

Internet Art and Science

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Internet Science

- Internet : the **culmination** of Telecommunications and Computer Science R & D over the last several years
 - Internet usage penetrates virtually all activities and crucially affects facets of everyday life
 - Generates huge complexity that we need to understand and assess
- Clean-slate, out-of-the-box approach
- Holistic understanding of the **several disciplines** that impact internet
 - their interactions
 - how they shape it and become affected by internet evolution
- ...with emphasis on **how they shape Grand Challenges:**
 - Energy
 - Environment
 - Transportation

Relevant disciplines to internet evolution

- Networking, computing, telecommunications, information theory, security, trust and identity
key research areas for internet development and evolution
- Complex systems, economics, game th., information th.
scientific areas to provide tools for internet understanding
- sociology, psychology, anthropology, economics
scientific fields that need to reconsider the new reality of a networked world

Grand Challenges

- **Energy-Environment-Transportation** emerge as the 3 interrelated **global grand challenges for humanity** for near future
- A synthesized effort at various levels is expected to deal with them including:
 - Advances in enabling technologies, i.e. novel methods for producing clean, cheap energy
 - Conservation and efficient use of resources
 - Increase societal awareness in way of life
- **The evolving internet is expected to play a key role in the last two objectives**

Grand Challenges (cont.)

- The **smart energy grid** expected to be realized by novel ICT tools
- Intelligent transportation systems** will leverage ICT for coordination at all levels
- Intelligent environmental monitoring** and control will rely on sensor web and user participatory schemes
- The need to address specific application challenges may necessitate novel approaches that will shape the future internet evolution

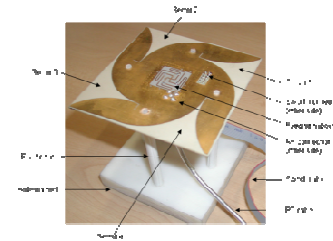
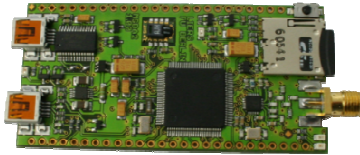
Need for Confederation of Disciplines

- **Statistical Mechanics / Physics**: microscopic interactions and microscopic behavior of particles
- **Cognition Science**: how entities develop cognition and learn amidst uncertainty and limitations, make sense out of data,...
- **Economics**: Internet to comprise a Resource Market
 - Web based advertising
 - Game theory, market-based transactional theory,
- **Control theory**: Stochastic / optimal control, network optimization
- **Network information theory**: value of information, fundamental performance limits
- **Evolutionary biology**
- **Experimentation in real-life test-beds (proof of concept)**

Experimentation



Sensor nodes at INRIA for Senslab and the MSB-A2 at FUB



Various network nodes and antennas deployed in the OPNEX experimental testbeds

- Internet experimental dimension develops rapidly
 - Test-beds developed with sole purpose studying internet evolution itself (Planetlab, Onelab, ORBIT, etc)
- Paradigms of Internet research test-beds (in **OPNEX** FIRE project)
- **NITOS: Mesh WiFi ORBIT devices (CERTH)**
 - Throughput / delay improvements by optimization methods
- **DES-test-bed: hybrid test-bed with WiFi and sensors (FUB)**
 - Energy efficiency in wireless sensor networks
- **Sectorized antennas 802.11 test-bed (Technicolor)**
 - Impact of PHY layer tx directionality on higher layers
- **PUT test-bed**
 - Application-layer impact of optimization-based techniques

Internet Science NoE Vision

- Enabling research areas constitute the **Pillars** of the activity:
 - Networking, communications, computing, algorithms, inf. theory, security
- Issues-questions that fall between the cracks motivate **Cross-disciplinary** efforts, may engage other scientific disciplines to generate answers i.e.:
 - Complex systems, economics, game theory, biology models
- **Cyberspace**: new domain of social interaction poses unique new challenges to Sociology, Anthropology, Law, Economics, Psychology, Marketing and Advertisement
 - Scientists from these fields, through the participation and interaction with internet designers will benefit by understanding internet better
 - Internet designers will be exposed on point of view of social sciences and will be inspired on designs from viewpoint of the semantics
- By keeping in constant perspective the Grand Challenges (Environment, Energy, Transportation), our vision will be shaped appropriately
- **We visualize the NoE as the appropriate means to foster above interactions**

Internet Science NoE Vision (cont.)

- Value of NoE will be on simultaneous participation of different scientific communities
- Structure of NoE should be carefully planned such that the managerial overhead that doesn't cancel the above advantage
- May have various modes of participation of partners that comply to their type and level of activity:
 - i.e. core partners participate in Joint Research Initiatives, user partners participate in joint workshops and interactive activities etc.
- Level of engagement of the various partners during preparation of the proposal will dictate to a large extend their mode of participation