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DIGITAL SERVICES FOR AN INTERNET OF PLACES: URBAN DIGITAL NODES FOR A SMART REGION BETWEEN MILAN AND TURIN

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Abstract

This paper presents the outcomes of a three-year research project developed by the Politecnico di Milano, Dipartimento di Architettura e Studi Urbani (DAStU), in collaboration with Telecom Italia. Looking at territorial smartness from a spatial perspective, that leaves aside the purely technological aspects, the research aims at exploring different ICT potentialities: from new uses of space, to socio-economic and physical regeneration. With this goal, it reflects about the possible updating of concepts, which are widely used in urban planning:

- (i) from smart city to smart region, to deal with the regional scale of contemporary cities, thus including peripheral and marginal 'in-between' spaces;
- (ii) from urban nodes to urban digital nodes, to design multi-scalar smart spaces able to integrate traditional and digital services;
- (iii) from Internet of Things to Internet of Places, to make spaces able to interact through (at the same time) real and virtual experiences of users.

These theoretical references are explored within the scenario of the metropolitan region between Milan and Turin. According to these issues, this paper presents the research process to the UDN localization along the infrastructural bundle between Milan and Turin: from the

identification of urban/infrastructural nodes, to the selection of potential Urban Digital Nodes. Furthermore, it highlights the UDN contribution to a smart region development through the spatial implementation of an Internet of Places.

Urban Nodes in the Metropolitan Region between Milan and Turin

In the traditional geographical and urban planning culture, nodes generally correspond to places within physical space connected to both infrastructural and social networks, and hierarchically provided with different sizes, shapes and functionalities. They are characterized by the polarization of a high density of flows and functions, as well as by the facilitation of exchanges and connections. They thus impact on the organization of the local space and on the relations (material and immaterial) between places and different subjects (Moretti, 1999). Within the research 'Digital Services and Territorial Innovation. The case of the Metropolitan Region between Milan and Turin' (developed by the Politecnico di Milano, Dipartimento di Architettura e Studi Urbani, in collaboration with Telecom Italia), these nodes are considered as urban, not only according to their physical density or their location within the urban fabric, but also to their intensity of existing and potential relations.

This concept is intrinsically multi-scalar, because it is declined in relation to territorial components which may assume different sizes according to the scales used for their observation: micro/local, meso/urban, macro/wide (in its turn, articulated into regional, macro-regional, global). From the services in neighborhoods, the main functions in cities and metropolitan areas, the urban poles in regional and macro-regional systems, to the territorial platforms formed by metropolitan regions in the global space. The reference scale affects the size of urban nodes, that ranges from a point dimension to an area one. At the local scale, they can be identified with a single building or an open space; at the urban scale, they can extend to a system of buildings or open spaces; at the wider scale, they can expand to the entire urban fabric (Morandi et al., 2016).

In order to overcome the 'not-places' dimension that frequently affect them (Augé, 1992), urban nodes can be considered as 'places' when meaningful practices take place (Malpas, 2012; Norberg-Schulz, 1988). For instance, through infrastructural connections, settled activities, and environmental relations, as well through their integration with shared strategic visions and design solutions at urban and architectural scale. To these conditions, urban nodes can be considered territorial landmarks that, at different scales, integrate different categories of user flows (both, insiders and outsiders), and condense several activities and functions, often representing interfaces between local and global systems. Furthermore, they can be opportunities for the retraining, regeneration and reconstruction of both physical spaces and local socio-economic relations (Morandi et al., 2016).

On the background of these references, the research applies its reflections to the spatial configuration of the Northern Italy city-region's sector between Milan and Turin. This is a wide area, where the recent completion of the infrastructural bundle (such as, the motorway and the new high-speed railway) is producing significant physical and socio-economic changes between the main nodes (related to long and fast networks) and the intermediate ones (related to short and slow networks). That is, in-between places, which risk being affected by segregation

processes or, otherwise, being excluded from different programmes (environmental, socio-economic, productive, and touristic) supported by the new infrastructures (Morandi et al., 2016). The Northern Italy city-region is a polycentric metropolitan system whose boundaries are difficult to distinguish. It is a wide urbanized area (consisting of a network of cities, characterized by different size and importance), that is connected by an articulated system of infrastructures, and that directly relate to other major world city-regions because of its economic value. Within this context, the research spatial reference to the metropolitan region along the Milan-Turin axis relate to its singular richness of existing (material and immaterial) networks and nodes:

