Moving Towards a Socially-Driven Internet Architectural Design

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ABSTRACT

This paper provides an interdisciplinary perspective concerning the role of prosumers on future Internet design based on the current trend of Internet user empowerment. The paper debates the prosumer role, and addresses models to develop a symmetric Internet architecture and supply-chain based on the integration of social capital aspects. It has as goal to ignite the discussion concerning a socially-driven Internet architectural design.

Categories and Subject Descriptors

A.1 [Introductory and Survey]; C.2 [Computer Communication Networks]: Network architecture and design.

Keywords

Internet architectural design; Future Internet foundations; prosumer; social capital; knowledge; supply-chain.

1. INTRODUCTION

The Internet has reached a new era in its evolutionary track, an era where user empowerment and engagement are gaining momentum due to the wide availability of the most varied *Social Media*. Social Media are often solely associated to *Online Social Networks (OSNs)*, to *Social Network Sites (SNSs)[5],* or to Web-based tools, such as Flickr, that allow Internet users to exchange content. Within the context of mobile networks, Social Media is the umbrella for mobile software that allows Internet users to actively engage in sharing some of their interests in their daily life experience. In the context of new media, Social Media expands to embrace any form of digital media where users can actively engage, e.g. digital Television, while if we consider Internet architectures and their evolution, then Social Media entails also disruptive architectures which rely on some form of user cooperation as occurs with *User-centric Networks (UCNs)* [29], i.e., networking architectures which grow in a "viral" way through user engagement, exchange of shared interests, and cooperation incentives. **In this paper, we refer to Social Media as the whole set of tools aforementioned.**

The fast-paced adoption of Social Media seems to provide Internet stakeholders with new forms of expression and knowledge exchange. Yet, from a provider's perspective these tools are still exclusively seen as a part of digital marketing. However, new results derived from the use of Social Media - such as open-data sets - are indicators towards the need to revisit Internet architectural design and to provoke a shift towards a more symmetric Internet supply-chain model by incorporating both economical and societal (interaction) aspects.

This paper is dedicated to the debate about the need to take an interdisciplinary approach to the design of future Internet architectures, services, and technologies. The paper is organized as follows. Section 2 goes over related work, while section 3 addresses the prosumer notion from the perspective of different layers on the OSI stack. Section 4 gives a perspective on the impact of the prosumer role integration into Internet supply-chain models. In section 5 we provide guidelines on the evolutionary process to drive the Internet architectural design into a structure that truly embraces both a technological and societal perspective more suitable to incorporate a *prosumer* notion, being the paper concluded in section 6.

2. RELATED WORK

The need to revisit Internet architectural design has been almost a constant on the past decade, from a technological perspective. Projects such as GENI [19] as well as initiatives such as EIFFEL [9] have given rise to a wide variety of innovative technological aspects concerning Future Internet foundations.

In the most recent years there has also been an increase in multidisciplinary work within the context of social networking and social interaction analysis. SocialNets [26] addresses the evolution of social structures relying on a cross-field perspective which combines pervasive networking and some aspects of social sciences related to human behavior. SocialNets lead to a better understanding of metrics (derived from a human interaction behavior) as well as to a better comprehension of assumptions that are being used to model our perception and knowledge of Internet evolution, e.g., the way that mobile nodes move and the way that users behave.

S. Ferlander analyzed the potential impact of technology on the development of social capital and of new communities in urban environments [11] both in terms of knowledge generation and in terms of community attractiveness. Pénard and Poussing have analyzed and formulated several hypothesis concerning Internet use and the development of social capital [21], having revealed that there is a significant positive impact both in terms of increase in volunteer activities and in terms of trustworthiness in online investments, concerning well established social capital ties.

A third relevant field of work to be cited is the one of social networking analysis as a multidisciplinary effort that is being applied across several domains. Borgatti et al. provide a multidisciplinary perspective to such evolution by describing how social networking structures [10] and related definitions can be addressed from a supply-chain modeling perspective [3].

