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# The construction of the digital city

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Helen Couclelis

Department of Geography, University of California, Santa Barbara, CA 93106-4060, USA;  
e-mail: [cook@geog.ucsb.edu](mailto:cook@geog.ucsb.edu)

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**Abstract.** In this paper I discuss the digital city as a comprehensive, web-based representation, or reproduction, of several aspects or functions of a specific real city, open to nonexperts. Much more than a technical and practical issue, the digital city has dimensions that are social, cultural, political, ideological, and of course also theoretical. I explore these broader conceptual underpinnings of the digital city idea. More specifically: where do urban ideologies, urban structures and functions, and digital urban representations meet? How may the digital city relate to the real city? On the basis of what choices might the digital city be constructed? What might the digital city mean to people? To be answered, these highly involved and interrelated questions require a coherent conceptual framework. By considering an overview of digital-city realizations, issues, and critiques, I adumbrate a theory of the digital city, seen as lying at the intersection of three domains: a physical urban area, the communities of people associated with that area, and the possibilities and constraints (technological, but also socioeconomic and ideological) of the evolving information society. A rough sketch is all that can be offered at this point because proper theories of the digital city cannot be developed independently of comprehensive theories of the real 21st-century city. I close with a brief discussion of what these ideas might imply for digital-city designers.

“Consider a Mirror World that captures a fair-sized city.”

Gelernter (1991, page 198)

## 1 Introduction

What is the digital city? Does it dwell only in cyberspace or does it mesh with the actual bricks-and-mortar city? Is it the old familiar city, drab and dysfunctional, equipped with some digital bells and whistles, or is it a vision of a better world that the digital age is bringing within our reach? Can it be edited and deleted like an outdated digital file, or must we break through the asphalt of its streets to lay down its fiber-optic cables? Does it fear fire, earthquakes, and gangs, or is it at the mercy of teenage hackers? Is it a sunny, comforting place, or is it more like a dark nightmare? Who lives in the digital city? Is it the home of digital citizens, or only of citizens who can use digital computers? Who builds the digital city, and for what purpose? Where is the digital city on the map?

Metaphors make the imagination soar, and bringing together cities and the digital age has proved a very uplifting mixture. The informational city, the wired city, the invisible city, the telecity, the intelligent city, the virtual city, the nonplace urban realm, Teletopia, and Cyberville—these are only some of the neologisms gleaned from the literature by Graham and Marvin (1996, page 9). To that long list we can now add the digital city. It is no wonder that Batty (2001) sounds perplexed at the lack of consensus on a definition. Therefore to write about the digital city it is necessary for the author to first define the term. For the purposes of this paper I adopt the following working definition, more useful for what it leaves out than for what it includes: *the digital city is a comprehensive, web-based representation, or reproduction, of several aspects or functions of a specific real city, open to nonexperts.* The definition

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therefore does not cover urban computer games and representations of fictitious cities (for example, SimCity or Alphaville) as these do not represent any specific real city. The digital city is not a traditional GIS representation or urban model, since these are not directly open to nonexperts, nor can it be identified with the many useful telematics applications—for example, intelligent transportation systems—developed to assist urban management or to make some urban function run more smoothly (these are not representations or reproductions of urban aspects or functions). However, all these forms of urban digitality (the games, GISs, models, intelligent technologies, and so on) may be related to the digital city as defined here. These possible connections will be explicated later. For now let us agree on just a couple of things. First, digital cities are ‘place based’, to use a term much *en vogue* of late; and, second, they are meant to be accessible to the public in the broad sense rather than to any particular groups of experts, professionals, special interests, or urban managers. This will suffice for now: in the rest of the paper I will explore the many facets of the digital city viewed from this partial but still very rich perspective.

In the narrowest and most straightforward sense, the digital city thus is a very large software application. Clearly the technical challenges of digital-city design and development are manifold and very complex, as shown by the growing literature on the subject. Equally clearly, however, the digital city is much more than a technical and practical issue. It has dimensions that are cognitive, social, cultural, political, ideological, and no doubt also theoretical. Reaching beyond the technical aspects, this paper explores these broader conceptual underpinnings of the digital-city idea. More specifically: how do urban ideologies, urban structures and functions, and digital urban representations intersect? What might the digital city mean to people? How might the digital city relate to the real city? On the basis of what choices might the digital city be constructed? The purpose here is to pose, not to answer, these highly involved questions: perhaps to adumbrate a road map that will help guide cyber-spatial urban developers towards more socially successful digital-city designs.