- (i) a system of larger and smaller urban centers closely integrated with the framework of historic communication routes and the agricultural landscape;
- (ii) large centralities consisting of new suburban commercial and service platforms;
- (iii) equipped sites for logistics;
- (iv) ecological networks and natural connections (such as, rivers and mountains);
- (v) infrastructural corridors (long and fast networks, such as the 5th and the 24th European Corridors, partially built, as well as short and slow networks consisting of canals, local roads and regional railways with historic origins, but in recent decades often penalized by current development strategies);
- (vi) new spatial configurations related to knowledge networks and information streams;
- (vii) cultural and functional collaborations (such as, the Alta Scuola Politecnica (ASP) between the Politecnico di Milano and the Politecnico di Torino; the joint venture between the Chambers of Commerce of Turin and Milan; and the MiTo Settembre Musica Festival);
- (viii) events celebrated in the two main urban poles (such as, the 2006 Winter Olympics and the 150th anniversary of Italian Unification in 2011 in Turin, and Expo 2015 in Milan).

Therefore, this wide area does not correspond to the organization of local authorities, but it is recognizable in terms of the existing spatial and socio-economic dynamics (De Magistris and Rolando, 2011).

According to these different categories of networks (material and immaterial), in the previous two phases the research focused on functional networks made by university campuses and exhibition centers. In this last phase, it instead focuses also on landscape and transport networks, and not only on functional ones, by taking into account:

- (i) for what is concerning transport networks, the system of motorways, regional roads, high-speed railways, historical railways, and regional cycle-paths;
- (ii) for what is concerning landscape networks, the system of rivers and canals;
- (iii) for what is concerning functional networks, the system of service, commercial, logistics, and productive platforms.

Referring to these systems, the final research phase at first tries to define criteria for identifying real urban nodes within the metropolitan region between Milan and Turin with relation to:

- (i) interchanging transport and/or landscape networks;
- (ii) close but not interchanging transport and/or landscape networks;
- (iii) local functional networks;
- (iv) supra-local functional networks.

According to these criteria, potential urban nodes could be recognized in:

- (i) the railway stations, from the one of Milan Porta Garibaldi (to the East) to the one of Turin Porta Susa (to the West);
- (ii) the motorway toll-houses and rest-stops, between the urban road gates of Milan Certosa (to the East) to Turin Giulio Cesare (to the West);
- (iii) the existing service, commercial, logistics and productive platforms, such as for instance the Vicolungo Outlet Village, or the Novara Interport;
- (iv) broadening the spatial observation from the Milan-Turin infrastructural corridor, the Milan Malpensa and the Turin Caselle international airports, which connect the metropolitan region with other nodes of global urban networks, and which integrate local systems of interchanging roads, motorways, and railways.

From Smart City to Smart Region. From Urban Nodes to Urban Digital Nodes (UDNs)

Whilst the development of the first digital city schemes led to the growth of a virtual, completely spaceless, city dimension, the current challenge is the real transfer of this digital system of information and services to physical places. This transfer may modify material space uses, organization and planning, and it may increase the level of economic, environmental, and social sustainability of cities (Fusero 2008). Accordingly, the research shares the criticisms brought against the concept of urban smartness (such as the risks of an excessively technocratic and market-oriented approach to city management and planning, and of an increasing social segregation in city use). At the same time, it acknowledges the potentials of the smart city concept (such as spatial regeneration, economic and social innovation, as well as environmental sustainability). Within this context, it aims at exploring the spatial effects of digital services at different scales (local, urban, regional); and at understanding how mobile services can encourage new spatial uses, new collective behavior, and better quality of places. This is, not only in main inner cities, but also in small villages, as well in suburban and in-between areas (Morandi et al., 2016).

