

# Hybrid Wireless Networks for Neighborhood Communities

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## ABSTRACT

In the wake of an increased interest in situated technologies, this paper probes the value of such propositions for community empowerment in residential neighborhoods. Based on the idea of hybridization, the paper proposes new conceptual perspectives for supporting neighborhood communities through ICTs—community networks in particular. Hybridization, in this case, refers to a two-fold design approach for community networks—shifting emphasis from the global to the local, and from the virtual to the physical. While community networks are typically based on services from and emphasize experience of the global internet, hybridization seeks to better anchor and reconnect community networks with local neighborhoods; and while the social activity on community networks commonly remains virtual, hybridization seeks to explore ways to give this activity a physical expression. Through making community networks better experienceable in the local physical spaces people inhabit, this research intends to foster new and emergent practices of how people living in a common neighborhood communicate, engage, and network with one another.

## Author Keywords

Hybridization; community networks; neighborhood communities; ownership; self-governance; empowerment; situated technologies; ubiquitous computing.

## ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

## INTRODUCTION

When neighborhood communities move online, they virtually disappear. Within the vast ‘global village’ that is the internet, local communities’ unique identities disappear through the imposition of standardized and de-localized systems and interfaces (e.g., Facebook or Nextdoor) (see, e.g., Foth, 2006). They are supplied with interfaces that are—by the very nature of the global internet—

*disconnected from the local spaces* that place-based communities inhabit. That is, online services for communities do not take any local specificity into account, are not rooted and not collocated in the physical space; they are not physically accessible and available to be directly experienced by community members. ‘Global’ networks and services that are disconnected from local spaces have shown to disempower communities and create complacency (Mainwaring et al., 2004). That is, the increasing trend towards community ICT infrastructures may in fact thwart the formation of a shared community identity and constrain community engagement by its members.

Hybrid spaces that bridge local and global, physical and virtual spheres increasingly pervade our everyday lives (de Souza e Silva, 2006). Hybrid spaces come about because our interactions with one another are mediated by mobile and pervasive information and communication technologies—most mundanely through mobile phones, social media, and wireless internet. However, as argued above, our interactions in virtual (online) spheres are still often disconnected from the immediate physical and social spaces we inhabit. To counter these phenomena and reconnect digital spheres with physical space, this paper suggests hybridization as a design approach for wireless neighborhood networks—i.e., the paper explores *the ways in which locally and physically experienceable by community members.*

Towards this goal, the present paper synthesizes three rich but as of yet separate threads of prior work: The underlying network infrastructures and topologies increasingly employed for bottom-up neighborhood networks; research on the socio-technical aspects of community networks; and the increasing trend of research on situated technologies. Based on these, the paper explores new opportunities presented by impulses to physicalize or materialize digital activity in the physical space applied in order to empower local communities in residential neighborhoods.

## PEER-TO-PEER AND MESH NETWORKING

A technical basis presents the wireless peer-to-peer or mesh networking research that studies novel communication infrastructures for, e.g., residential areas that aim at being more resource efficient in bringing fast and reliable internet services to a large number of households (Antoniadis et al., 2008). Applied to local communities, such research concerns itself with autonomous networks that are self-governed, owned, and operated by local communities (e.g.,

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Gaved & Mulholland, 2005; Oliver et al., 2010; Schmidt & Townsend, 2003). Mobile and ad-hoc networking research, in addition, aims at creating temporary communication systems independent of the internet or mobile phone networks, e.g., during crisis situations, large-scale temporary events, or social movements (Basagni et al., 2013). Here, research increasingly focuses on ways to make such mobile networks easier to set up, configure, use, and maintain to enable self-governance by amateurs (e.g., Antoniadis & Apostol, 2014).

A number of city-, region-, or nation-wide wireless peer-to-peer networks governed by community organizations are in actual operation today in countries across Europe such as Freifunk in Germany, guifi.net in Spain, Ninux in Italy, or CZFree.Net in the Czech Republic. It is particularly fruitful to engage with the communities around these existing networks to explore possibilities introducing hybrid elements that reach back into the geographical areas they cover.

### COMMUNITY NETWORKS & SITUATED TECHNOLOGY

Community networks research addresses the development, application, and evaluation of networks and services *for* local communities (e.g., Foth, 2006; Carroll, 2012). Many efforts to design community networks build services *on top of* the internet and the World Wide Web, such as online discussion forums, local news and events, blogs, email accounts, etc. It has been shown, however, that a reliance on ‘global’ infrastructures that impose values of outside actors onto the community may disempower and alienate communities, creating stasis and complacency among infrastructure users (Mainwaring et al., 2004; Carroll et al., 2015).

