

FIRE Workshop

Scientific expert group

14 -15 February 2007

Solving some issues of the future Internet:
a disruptive marriage between 2 opposite paradigms ,
virtualization & incarnation

to be used by all the network property concepts
(architecture & protocols) and the moving entities

Michel Riguidel

riguidel@enst.fr

The new digital horizon : poly-infrastructures

- New objects, new architectures, new infrastructures, new standards
 - Smart dust, sensor networks
 - RFIDs, physical communication objects
 - Ad hoc networks & beyond 3G infrastructures
 - New infrastructures (WiMax, etc)
 - Grids, middleware, P2P, SoA
 - Galileo (trusted clock, trusted location) – 2011 –
 - Quantum networks – 2012 –
- New issues : complexity of existing foreign baselines
 - Urbanization of digital infrastructures
 - Massification, scalability, illicit grids, domino effects, ...
 - Global interoperability, end-to-end communications
 - Vertical & horizontal roaming
 - Trust, security, dependability, traceability
 - Management of Babel digital towers
- New services : simplification by new paradigms & models
 - Virtualization of OS, of Services, of Plug & Play to solve heterogeneity
 - **Cross-fertilization of different infrastructures**
 - Just one example :
 - Cryptographic protocols on 3G/WiMax/Internet + Galileo to improve Trust

Old digital networks : several single technologies

- to **move bits of information** through a single infrastructure
 - requirement : fast, reliable
 - a network has a flat encephalogram
 - a network is not a computer
 - a network is a quasi deterministic system (route algorithms, etc)
 - architecture
 - naïve (static, centralized, decentralized, etc)
 - routes with trees and graphs (no latitude-longitude-altitude)
 - IP networks
 - overhead with IP format for scarce resources
 - low functionalities of IP protocol
 - necessity to virtualize packets and security functions
- ideologies' confrontation
 - Internet technology incantation rather than real argument
 - Telecom Operator conservatism
 - Broadcaster protectionism

Next Generation Networks :

a **system** made of different niches of interconnected NGN & managed by several organizations

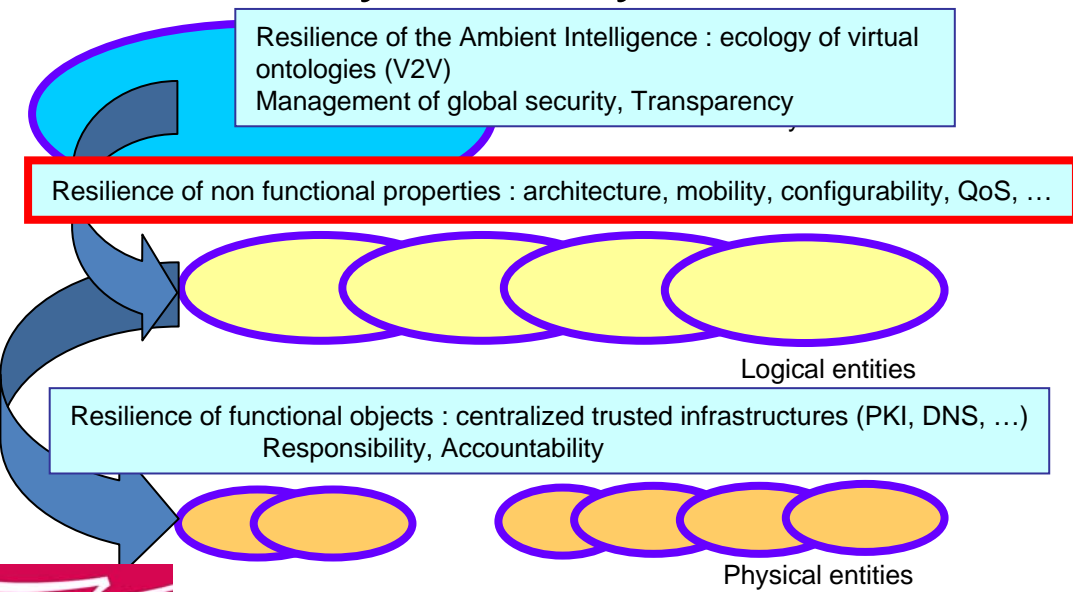
- to move “digital living” states through several different networks
 - transcend heterogeneity
 - to absorb existing paradigms and to grasp potential ones
 - a network to link
 - computers (machine to machine) and sensors/actuators (fleets of engines)
 - communication devices (people to people)
 - real things (physical objects) (physical things to physical things) (RFIDs, ...)
 - transport (not agnostically, sometimes virtually)
 - bits / quantum bits and also
 - words & data, streams of pictures and
 - cognitive concepts (marks and traces which are cookies – programs)
 - no more signaling plane and data plane : security aware networks
 - the network is a (distributed computer) program
 - stochastic routes, dynamic flexible architectures
 - a network with self capabilities
 - non functional properties are “programs” and flexible services are customized for virtual spontaneous organizations
 - beyond the horizon, a network to link the invisible life and nature
 - cells (bio) and atoms (nano)

