

# Moving towards a socially-driven internet architectural design<sup>1,2</sup>

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*Session 2: Internet Architectures – Fixed and Wireless*

1: ACM SIGCOMM Computer Communication Review, volume 42, issue 3, July 2012, pages 39-46. R. Sofia, P. Mendes, M. J. Damasio, S. Henriques, F. Giglietto, E. Giambitto, A. Bogliolo

2: S-BRAIN #28: Evolving Social Structures: metrics incorporating social behavior. S-BRAIN series 2012, May 2012, SITILABS, University Lusofona.

# SITILABS Background

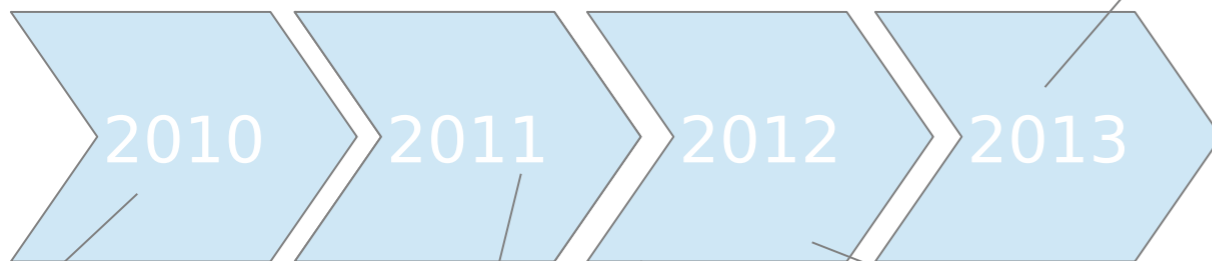
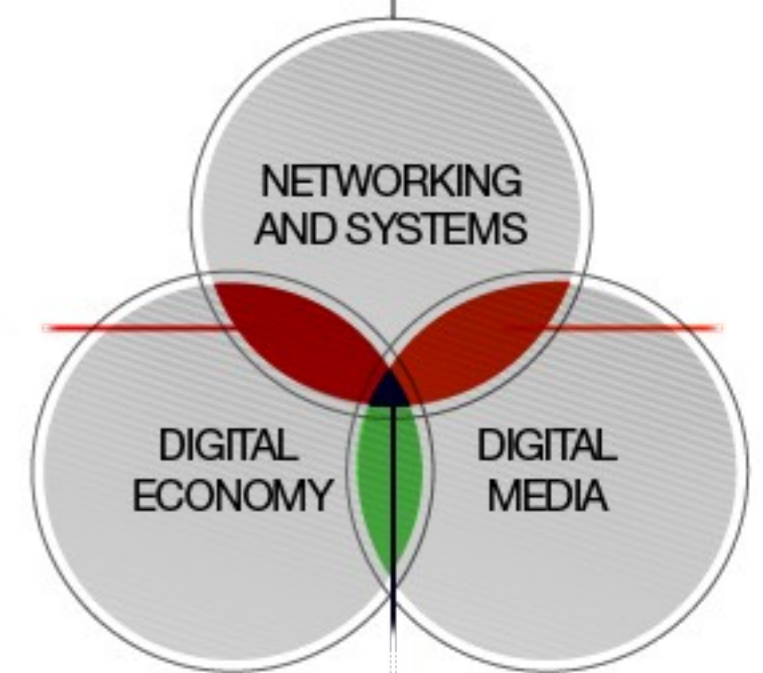


to improve the day-to-day living of today's information society, based on the development of user-centric technology

to contribute with low-cost, user-friendly solutions that will change the way informatics systems and technologies are perceived today