Taking the excessive fragmentation of technologies and the continuous overlaps among digital infrastructures (as well as their indifference to the specificities of places) into account, the research aims at encouraging the coordination and integration of several service platforms, and at promoting site-specific services. With regard to these goals, the two concepts of urban digital nodes and Internet of Places have been introduced. The metropolitan region scale of the research spatial scenario requires the enlargement of these reflections and these concepts from smart city to smart land by disrupting the localistic logic that is usually adopted by single municipalities and frequently risks penalizing both technological and socio-economic development (Bonomi and Masiero, 2014). That is, from a smart city to smart region, brought about by paying particular attention not only to the main urban centers, but especially to the suburban and intra-urban areas, as well to small villages in peripheral spatial contexts (Morandi et al., 2013). In particular, the potentialities of wider-scale smart programmes and projects relate to the involvement of these marginal areas (often penalized by high levels of digital divide) in socio-economic innovation processes and in spatial regeneration plans, also thanks to the ICT

development. Digital technologies may be considered opportunities for a spatial rebalancing (at local, urban, and regional scales) by making single places (which are network nodes) equipotential, independently of their effective spatial location. By the way, the conceptual transition from smart city to smart region implies not only the necessary reference to a new spatial scale, but also the transfer of methodology and contents to low-density (and sometimes low-digital) areas (Morandi et al., 2016).

For what is concerning the evolution from the urban nodes concepts to the urban digital nodes concept, UDNs are physical places, which are located in proximity of (material and immaterial) network junctions. They are urban because they are characterized, on the one hand, by compactness and density of architectural components and urban fabrics or of physical flows, and on the other, by high level of exchanges and relations activated by their functional mixing. At the same time, they are digital because they integrate physical and virtual dimensions by providing traditional and ICT services, which are site-specific and location-based, in order to encourage social inclusion, economic innovation, and spatial regeneration. Differently from traditional urban nodes, UDNs are made of both material and digital components, and they are featured by high spatial quality. However, as traditional urban nodes, UDNs are located in accessible places, characterized by high densities of flows (of people, goods, and information), which they provide different services to, and they are multi-scalar. From territorial platforms formed by large metropolitan regions in the global space – such as for instance the entire San Francisco Bay Area, that is the world capital of digital and sharing economy and society – to innovative services in city neighborhoods – such as for instance the IIT McCormick Tribune Campus in Chicago, where the tube station has been integrated by university facilities provided with digital devices and applications.

At the urban and neighborhood scale, UDNs could be located in:

- (i) new buildings in public spaces or in open spaces to be improved;
- (ii) new buildings in brownfield sites to be transformed;
- (iii) existing spaces in abandoned or partially used buildings to be recovered.

Designed as smart spaces based on the interaction between humans and sensors, UDNs could provide different kinds of users with ICT services through a coordinated system of applications. These APPs could offer augmented reality experiences through NFC technology, thus encouraging innovative – dynamic and interactive – uses of physical spaces (situated cognition).

Through ICTs, UDNs offer site-specific and location-based services for personal devices, which can directly link virtual worlds with the real world, and are able to enhance people-place-people relationships. By integrating physical and digital dimensions, UDN approach could contribute to the theoretical debate on the potential transfer of the enhancement of city performances through the virtual dimension, produced by new technologies, to the physical one, beginning with the innovation of space uses and organization driven by ICTs. At the same time, they could provide the opportunity to experiment with the use of the Internet to promote local interactions among individuals, and to stimulate the development or reinforcement of communities (Morandi et al., 2016). In this perspective, the research deals with two of the main risks and criticalities of the smart city approach, related to the quality and sociality of spaces. On the one hand, the lack of