2 orthogonal dashes in the paradigms evolution

- the virtualization paradigm
 - to juggle with entities of a different nature to mask exotic forms and reduce complexity
 - memory, storage
 - hw (virtual machine)
 - sw (OS)
 - architecture (overlay)
 - protocols (circuit/package) ...
 - Ephemeral instantiation and dynamic configuration of systems' properties
- the incarnation / embodiment paradigm
 - Thinking requests a knowledge posture (it is not only computation)
 - **intelligence requires a body**
 - Instantiation for networks
 - Old vision : signaling protocols, control plane
 - Distributed instrument (usually software) to grasp the context and the situation
 - Today vision : overlay structures
 - Tomorrow vision : overlay and incarnation over network-computer, hw/sw, content-services

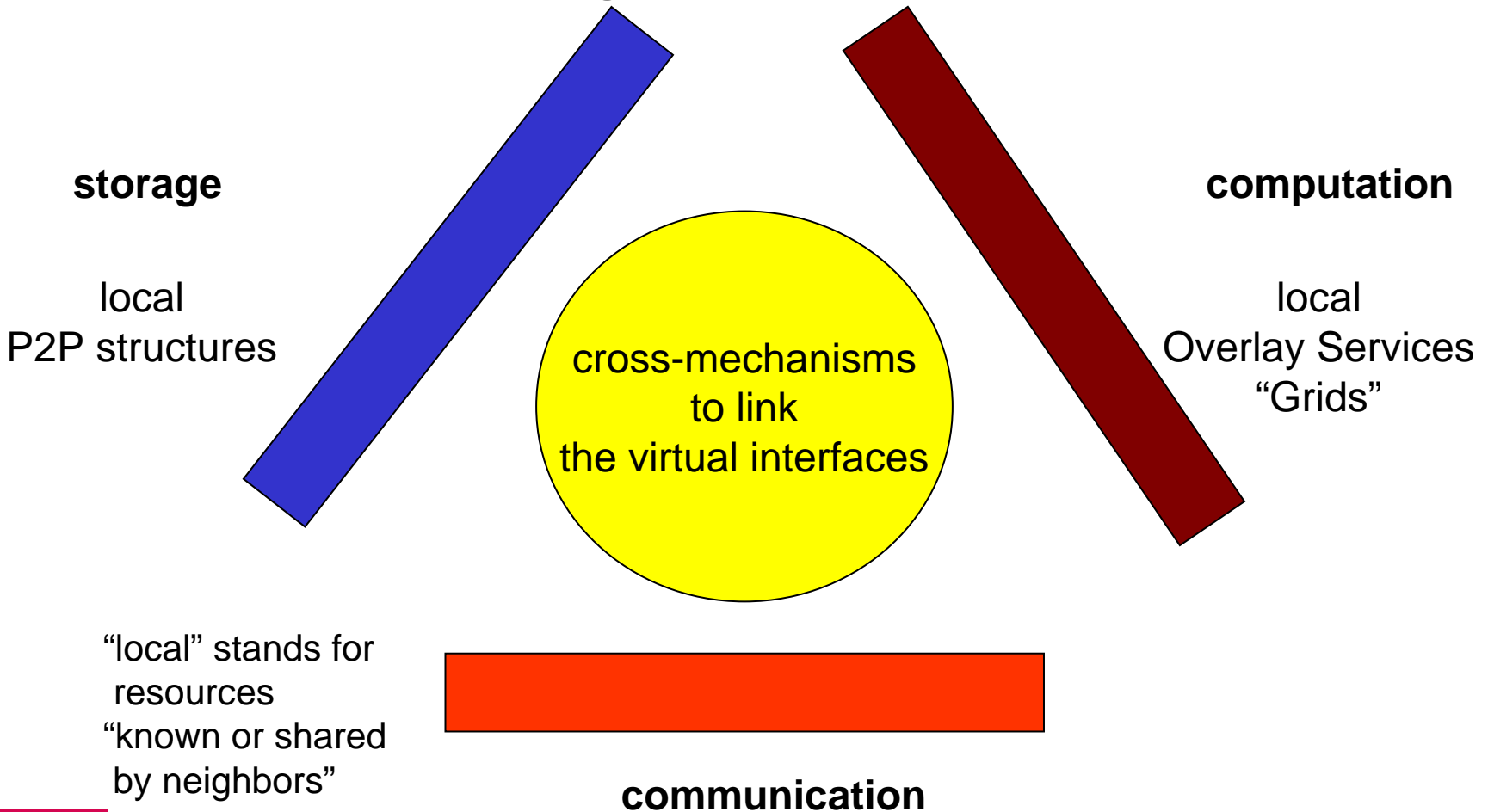
Virtualization – Incarnation dialectic

- Virtualization of properties
 - Heterogeneous infrastructures
 - Mobility, security ...
- Network concepts incarnation
 - Situated services, context
 - Neighbors, Topology