3. USER EMPOWERMENT MODELS

This section addresses two main user empowerment models that we believe impact Internet foundations design: the *prosumer* model, which is based on the need for collective expression; and the *network prosumer* model, a natural evolutionary step of user empowerment and participatory models which, allied to the pervasiveness and lower costs of networking technology, is giving rise to new types of Internet architectures.

3.1 Prosumer

It has often been debated that the current Internet end-user is moving from a plain consumer towards a *prosumer* model [28]. The key difference between a consumer and a prosumer is that the latter embodies a form of empowerment in the sense that the user plays an active role in improving products/services.

The impact of this model on Internet architectural design relates to the real value of Social Media. Such value is created by users who share their interests (their perspective of knowledge based on their daily life experience) in the form of digital content - user generated content. This sharing seems to go beyond a basic human need of socialization, being driven by a social need related to **collective expression**.

Ritzer et al. have further analyzed the prosumer notion, having considered a fast-food metaphor to describe a change that Ritzer first observed in the American society [24]. Ritzer then pursued an analogy concerning the role of Social Media, in the form of OSNs and SNSs [24], pointing out negative aspects such as the possibility of abuses in the form of unpaid labor. This unpaid labor is, according to the authors, only in part balanced by the fact that Social Media are often offered for free.

The prosumer model is also impacting content dissemination strategies. Social Media give the means to disseminate knowledge in new ways and based on new formats; the Internet user has the means to enjoy services in a quite independent way. Even more relevant is the fact that Social Media allow the consumer to became a producer at a quite low cost. Hence, *convergence* becomes a product of social, cultural, industrial, and technological changes; a process that influences and modifies the circulation of knowledge (culture) [16] to create a collective expression (social) by means of even more complex and pervasive products (technology, industry) [15].

A final relevant aspect related to the prosumer model is that its Internet presence seems to exhibit power-law properties [1, 14]. Such properties are a sign of the presence of a social process in OSNs, as a small percentage of users produces the most significant share of content, while the majority remain within the consumer model; these observations provide the proves of the coexistence of the consumer and prosumer models and their impact on the evolution of the Internet design.

3.2 The Network Prosumer

Today, the prosumer notion embraces more than content development and user engagement/participation: it impacts Internet access provisioning, as the Internet end-user has at his/her disposal technology that allows him/her to behave as a *network prosumer*. In *UCNs* [29, 27], the user becomes actively engaged on the networking operation and process. From an Internet connectivity model perspective, a UCN can be represented as a time and space varying graph where nodes are wireless devices belonging to Internet users, and where edges represent trust and affinity associations. The edge cost is a measure of the trust association strength as well as the level of influence that users play on each other. From a pure connectivity perspective, nodes have two roles: *regular* and *network prosumer* (NP). Regular nodes use network resources provided either by an NP or by a regular access provider. The NP is therefore a prosumer at a networking level. NPs provide (networking) services to a specific community of users, e.g. share

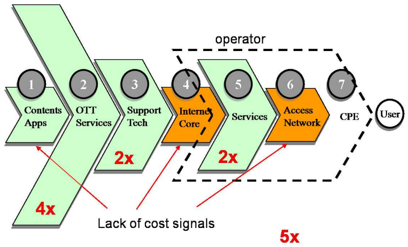

Figure 1: Internet supply-chain representation.

bandwidth driven by a social process (shared interests, even if amongst real-life strangers) or in a coordinated way with one or several access providers.

UCNs reside on the Internet fringes and this is a consequence of prosumer integration. Prosumers rely on low-cost wireless technologies, software defined networks, and also on their willingness to cooperate due to some form of communal or individual benefit (*incentive*) - **a social aspect**. Moreover, UCNs embody four main properties: *network resource sharing*, *cooperation*, *trust*, and *self-organization*.