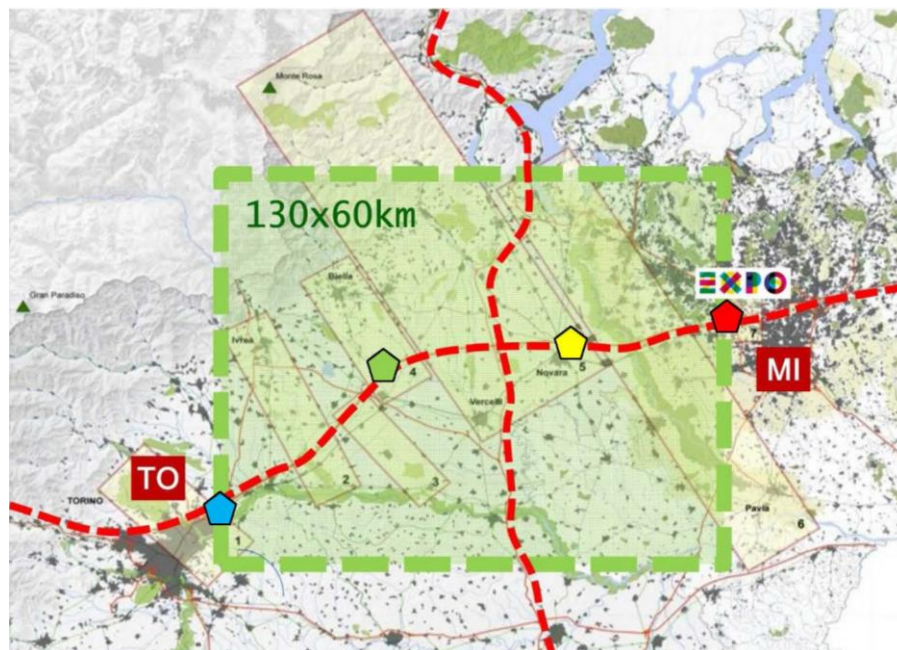
urban form responses to new social relationships offered by ICTs. On the other, the reduction of people to service addressees, without the mediation of physical places or persons, thereby compromising traditional systems of social relationships within the space (Paris, 2014)

The UDN Pilot Projects within the Metropolitan Region between Milan and Turin: Rho Fiera Expo 2015, Novara, Villarboit, and Settimo Torinese

Within the research spatial scenario of the metropolitan region between Milan and Turin, the urban digital nodes concept refers to an urban space extended to a wide scale by the current phenomenon of city regionalism (Scott, 2001; Hall and Pain, 2006; Herrschel, 2010). That is, to an urbanity dimension related not only to physical features, but also to use and relation intensities. A conceptual milestone of UDNs is their replicability as regards goals, targets and basic components, as well as their adaptability to different physical and socio-economic contexts. After testing methodologies and contents within the Milan urban context in its previous phases, the last research part aims at applying and verifying these approaches, procedures and matters at the wider scale of the potential smart region. Along the infrastructural bundle between Milan and Turin, a system of potential UDNs is selected in order to check the research methodologies and contents for what is concerning localization and service endowment of Urban Digital Nodes:

- (i) the Rho Fiera Expo 2015 railway station (in red in Figure 1);
- (ii) the Novara railway station (in yellow in Figure 1);
- (iii) the Villarboit motorway rest-stop (in green in Figure 1);
- (iv) the Settimo Torinese motorway toll house (in blue in Figure 1).

Figure 1 The location of potential UDNs within the metropolitan region between Milan and Turin



Source: authors' elaboration

The suburban Rho Fiera Expo 2015 railway station intercepts Italian high-speed trains, international trains to Europe, regional and suburban trains, Milan underground trains, two motorways to France and Switzerland, a system of provincial roads connecting Milan with its surrounding cities (Figure 2). This is an important interchange node, and it is one of the main city-gates at a European level, located along the North-Western axis (Bolocan Goldstein et al., 2011). Consequently, this is the axis where the Malpensa international airport is located, as well as several important urban functions and large urban change projects. Among them, in the station surroundings, the new Milan Trade Fair exhibition center (opened in 2005), the Expo 2015 site, and the future post-event research and innovation district are situated, mainly attracting the following users: not only inhabitants, but also commuters, students, local workers, and tourists (for business or for leisure).

The urban Novara railway station, that is located in one of the medium-seized cities of the Northern Italy city region, intercepts a system of historical railways to Milan, Turin, Biella, Mortara and, in the future, the Malpensa international airport (Figure 3). At the same time, the location of the entire city is strategic, as it is situated at the crossing point between two important European corridors: the 5 (Lisbon – Kiev, partially operated) and the 24 (Genoa – Rotterdam, under construction). As the urban development is strictly related to this existing and coming infrastructural system, the historical center and the main university campuses of the Università del Piemonte Orientale are situated in the station surroundings. An interchange node for both people flows from nearby small cities and to nearby large cities, mainly attracting the following users: not only inhabitants, but also commuters and students.

