more flexibility.
- Thus, we need a system to govern relations between activity, mobile device, and 4G networks resources.



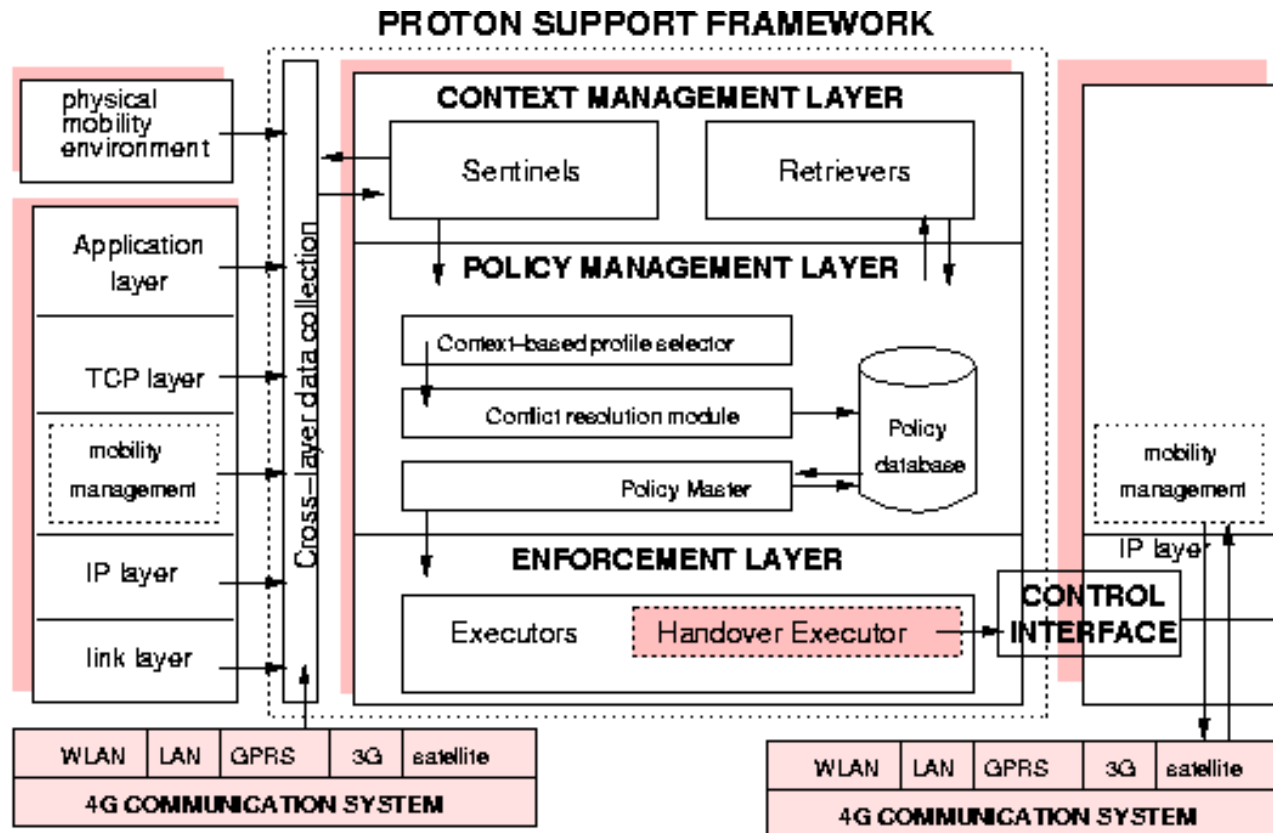
- Policy-based solution
- Mobile host approach
- Context-aware policy model
- Mobility support for 4G systems (handover initiation, network selection, execution, adaptation)
- Augment networking capabilities (e.g., flexibility, seamless roaming, and security)
- Cope with 4G challenges (e.g., heterogeneity, decision complexity, and dynamics)