Scholars in related areas have therefore begun to focus on community infrastructures that take the local specificity of place-based communities into account. Under the rubric of situated technologies (Kahn et al., 2007-2012), research seeks to spatially align engagement opportunities with people’s whereabouts in the city (Korn, 2013). Such spatially situated community engagement seeks to make relevant and meaningful to people the issues and topics of discussion that are in their close proximity as they move about their day (Korn, 2013). Spatially situated technologies for community engagement range from being *stationary* (such as public displays installed at places of interest; e.g., Hosio et al., 2012; Schroeter et al., 2012; Taylor et al., 2012; Wagner et al., 2009), to *mobile* (typically location-based and often with rich media capturing capabilities; e.g., Bohøj et al., 2011; Carroll et al., 2015; Korn & Back, 2012), to *ubiquitous* (more deeply embedded into the fabric of the city in the form of sensors, smaller pervasive displays, ubiquitous input/output modalities, etc.; e.g., Kuznetzov & Paulos, 2010; Vlachokyriakos et al., 2014). Such efforts provide *locally* more relevant offerings to citizens and *physically* situate digital engagement opportunities within the environment itself.

### MATERIALIZING VIRTUAL COMMUNITY ACTIVITY

Situated technologies already seek to make digital engagement opportunities more present in people’s lives and their immediate living environment by co-aligning them tempo-spatially. Building on this work, this paper argues for new pathways exploring the *social dimension of materialization*—i.e., the ways in which networks and the social activity they support can be made locally and physically experienceable by community members.

Design research increasingly engages with the materialization of immaterial phenomena—be that through digital fabrication and maker culture (e.g., Ludwig et al., 2014; Tanenbaum et al. 2013), or visualizing otherwise invisible phenomena in our environment such as radio waves (e.g., Arnall, 2014; Arnall et al., 2013).

Similar approaches of materializing digital phenomena are slowly applied to issues of local communities as well. For example, Kuznetzov & Paulos (2010) designed small digital sensors that people can attach to objects of interest sensing and collecting data about, e.g., exhaust, smog, pathogens, chemicals, noise, or dust. Korn & Bødker (2012) explored how location-specific QR codes placed at sites of interest reconnect those sites with the digital discussions about them. Similarly, Vlachokyriakos et al. (2014) augmented physical posters with low-cost interactive input capabilities that, placed on lampposts, allowed the neighborhood community to vote on issues of local interest. All these examples augment community engagement with digital technology *and*, at the same time, bridge this back into the physical space the community inhabits—i.e., they create hybrid space of physical/virtual community engagement.

How, then, can this thread of prior work be applied to wireless neighborhood networks that are sought to facilitate local community engagement?

### A TWO-FOLD DESIGN APPROACH

Building on impulses from prior work, this paper suggests two directions with regard to hybridization to overcome the disconnection between local communities and digital spheres and develop the socio-technical conditions that enable neighborhood communities to thrive. Each dimension posts a particular set of questions to designers of community ICTs.

#### Global-to-local hybridization

How can global communication infrastructures be localized? How can community ICTs be locally situated within and independently operated by the local community? How can they better facilitate a sense of ‘here’ and ‘us’?

Along global-to-local hybridization a number of issues may become central. Local specificity and a sense of ownership over community ICTs have been identified as crucial for the successful uptake and sustainability of ICT initiatives (Foth, 2006; Simpson 2005). This entails questions of self-governance by community members and hence ease of setting up, configuration, use, and maintenance of ICT

infrastructures by amateurs (e.g., Antoniadis & Apostol, 2014). Local specificity may also be facilitated by concepts of hyperlocality that draw attention to the immediate use context of participatory community IT (Bødker et al., 2014; Carroll et al., 2015), and by mechanisms that limit participation to the immediate environment where site-specific participatory interfaces are deployed, e.g., through proximity-based access (Bødker et al., 2014; Klokmoose et al., 2014).

### Virtual-to-physical hybridization

How can the virtual network activity be physicalized, or materialized? How can community members see and experience the social activity on the network in the physical space of the neighborhood? How can the virtual activity be manifest in the community's environment?

Along virtual-to-physical hybridization issues of im/materiality, as discussed above, become central. A few examples and mechanisms have been suggested along these lines (e.g., public community displays, location-specific QR codes, digitally augmented posters, etc.). What these may mean for neighborhood networks remains open to empirical and design inquiry. Interestingly, however, another workshop at the Critical Alternatives 2015 conference similarly inquires into modes of participation, here, through Internet of Things (IoT) to design interventions intended to server community interests.<sup>1</sup>

### CONCLUSION

In sum, this paper has argued for the benefits of better facilitating hybrid interactions in neighborhood communities. It has explored socio-technical concepts that (1) strengthen community ICTs' locally rooted and bottom-up character and improve their capabilities to be self-governed by community members, and that (2) improve the ways in which the virtual activity on those networked ICTs can be seen and experienced by community members in the physical space of the neighborhood.

Prospectively, concepts of and approaches to hybridization of wireless community networks are planned to be carried out in a participatory design project that engages with stakeholders in a concrete field setting. On such an empirical footing, this research will eventually foster new and emergent practices of how people living in a common neighborhood communicate, engage, and network with one another.

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<sup>1</sup> See <http://participationiot.tumblr.com/>

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