technology disruption  
user empowerment  
simplicity

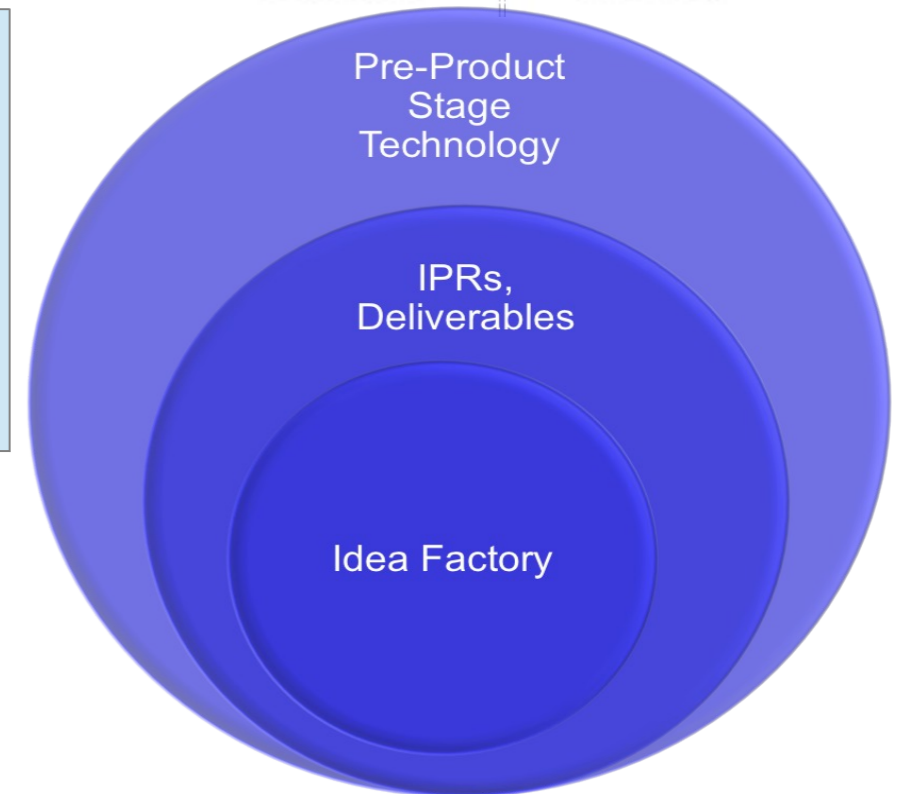


17 elements,  
8 PhDs  
First spin-offs  
First IPRs

7 elements,  
2 PhDs  
Focus: Internet architectures and networking

20 elements,  
5 PhDs  
Focus: networking and digital media

20 elements,  
5 PhDs  
First technology available  
Model: private, non-profit association  
Founder: COFAC c.r.l.



# Social Structures

## Interdisciplinary Perspectives



### **Social and Behavioral Sciences**

A concrete and stable arrangement of entities, within which humans in a society (community) interact. Refers to regularities of social life.

Nodes are entities/persons; links are based on the interaction between nodes.

### **Social Networking**

A graph (time/space variant) that represents user/entities profiles (nodes) and associations between them. Often denoted with social ties (virtual or real).

### **Pervasive Networking**

A time and space variant graph that represents entities and their interactions (links), in terms of sharing services (e.g. possible connectivity between nodes).

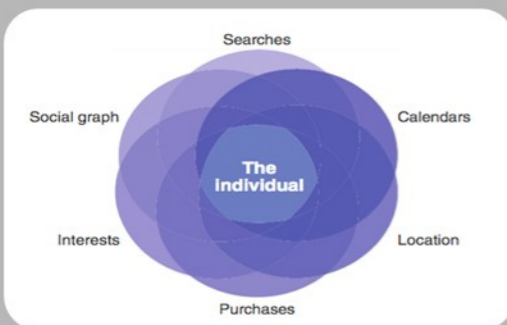
# Social Structures

## Examples



### Mobile calls

- Structure and tie strengths in mobile communication networks. J.-P. Onnela , ,J. Saramäki \*, J. Hyvönen , G. Szabó , D. Lazer II , K. Kaski , J. Kertész, A.-L. Barabási



### Social Graphs

- Monetization: Klout
- Connections: linkedin inMaps



### Large Public Data Sets

- Livehood
- Smart Cities (e.g. cityforward)
- MTA (transports), etc.

# Modeling Technology Adoption and Impact

## Internet architectural design

- ❖ Driven by technology adoption/acceptance modeling (TAM)
  - ❖ Models how users accept /use technology (services, resources, apps, etc) – perceived usefulness
  - ❖ Only considers economical aspects
  - ❖ **Not capable of addressing user empowerment models (e.g. where user is a provider)**

## In Social Sciences

- ❖ Measures relationships
- ❖ Analyzes interactions
- ❖ Considers social capital aspects e.g. possibility to reinforce trust relations, or to generate knowledge

**Socially-driven Internet modeling: TAM+Social Capital Modeling/metrics**

# Internet as a Complex System

## Why Social Behavior is Relevant

### ❖ Internet is a social structure

- ❖ Nodes are devices controlled by users/entities
- ❖ Its value is both societal and economic - Platform for the exchange of knowledge
- ❖ Complex system with simple behavior
  - ❖ Self-similar traffic
  - ❖ Power-law based connectivity (a few are connected to many; many are connected to a few)