Figure 2 The spatial and infrastructural context of the potential UDN connected to the Rho Fiera Expo 2015 railway station



Source: authors' elaboration

Figure 3 The spatial and infrastructural context of the potential UDN connected to the Novara railway station



Source: authors' elaboration

The inter-urban Villarboit rest-stop, that is now referred only to the Milan-Turin motorway, also intercepts a system of (local and rural) roads and paths (Figure 4). It is immersed in the fascinating landscape of a rich agricultural area, even crossed by the Canale Cavour and its related landscape networks, mainly attracting the following users: commuters, local workers and tourists (mostly for leisure).

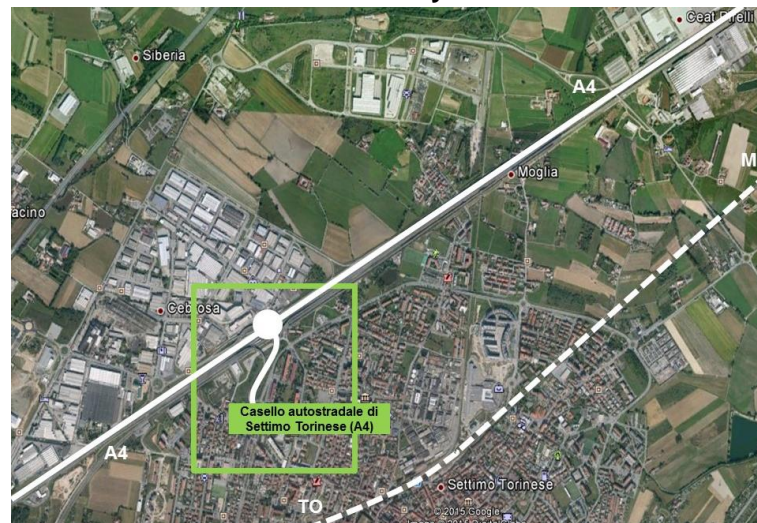
Finally, the suburban Settimo Torinese toll house along the Milan-Turin motorway (Figure 5), endowed with a motorway bus stop, is located in-between a residential area and an industrial district, mainly attracting the following users: not only inhabitants, but also local workers and tourists (mostly for business).

Figure 4 The spatial and infrastructural context of the potential UDN connected to the Villarboit motorway rest-stop



Source: authors' elaboration

Figure 5 The spatial and infrastructural context of the potential UDN connected to the Settimo Torinese motorway toll house



Source: authors' elaboration

Within the system of urban nodes identified by the research in the metropolitan region between Milan and Turin, these four (above mentioned) are selected for the development of UDN pilot projects according to different reasons:

- (i) their interaction with infrastructural corridors;
- (ii) their articulation among different kinds of infrastructures (such as roads and railways);
- (iii) their distribution among different spatial and socio-economic contexts (that is, urban, suburban and intra-urban);
- (iv) their equidistance.

On the basis of this selection, the research is now completing its investigation beginning with the best localization of these potential UDNs, as well with the definition of their functional components by declining site-specific and location-based services, both traditional and digital. This research activity integrates top-down and bottom-up approaches:

- (i) on the one hand, by developing traditional few to many design processes; that is, looking from above, using different tools (by experts);
- (ii) on the other hand, by giving an important role to final users on a many to many logic (for instance, by administering questionnaires); that is, walking through, doing direct experiences (by users).

The UDN Contribution to a Smart Region Development: the Internet of Places

According to the multi-scalarity of UDNs, a smart region could be considered both in relation to its single components (through local-scale services, such as public spaces and facilities directly integrated and empowered by ICTs) and in its overall extension (through large-scale services, such as physical and digital infrastructures at the overall regional level). The research proposes to provide existing spatial networks and nodes with digital services, as if they were hypertextual

references that favour immaterial enlargement of physical places. It highlights the analogy between spatial networks and nodes (made by infrastructures, environment resources, or main urban functions), and digital networks and nodes (represented by the Internet). These integrated (spatial and digital) networks and nodes could be considered as milestones for the development of a regional smartness governance and agenda, by contributing to a rebalance between major urban centers and intermediate places (Morandi et al., 2016).