Network resource sharing today is mostly associated to Internet access or connectivity sharing. However, as these architectures evolve, we will likely observe sharing of additional network resources (e.g. energy) or of additional network services (e.g. mobility management).

Cooperation relates to users willingness to participate in UCNs, both sharing and profiting from available resources. Incentives to cooperate can be related to trust (e.g. social association), to some form of gratification (e.g. broader Internet access), or even to a more efficient network operation.

Trust management is today performed by having users signing up to a "community". However, to create UCN secure environments, user identification and traceability are issues that have to be addressed. Hence trust management relates to three main concerns: *i) assist users in terms of traceability; ii) guarantee user privacy; iii) provide data confidentiality when/if necessary.*

Self-organization relates to the capability to coordinate connectivity in scenarios where it is based on users willingness to cooperate or adhere.

The example based on UCNs intends to explain why, from our perspective, the prosumer role is moving towards the lower layers of the OSI stack thus eventually resulting in significant implications on the Internet architectural design.

4. PROSUMER IMPACT ON THE INTERNET SUPPLY-CHAIN

This section provides a perspective on the Internet supply-chain evolution and also debates on how we believe the Internet supply-chain may evolve, based on user empowerment and from a technological perspective, towards a stage that is more prone to consider knowledge exchange as *Return-of-Investment (RoI)*.

4.1 Asymmetry in the Internet Supply-Chain

User empowerment requires a paradigm shift in Internet architectural design as a way to unlock the potential of new business models, which can only be deployed if the Internet supply-chain becomes symmetric. To explain this perspective let us consider Fig. 1, where a 7-stage model for the Internet supply-chain [22] is illustrated. In this model the Internet is seen as a two-sided market where bits are the product unit, and where users are seen as consumers. The supply chain follows a producer to consumer flow comprising seven stages: (1) content and application right owners; (2) *Over-the-Top (OTT)* online services; (3) support technology, e.g. hosting services and content delivery networks; (4) Internet core, made of exchange points and core networks of incumbent operators; (5) managed services directly provided within operators' networks; (6) access networks; (7) customer premises equipment and software components used to connect to network termination points, and to gain access to the Internet. The dashed line in Fig. 1 shows that operators tend to adopt a vertically integrated business model in order to use the profits generated by thriving market segments to sustain the stagnating ones. Vertical integration, however, does not provide an ultimate answer, since it contrasts with the modular nature of the TCP/IP stack; it limits innovation; and it creates a misalignment between costs and price models.

It is apparent that some of the stages (2, 3, 5, and 7) have taken advantage of the exponential growth of Internet traffic, while some others (1, 4, and 6) have suffered from the lack of price signals, which has prevented investors from supporting their development. For instance, the *Capital Expenditures (CapEx)* required to increase the capacity of fixed and mobile networks at the rate of IP traffic growth are much higher than those estimated by projections of historical data. The bottlenecks created by stagnating segments risk the impairment of the development of the Internet as a whole, unless new models are adopted.

4.2 Symmetric Internet Supply-Chain, Accommodating Prosumers

Accommodating prosumers implies the need for symmetry, from a supply-chain perspective. Fig. 2 provides an illustration of the Internet supply-chain previously depicted in Fig. 1, having as recipient the Internet user (E-U). For the sake of clarity, we provide concrete technological examples for each of the stages. For instance, (1) could be a community where some Internet service

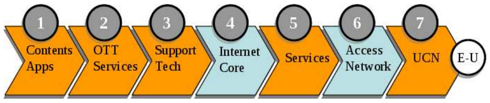

Figure 2: Supply-chain with the Internet user (E-U) as recipient.

is shared, OSNs, or applicational markets (e.g. Android market); (2) could refer to blogs, Wiki pages, or online co-working initiatives; (3) could integrate new forms of collective networking such as Peer-to-Peer or overlay networks; (5) could embody community-scale networks and services; (7) could represent UCNs extending and complementing access infrastructures.