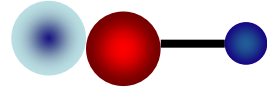


| Projects               | MIP | Scheme             | Context | Host or Network | Handover Initiation | Network Selection | Handover Execution | Inter-system Adaptation |
|------------------------|-----|--------------------|---------|-----------------|---------------------|-------------------|--------------------|-------------------------|
| H Wang et al, 1999     | ✓   | <b>Hard policy</b> | ✗       | ✓               | ✗                   | ✓                 | ✓                  | ✗                       |
| J Makela et al, 2000   | ✗   | <b>Neural nets</b> | ✗       | ✓               | ✓                   | ✗                 | ✗                  | ✗                       |
| P Chan et al, 2001a    | ✗   | <b>Fuzzy logic</b> | ✗       | ✓               | ✓                   | ✗                 | ✗                  | ✗                       |
| P Chan et al, 2001b    | ✗   | <b>Fuzzy logic</b> | ✗       | ✓               | ✗                   | ✓                 | ✗                  | ✗                       |
| K Jean et al, 2003     | ✗   | <b>Hard policy</b> | ✓       | ✗               | ✓                   | ✗                 | ✗                  | ✗                       |
| N Vandalachos, 2003    | ✗   | <b>Hard policy</b> | ✗       | ✗               | ✓                   | ✗                 | ✗                  | ✗                       |
| K Yang et al, 2003     | ✗   | <b>Hard policy</b> | ✓       | ✗               | ✓                   | ✗                 | ✗                  | ✗                       |
| N Fikouras et al, 2003 | ✓   | <b>Hard policy</b> | ✗       | ✓               | ✓                   | ✗                 | ✓                  | ✗                       |
| K Murray et al, 2004a  | ✗   | <b>Hard policy</b> | ✗       | ✓               | ✗                   | ✓                 | ✗                  | ✗                       |
| K Murray et al, 2004b  | ✗   | <b>Fuzzy logic</b> | ✗       | ✓               | ✓                   | ✗                 | ✗                  | ✗                       |
| P Vidales el al, 2004  | ✓   | <b>Hard policy</b> | ✓       | ✓               | ✓                   | ✓                 | ✓                  | ✓                       |



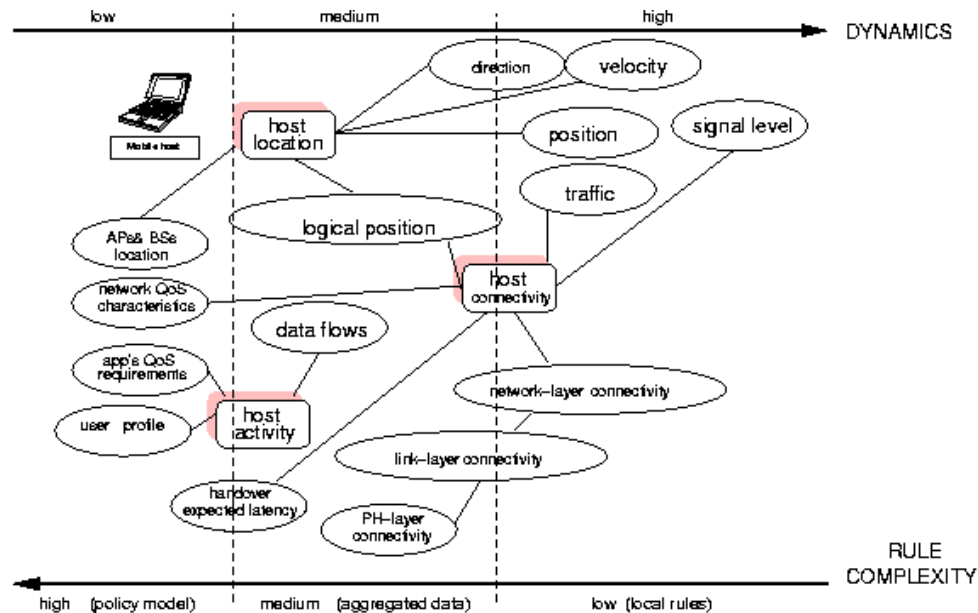
- A three-layered middleware stems from a cross-layer approach to tackle 4G systems' challenges