Waiting for an imminent definition (at the same time, top-down and bottom-up) of site-specific and location-based services provided by the UDNs (also thanks to the collection of users' questionnaires), the research can anticipate them through some theoretical references. The integration of mobile telephones with web-based services and applications generates ubiquitous social contacts, as well as ubiquitous access to cyberspace, which may be considered a new urban domain (Mitchell, 1995) and favours the development of augmented urban spaces (Aurigi and De Cindio, 2008). At the same time, ICTs can enable people who stay or move in space to interact with each other or with places where they are immersed. They can directly transmit information related to physical spaces, or socially share information received by a myriad of sensors located in physical spaces. This relationship between people and places within the urban environment has analogies with the growing Internet of Things concept and towards the Internet of Cities one (related to the development of increasingly connected self-sufficient urban poles consisting of systems of intelligent components) (Gullart, 2012). Therefore, this relationship may give rise to an Internet of Places concept. This notion refers to groups of users with common interests who may share real-time information about built or unbuilt places; that is, an instant social community created by people sharing interests in specific places (Morandi et al., 2016).

The post-industrial society, which has replaced the centrality of manufacturing activities with the development of a service economy, has been otherwise termed the 'information society' or 'communication society', that is, the 'knowledge-based society'. These concepts express a transition from industrial capitalism, based on the construction and distribution of material products, to cognitive capitalism, which is oriented to the development and dissemination of information and expertise. Knowledge results from information shared through polycentric and global networks provided by ICTs, which have disrupted the traditional organization of polarized and hierarchical Fordist society (Rullani, 2004). The evolution of the economic and social system, the spatial dynamics and technology development that have arisen in recent decades require enlargement of the concept of community services, which in contemporary cities is articulated into different forms. It integrates material services located in space (such as schools; cultural, social and sport facilities; public green areas) with immaterial services unrelated to physical places (such as, partially, welfare and health); that is, it merges fixed services with mobile ones (such as services provided through telecommunication systems using different kinds of personal devices). Mobile services, in particular, empower traditional relationships between services and users by favouring immediate accessibility to and sharing of information, as well as flexible use of smarter spaces. On the one hand, the boom in mobile services enables (anytime and anywhere) close and distant relations between things and places, or between experiences and knowledge. On the other hand, the analogy between physical and

virtual networks, or between nodes/places of material networks and nodes/sites of Internet networks, requires exploration about existence and meaning of relations between physical spaces (of urban, suburban and intra-urban areas) and virtual spaces of ICTs. This is another way to approach the suggested analogy between the Internet of Things (a concept frequently exploited by research and innovative productions) and the Internet of Places (a new concept that still needs to be explored) (Morandi et al., 2016).

The space-time extension of experiences and information provided by digital devices introduced in the past fifteen years enables recognition of close analogies between immaterial communications networks and material networks which innervate physical space (Ferraris, 2014). That is, it allows places to sediment and provide more detailed and stratified data and information, and to integrate the experimental field of the Internet of Things (on which innovation in industrial production is taking place) towards the new frontier of the Internet of Places. ICT services contribute to the development of social spaces by improving the spatial quality and the social value of places. Consequently, digital services can be considered innovative location-based services, where location is not only a position but also a stronger relationship between users, devices and surrounding spaces. At the same time, spaces which are shared (physically or virtually) by people through ICTs can be considered digital nodes: places which in a general sense can furnish services, both physical or digital, to people through the direct interaction between users and the digital infrastructures provided by the space itself, and which may therefore enhance their role. Conceiving the metropolitan region between Milan and Turin as a network of physical nodes potentially enriched by ICTs, and consequently as a network of digital nodes, these places can be considered by analogy Internet sites, which could be directly accessed by users with their mobile devices in order to obtain and share information.

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