Fig. 2 introduces three new features when compared to Fig. 1: firstly, it points out the impact of users on all of the different stages; secondly, it represents UCNs as part of the supply-chain; thirdly, it integrates the prosumer as part of the supply-chain. What Fig. 2 intends to exemplify is that when we speak of the need to remove asymmetry, we are referring to services and to their time correlation; not to deep, clear-slate foundational changes as well shall explain in the next section.

5. SOCIALLY-DRIVEN INTERNET DESIGN

Albeit social networking is currently a research area that is being addressed by the most varied fields (e.g. pervasive networking; social sciences; communication sciences; behavioral economics), there is also a concrete need to align the different notions and perspectives derived from research on these fields. For instance, most of the solutions in the field of opportunistic routing relies today in several social similarity notions, being *centrality* one of the most used social similarity concepts applied. However, there are strong discrepancies concerning centrality depending on its applicability domain. Specifically, new Internet services/solutions are taking into consideration notions from complex networks, while leaving aside societal aspects which can be derived from the application of social capital models and metrics, i.e., an integrated perspective of the different, multidisciplinary fields. For instance, to derive networking operation based on a behavior that is closer to the one of social structures, social-based opportunistic routing solutions should consider the dynamism of users' behavior and affinity resulting from their daily routines in order to create durable networks in dynamic scenarios [30]. In the future, Internet graph representations should incorporate information about the affinity level of user profiles (e.g. based on behavior and knowledge). To achieve this, it is necessary to adopt metrics that can track social capital evolution, and not only network centrality metrics (degree, betweenness, closeness), as the latter only assist the coordination of actions within a social structure.

This contribution alerts to the need to make the Internet architectural design evolve by adequately integrating user empowerment and that such compliance goes well beyond the need to address new business models. Instead, it is necessary to address social structures evolution and to embed new lines of thought, multidisciplinary in nature, which can then give rise to the development of metrics and algorithms that may truly sustain not only a self-organizing and potentially power-law based nature of the Internet, but also its evolution towards a robust knowledge exchange platform. This can be achieved if technological adoption techniques coexist with societal adoption metrics. For the latter, social capital models and metrics are the relevant embodiment in terms of application to the Internet architectural design.

5.1 Brief Introduction to Social Capital

Social capital is a concept that today is applied in a wide variety of fields, e.g. economy, media studies, sociology. Its roots can be traced back to Bourdieu, who defined social capital as "the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance and recognition" [4]. To give a concrete example related to social capital applicability on the field on Future Internet architectural design, "potential resource" can be seen as the knowledge exchanged/gained through interaction with specific clusters of nodes (e.g. affiliation, family); ways to measure such resources can be "gratitude" or "trust".

As Bordieu's definitions have been hard to quantify across different fields, Coleman's definition of social capital [8] gained wider acceptance. Coleman defines social capital as a set of "entities" that share two main features: i) each entity is part of a social structure ii) each entity has, on that social structure, a concrete purpose which facilitates some interaction among individuals belonging to the structure. Coleman has also contributed with potential models to derive social capital, but has been often criticized for failing in contextualizing relationships and structures in a larger socioeconomic perspective. Putnam's notion of social capital is the most popularized one [23]. He defines social capital as a set of features that assist in facilitating and coordinating actions in structures. From a social networking perspective, examples of such features can be levels of trust, or reciprocity. Recent conceptions of social capital perceive it as a metaphor about the advantage that is inherent to the strength of social relationships, and the access an actor has to the resources available in a network [4]. This concept is an aspect or function of a social structure, or it refers to resources embedded in a social structure [6].

Although from a networking perspective social capital is still a notion that is far from being quantified, there seems to be a common link to social networking: associations between nodes (relations) make a difference from the global network perspective. In other words, there is a concrete relational notion associated to social capital, that we believe is essential to consider when developing novel networking structures and architectures. Moreover, different dimensions of social capital can be delineated in function of several elements.