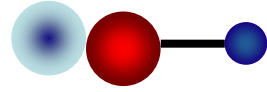


## • Networking context

- PROTON depends on accurate extraction, combination, and expression of unsteady elements into its policy model
- Three-level hierarchy according to dynamics and complexity
- Context management layer formed by Sentinels and Retrievers



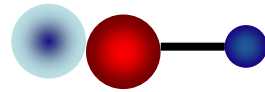




- Policy model
  - Express in PROTON by the Policy management layer
  - Network policies to control QoS using the IETF/PCIM
  - Policies triggered by implicit events (**context changes**)
  - **Time period can be a condition** (according to context)
  - Prioritise policies to optimise evaluation (**macro-events**)
  - Policies can be selected according to mobility profiles

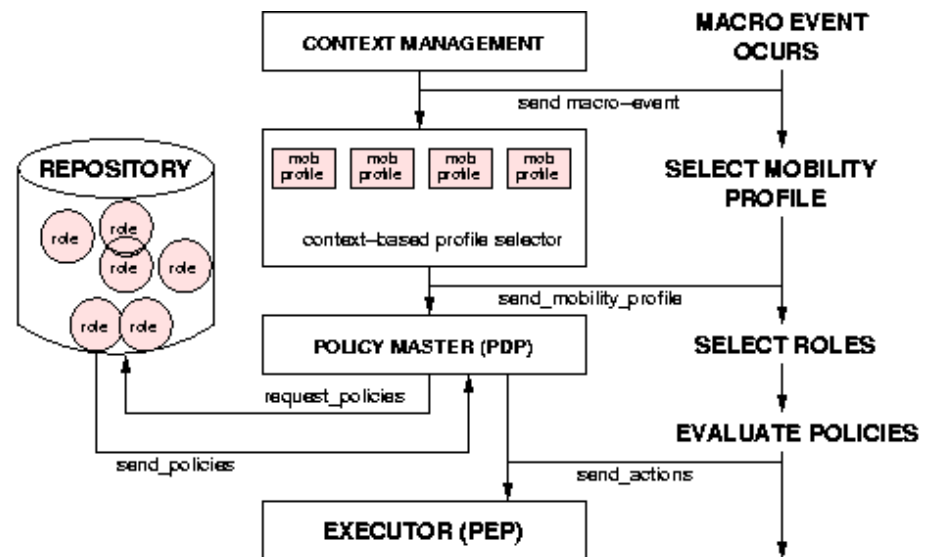
*e.g. IF velocity<30km AND **hotspot=TRUE** AND current=GPRS AND **available=300s** THEN downwardHandover=TRUE*

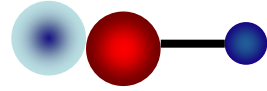
*e.g. IF **velocityChange>30km** THEN mediumMobility=TRUE*