Technology for Information Systems & networks : “private dedicated local” overlay technology

technologies for the three functions



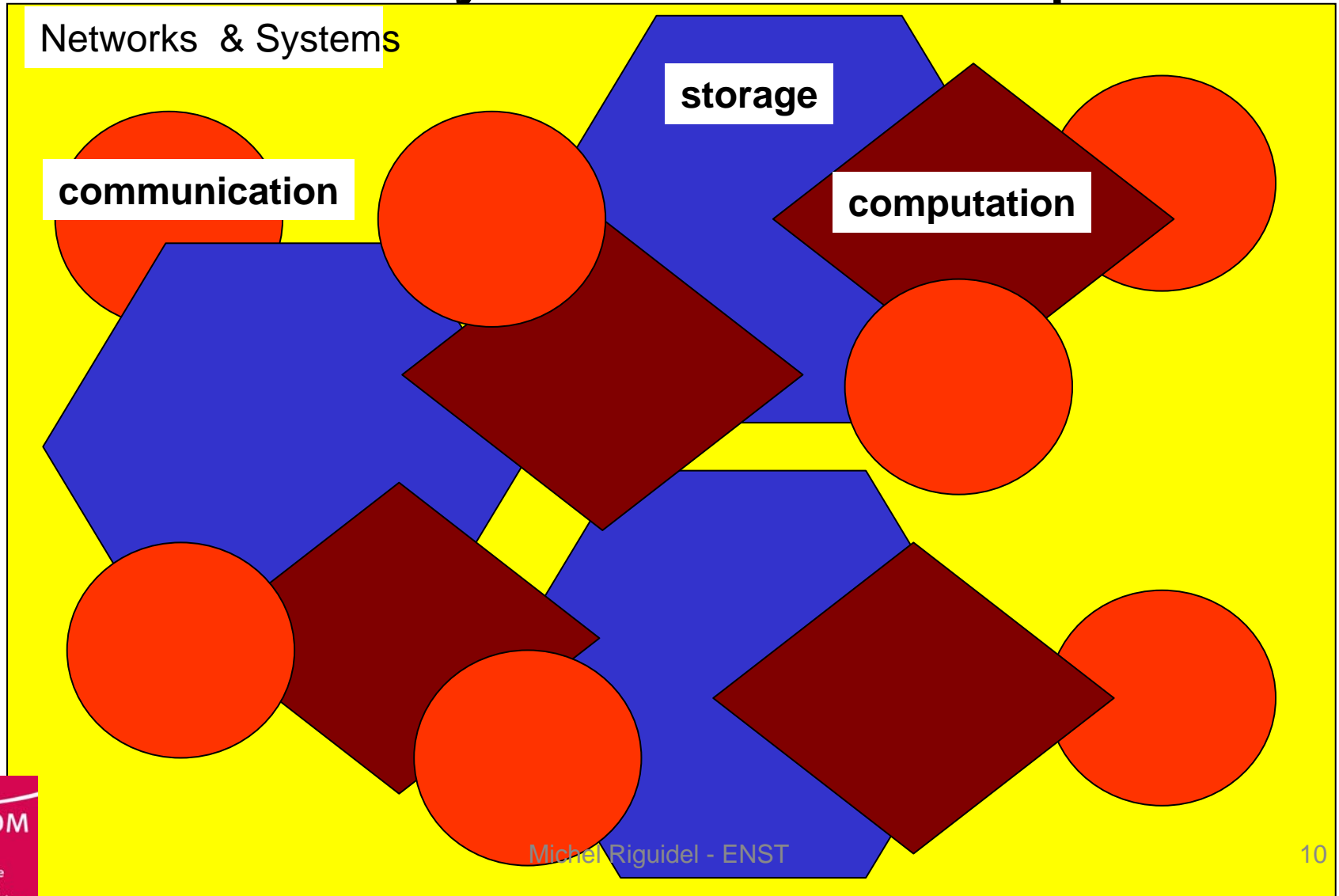
Articulation between Protocol & Architecture