Furthermore, social capital value can be addressed both from an *individual* as well as from a *collective* perspective. On the individual level [4], individuals are entitled (based on reciprocity) to claim access to resources possessed by other members of the network (cluster, community). The amount of social capital to which an actor has access to depends on both the quantity of the network connections that he/she can enlist, and the sum of the amount of capital that each network member possesses [12]. Individual level social capital claims stress the ability of the actor to secure benefits via social structures, suggesting that social capital is to be regarded as social resources that are accessible through participation in various types of social networks [25]. However, the process of making individual resources available to others through social relationships does not assume that social capital is solely "owned" by individuals. As Coleman suggests, social capital, unlike other forms of capital, is inherent to the structure of relations between individuals. This difference between actual and potential resources – the ones that individuals use and the ones that are available on the network – assumes the previous existence of a relation as a condition for social capital to be used. That is why the term "individual social capital" is in fact misleading, as social capital is always relational, although it can be used to achieve individual ends.

The collective social capital definition is provided by Putnam who claims that social capital is created through citizens' active participation in organizations and groups, but is in itself a set of features of social organizations – like trust, norms, and structures – that can help, via coordinated actions, in creating a better society [23]. Trust is central in Putnam's notion of social capital. He emphasizes both *formal* (i.e. participation in organizations) and *informal* (i.e. socializing with friends) collective expressiveness, where social capital is a collective good, one that is non-exclusive in terms of consumption and that is publicly available, though a part of the knowledge remains unleashed and intrinsic to the structure of social relationships.

5.2 Social Capital Metrics

Within the context of social capital, the Internet can be contextualized as a complex structure composed of network clusters. Each of these clusters contains a set of nodes (*actors*) that are linked together by edges (*relations, associations*), whose cost can be derived both from virtual and from real-life interaction. From a networking perspective we highlight that interactions may occur between nodes that do not have a relation in real-life, e.g. strangers traveling on the same bus. The network evolves as the actors develop some kind of link (a single type of relation), either formally or informally. Metrics related to these associations can be e.g. friendship; trust; influence; recognition; reciprocity; knowledge. These are therefore metrics derived from social behavior, and knowledge gained/exchanged seems to be the common link for both formal or informal associations, where actors exhibit some form of "shared interest". Being capable of quantifying these metrics up to some extent is a key aspect to develop algorithms that can assist the Internet to evolve into a robust knowledge-generation architecture, and social capital seems to have a primordial role in such evolution, as it integrates principles that can be used to facilitate knowledge exchange. For instance, such principles can assist in providing sustainability required in the infrastructure to foster the interactions and beliefs that feed the commendable cycle of connectedness and trust/reciprocity, both integrating positive and negative outcome. A concrete example of negative outcome that can be embodied relates to alienation due to the heavy usage of Social Media [23]. It is also relevant to consider models that address the Internet as a means for fostering interaction [2, 17, 18], engagement, and social activism [13].

Fig. 3 provides a global perspective concerning the mechanisms of social capital creation and derived outcome, having as means both communication and trust. Trust stands for participation while communication stands for the interactions derived from Social Media usage. If we take a more network oriented approach, we would have - as a basic source of social capital - interactions at an individual level. If we take a more social approach, we would consider trust as the core element prompting communities and society in its entirety to act and develop ties. On the other side of the diagram we have consumption benefits as a direct outcome of individual interactions, and capital benefits as a more collective outcome.