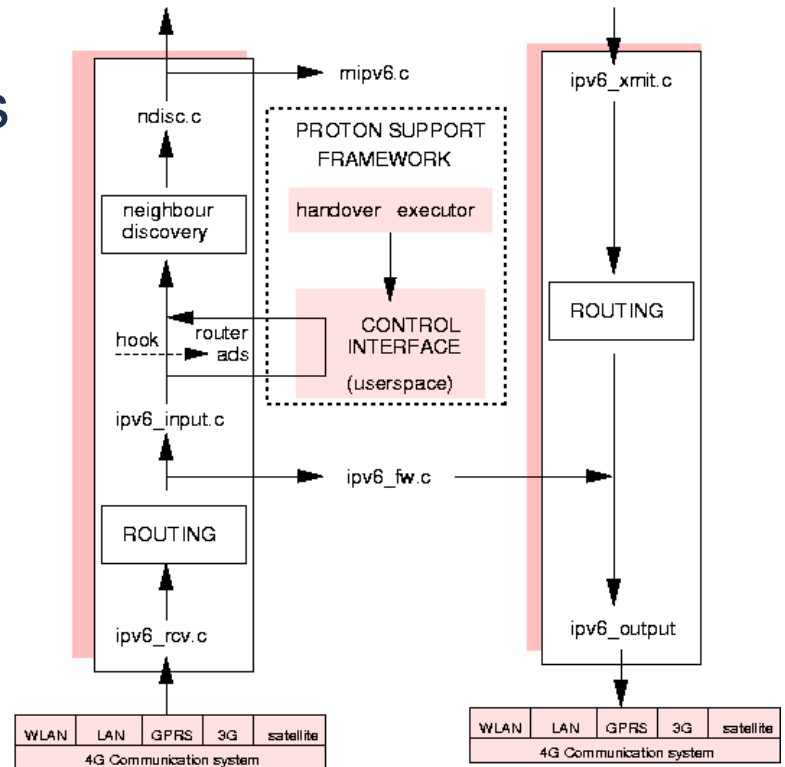
- Policy model
  - Groups policies into roles
  - Roles selected according to mobility profiles
  - Mobility profiles selected according to macro-events
  - Macro-events represent drastic changes in networking context

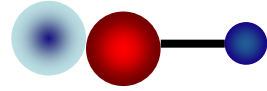
velocityChange > 30  
 ↓  
 currentMobility = MEDIUM  
 highMobility = TRUE  
 ↓  
 downwardHandoverRoles = FALSE  
 upwardHandoverRoles = TRUE





- MIPv6 supports mobility management (network layer)
- Handover Executor part of the enforcement layer
  - Policy should control handover
  - Filter/allow incoming RAs
- Share policies to other modules

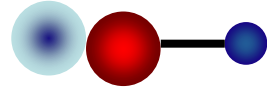




**Pervasive Networking** is the Holy Grail in mobile computing, always-on access to a plethora of services, through an ubiquitous network with unlimited bandwidth.

**VS**

**4G Communication Systems** providing best-effort access to services with different QoS, through an integrated platform – conformed by many radio access technology –, the next generation.



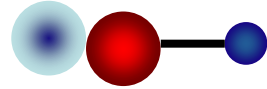
- **Future work**

- Implementation

- Java objects and events architecture for Context Management Layer
    - Evaluating tools for specification and evaluation (e.g., Ponder, XACML, and WSPL) for Policy Management Layer
    - Java for Enforcement Layer together with IPv6tables for lower network layer control
    - Modifications to MIPL (MIPv6 implementation) to reduce vertical handover latency

- Validation

- Test traditional algorithms using networking context as the input such as lazy switching, parametric switching, and dwell timer switching

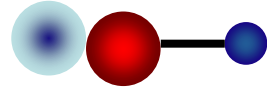


## Publications

- Ubiquitous Networking in Heterogeneous Environments, Pablo Vidales, Leo Patanapongpibul, Rajiv Chakravorty, **MoMuC 2003** (paper).
- Performance Issues with Vertical Handovers: Experiences from GPRS Cellular and WLAN hot-spots Integration, R. Chakravorty, P. Vidales, K. Subramanian, I. Pratt, J. Crowcroft, **IEEE PerCom 2004** (paper).
- A Data Repository for Fine-Grained Adaptation in Heterogeneous Environments, Calicrates Policroniades, Rajiv Chakravorty, Pablo Vidales, **ACM MobiDE'2003** (in conjunction with MobiCom 2003), (paper).
- PROTON: A Policy-based Solution for Future 4G devices, P. Vidales, R. Chakravorty, C. Policroniades, paper in **IEEE POLICY 2004**, (paper).

## Links

- <http://www.cl.cam.ac.uk/coms>
- <http://www-lce.eng.cam.ac.uk/~pav25/publications.htm>



“There are three kinds of death in this world.  
There's heart death, there's brain death, and  
there's being off the network”

*Guy Almes*

**THANKS! -- Questions?**