- Inserting non-functional properties of communication
 - Mobility
 - Reconfiguration
 - Security
- Through virtualization & Incarnation
 - Balancing the semantic of properties onto the infrastructure & the transported bits
- Virtualization of entities
 - Cells, Nodes, packets, groups or sequence of network entities
- Virtualization of architectures
 - P2P
 - 7 layer models
 - Communication models
- Incarnation of the properties
 - Sensor networks
 - Distributed instruments to detect and react on weak events

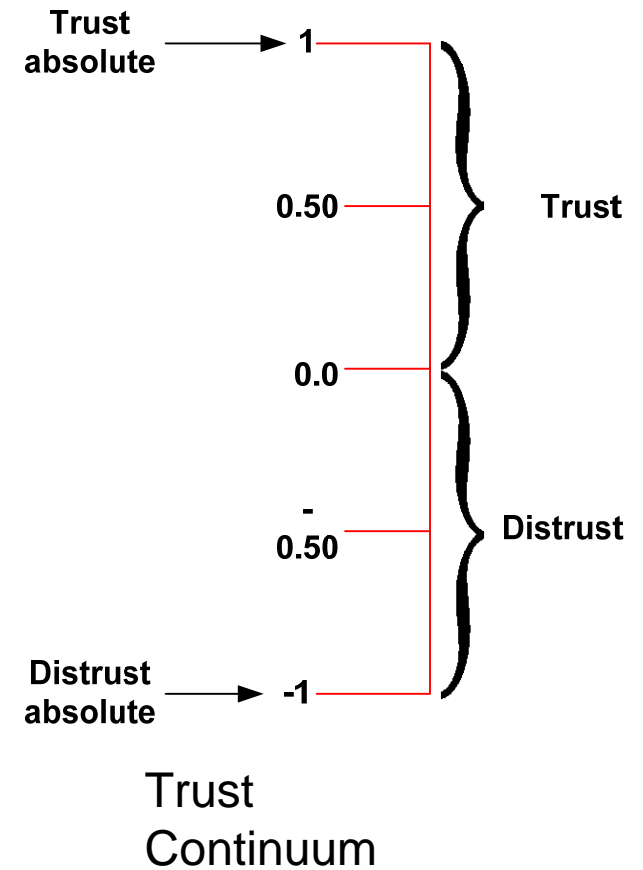
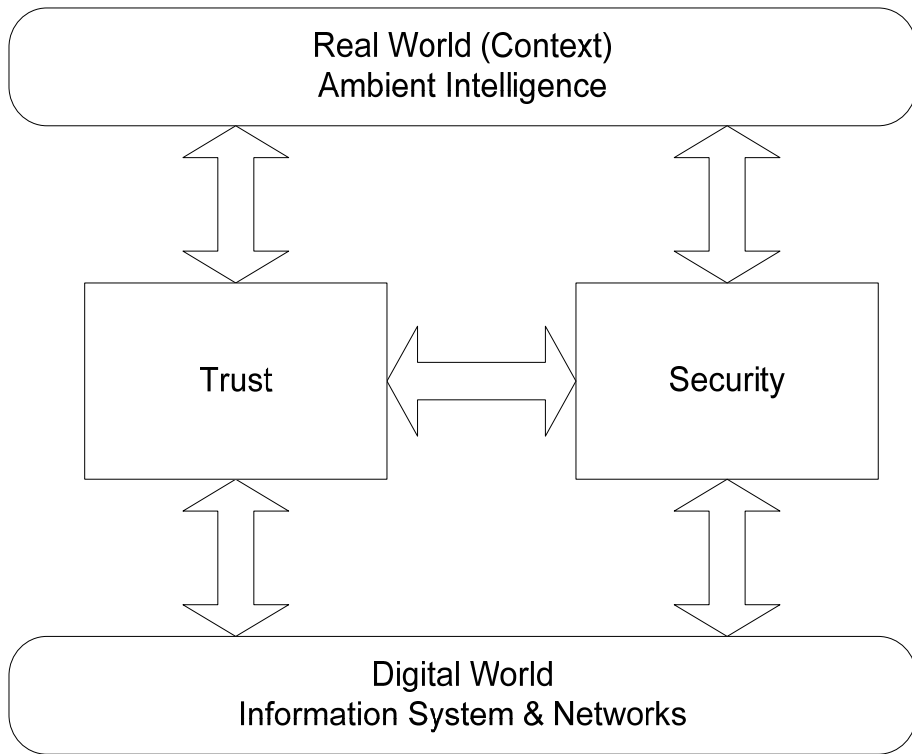
Test beds & Experimentation

Validation & benchmarking of
these 2 joint paradigms at large
scale

scalability & granularity issues : overlays do not overlap



Dissociation between both Infrastructures/Instrumentations of Trust & Security/Dependability



We must not forget the roadmap of the Future Internet for converging sciences

(Roadmap for security)