Based on Fig. 3 we can verify that the sources of social capital integrate both an individual and collective relational approaches; the central mechanisms are structural and cognitive forms of relationships, and the outcome is either of an individual or of a collective nature. This perspective emphasizes trust and reciprocity as core elements and look at participation as an outcome of the process. If, on the contrary, we were to focus on resource availability, we would then have the media as an internal element of the system intrinsic to the relation between the individuals and the gratifica-

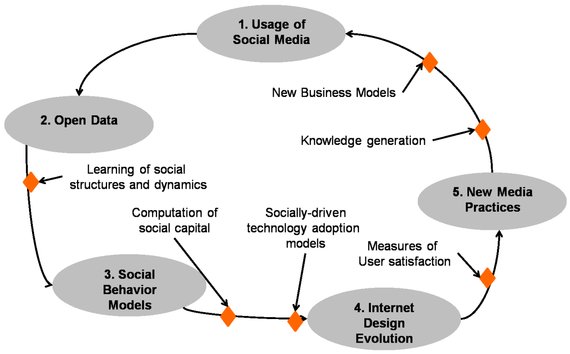

Figure 4: Socially-driven design cycle.

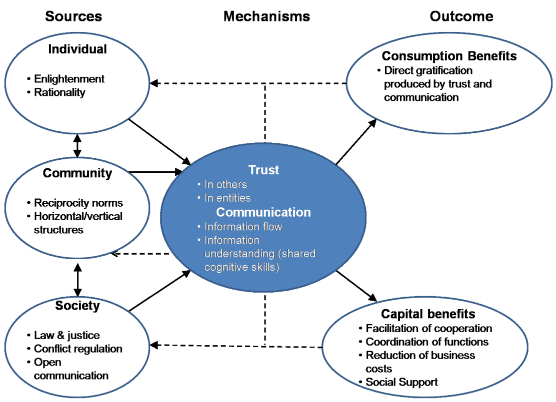

Figure 3: Sources and outcome of social capital.

tions derived from consumption. These two distinctive views assign to technology completely different roles as either enablers or blockers of social capital. Therefore, social capital theory presents a set of definitions and relationships that seem valuable to be integrated into technology adoption modeling of the Internet, to be able to drive the Internet towards (also) a socially-driven design and as consequence, towards a more robust platform for knowledge generation and exchange.

5.3 Why Do we Need Social Behavior?

The pervasive adoption of Social Media is a strong indicator of the need to revisit the Internet supply-chain to be able to truly take advantage of the prosumer model. Being capable of both integrating social metrics and technological adoption metrics into multi-objective utility functions is a requirement to further evolve the Internet supply-chain. Such a methodology requires as a first step to go beyond the pure technological perspective and to incorporate the social capital perspective. Today, it is widely accepted that the Internet end-to-end design principle [7] is hedged around with stronger caveats than before. Hence, we must be open to understand how we can establish design processes that allow evolution towards the future requirements without adding further entropy to the natural Internet evolution process.

Fig. 4 illustrates our proposal for the evolutionary and gradual development of a Future Internet. Social Media today are already the main tools assisting the development of large-scale open-data sets (1., 2.). These in turn are more and more the study basis for social structures dynamics. An Internet architecture aware of social behavior models (3.) will give rise to new media practices, as well as new business models and knowledge creation (4.). Devised social behavior models are useful for contextualizing relationships and structures in a larger socioeconomic perspective, aspect which is relevant for the computation of social capital as well as for identifying features that assist in facilitating and coordinating actions in structures (5.).

In order to allow the Internet design to be adjusted based on evolving social models, behavior of a node should express the logic of its computation without describing its control flow. Hence, the design of future Internet functionality should be based on an expressive language (e.g. declarative or functional programming) in order to accommodate a potentially more complex event structure and node operation.

5.4 Incorporating Social Capital into Internet Design

Within the context of social capital, it is our belief that the social properties that are the most relevant to be applied to Internet design are *reach, engagement,* and *influence*.

Reach corresponds to the degree of effective dissemination of certain content or potential spread that a single actor or node (a profile) has in the network. Networking measurement metrics that can be applied to incorporate this property may be, for instance, rate of nodes reached; proximity; propagation speed.