### ❖ Internet end-to-end principle

- ❖ The network is dumb, intelligence is on the edges

### ❖ Prosumer: user empowerment

- ❖ User provides content via Social Media: user becomes a content/service provider
- ❖ Network user profits from technology to provide networking services (e.g. connectivity) – prosumer extends to the OSI Layer 3

### ❖ Internet value-chain

- ❖ Due to the end-to-end principle, flows from user to provider.
- ❖ Not assymetric

**Social behavior integration: the next step towards Internet evolution**

# Social Behavior on the Internet

## Relevant Metrics/Models to Incorporate

### ❖ Social Capital metrics

- ❖ Trust
- ❖ Influence

### ❖ Connectivity Modeling

- ❖ Analyse social behavior (e.g. skype calls within a specific area) – **considers traffic locality**
- ❖ Place networking nodes accordingly to user perceived usefulness – **improve adoption modelling**

### ❖ Routing

- ❖ Improve dissemination of information
- ❖ Take advantage of any possible contact – ***social interaction as the vehicle for dissemination***

### ❖ Mobility management and modeling

- ❖ Nodes are carried /controlled by humans – ***nodes move according to a social behavior***
- ❖ Estimate social movement → Anticipate movement → improve mobility management

...

# Social Behavior on the Internet

## Centrality Metrics – Networking and Social Capital



Property/Parameter	Social Capital Perspective	Networking Perspective
<b>Centrality:</b> determine the relative importance of a vertex within the graph	The influence of a person on the social structure	The impact a node has on the graph. Importance here relates to information dissemination.
<b>Degree centrality:</b> Nodes that have more ties to other nodes have a higher degree centrality.	Considers that such nodes are better positioned (influence, information dissemination). Alone, says little about node influence. Together with the degree centrality of neighbors, provides a better measure	Nodes that have more ties to other nodes have a higher degree centrality. <b>These are not necessarily better positioned.</b>
<b>Betweenness centrality:</b> nodes that have a high probability to occur on a randomly chosen shortest path between two randomly chosen nodes have a high betweenness.	Assists in finding “bridgers”: these are nodes that limit clusters (interconnect different clusters).	Links that are more central assist nodes in better dissemination information, assuming a plain connectivity model.
<b>Closeness centrality:</b> Sum of its (shortest-path) distances to any other node y normalized by the maximum shortest-path length.	High closeness centrality implies better information propagation.	A node that has a higher number of shortest-paths to all other nodes has a higher closeness centrality. <b>It also has a higher probability of becoming a bottleneck</b>
<b>Link Strength:</b> The strength of a tie depends on the amount of time spent on it and the emotional intensity and intimacy of the relation	If there is a strong tie between A and B as well as between B and C, A and C are likely to develop a strong tie as well. This tendency cannot be observed for weak ties.	If there is a strong tie between A and B and another between B and C, this says nothing about A and C..



# Social Behavior on the Internet

## Integrating Social Capital Aspects

### ❖ Social Capital metrics

- ❖ Trust
- ❖ Influence

### ❖ Revise the notions of centrality

- ❖ Analyse the impact from a social capital perspective to improve dissemination of information
- ❖ Take advantage of any possible contact – ***social interaction as the vehicle for dissemination***

### ❖ Integrate metrics to measure influence

- ❖ Not to be mistaken with node popularity
- ❖ Purpose is to assist in defining better interaction matrixes, by integrating social capital metrics

# Sumarising...

## ❖ **Internet architectural design requires a revision**

- ❖ Address technology adoption modeling and social behavior metrics side-by-side
- ❖ Design new technologies by considering that the user is also a provider

## ❖ **Social Capital Aspects should be integrated**

- ❖ Better definition of what communities/clusters can be and how they can be formed
- ❖ Alignment of metrics being applied to different operational fields is essential

## ❖ **Social networking analysis...**

- ❖ Is key to assist in a better definition of pervasive networking environments
- ❖ OSNs are NOT a relevant tool as from a social capital perspective, they relate to weak tie development...
- ❖ Instead, it is necessary to delve deeper into the notions of influence, mind sharing, and trust.
  - ❖ Consider networking measurement metrics

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R&D in Informatics Systems and Technologies