Engagement refers to the degree of participation and involvement of a specific actor or node. A profile in networking can be seen as e.g. a preferred location; an interest towards a node/cluster/location. Metrics that we can consider in Internet architectural design to define engagement can be, for instance, the growth of the direct neighbors (also known as *followers*) of nodes; time spent around a specific node (e.g. volume of inter-contact times). Reciprocity of contacts is also a metric that can assist in defining engagement.

Influence refers to the degree of attention and mobilization that a certain actor can generate in other actors. From a networking perspective, influence is by far the hardest property to quantify. A potential approach to such quantification is provided in FRINGE [20] for the context of community detection. Such proposal can be a starting point to attempt to quantify the notion of influence in pervasive networking. We highlight that measuring up to some extent influence is not to be mis-

Table 1: Centrality definitions, the social capital and the networking perspectives.

Property/Parameter	Social Capital Perspective	Networking Perspective
Centrality: 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.
Degree centrality: 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. **These are not necessarily better positioned.**
Betweeness centrality: 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.
Closeness centrality: 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. **It also has a higher probability of becoming a bottleneck**
Link Strength: 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..

taken by metrics that measure node popularity. The integration of influence is expected to assist in a better definition of interaction matrices, an aspect that today is key for several aspects of the operation of the Internet, such as new ways to route traffic, or a better definition of self-organizing environments.

In addition to incorporating new metrics rooted on social science, it is also necessary to revise a few aspects concerning network centrality. Today, several notions of centrality are the basis for new concepts being addressed in the Internet, e.g. information-centric routing; opportunistic routing; self-organization based on small-world evolution. However, there are a few differences between the application of centrality as it is being done today in the context of networking, and within the social capital modeling context. In Table 1 we provide the two perspectives for the most popular centrality definitions being applied in Internet architectural design.

As shown in the table the definition for *degree centrality* when applied to the context of social capital modeling differs from the definition being employed in networking: in networking, nodes with a higher degree centrality are not necessarily better positioned in a network.

Crucial differences arise also in the application of *betweeness centrality.* When applied to social capital modeling, nodes with a higher betweenness centrality are cluster heads known as *bridgers:* their power resides in assisting in the interaction between different clusters. However, within the context of networking nodes with a higher betweeness centrality supposedly assist in a better dissemination of information as they are more "central". The role of bridger is not addressed from a networking perspective and yet, this is a highly crucial role as it assists the dissemination of information across different communities.

We observe also some discrepancies in the notion of *closeness centrality.* While in social capital models nodes with a higher closeness centrality imply better dissemination of information, in networking such nodes will most likely end up being bottlenecks.

A final property that relates to the notion of *link strength* (e.g. trust association) incorporates within the context of social capital modeling the transitivity property: if A and B share a strong link, and B and C share also a strong link, then it is highly likely that A and C shall also share a strong link. This is currently not incorporated in pervasive networking, from an information dissemination perspective.

Summarizing, it is our belief that a starting point to address a socially-driven Internet design can simply start by addressing two simple aspects: i) integrate the notions of trust and influence in pervasive routing, by developing measurement metrics capable of sustaining such properties; ii) revise the notions of centrality that are being heavily applied today, ensuring that there is alignment between the definitions that are today applied in exclusivity within the context of social capital, and in pervasive networking.

6. CONCLUSIONS

This paper addresses the need to consider a real merging of social capital principles into technology adoption modeling as a way to assist future Internet architectures to naturally evolve beyond their role for service provisioning, thus enabling network prosumer models to be fully exploited as tools that can give rise to new business models and to both social and technological advances.

Our belief is that this is a process that can be applied to the natural evolution of the network core, by removing artificial barriers related to Internet supply-chain management, as well as by incorporating a multidisciplinary perspective to the dynamics of social structures, through the integration of social capital models and metrics. To assist in such integration, we have provided a few design guidelines concerning how the implementation of such changes could be applied to the current Internet architecture.

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