In section 2 I provide the background to the argument. I begin with an overview of the history of the digital city: as a concept and the many meanings that have already been associated with it in its short life. Utopian and dystopian pronouncements by scholars and others make it clear that, however defined, the issues surrounding the digital city, far from being merely technical, are also strongly political and ideological. Further, the multifaceted nature of the relation between digital and real cities, between computer software, urban theory, and politics, appears to be a core problem area. Section 3 reviews the types of functions and interface designs found in a range of digital cities proposed to date, along with critiques by both insiders and outsiders. Clearly there are many challenges that digital-city developers face, from public indifference towards their efforts to scathing condemnations of the entire enterprise. The whole spectrum of issues, from the mundane to the philosophical, reveals itself again here. Section 4 proposes a sketch for a theory of the digital city, seen as lying at the intersection of three domains: a physical urban area, the communities of urban dwellers associated with that area, and the affordances (technological, but also socio-economic and ideological) of the still evolving ‘information society’. A rough sketch is all that can be offered at this point because a proper theory of the digital city presupposes a comprehensive theory of the 21st-century real city. I close with a brief discussion of what these ideas might imply for the designers of digital cities, and for those working with GISs in particular.

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## 2 Contrasting visions of the digital city

The idea of the digital city is a product of several of the broad factors that define our postindustrial age. Foremost is the technological convergence of computers, telecommunications, and mass media that gave rise to telematics, along with the GISs that greatly facilitate locally integrated implementation of these technologies. The wider context is provided by the socioeconomic and cultural developments described by the terms ‘information society’ and ‘network society’, and the continuing—if not worsening—problems of many major cities of the industrialized world. Also critical is the growing public ambivalence towards the forces of globalization. This has sometimes resulted in an increased appreciation of the local and a romantic yearning for the small-town sense of community of times past.

Capturing the world (or some part of it) inside a computer is a dream that dates back to the dawn of cyberspace. As many scholars have noted: the notion of cyberspace is replete with spatial and geographic metaphors; among these, conceptions of the virtual city have always been prominent. In *Mirror Worlds*, Gelernter (1991) presented a popular, book-length discussion that culminated in the description of the ‘Mirror City’, or the ‘City Mirror World’. Gelernter’s vision—unlike earlier, more fanciful accounts—was based on the author’s advanced computer science background and soon found its way in several other formulations. In practical terms the most significant of these has undoubtedly been the notion of ‘Digital Earth’ proposed by former US Vice President Gore. For a time this generated a flurry of activity, primarily among US government agencies, towards its eventual realization (see <http://www.digitalearth.gov>). As for the digital city, among the earliest official uses of the term was by the European Union (EU), which sponsored a series of five annual European Digital Cities conferences, first held in 1994. On 1 January 1996, the EU launched the four-year European Digital Cities project (EDC) under the auspices of the Telematics Applications Programme. The purpose of the project was to support European cities and regions in the deployment of new, economically and socially sustainable telematics applications, and to identify related future needs and priorities of local authorities. The project spawned a number of applied urban and regional initiatives relating to telematics services and applications—not all of them digital cities in the restricted sense discussed here (European Commission, 1997; Rupprecht Consult, 1998). The various experiences and lessons from the EDC project are summarized in Mino (2000). Outside the EDC project, interesting initiatives such as Digital City Amsterdam and Virtual Helsinki have been sponsored in Europe by local authorities and telecoms service providers, respectively. Both these examples meet the definition of digital cities, and will be briefly discussed below. Systematic overviews of these, and several other digital-city projects, are provided in Ishida (2000) and van den Besselaar et al (2000).

Digital cities have also been proliferating in the United States, but there their builders tend to be driven, overwhelmingly, by commercial interests. Major Internet service providers in particular have developed extensive networks of websites covering most major US cities. The site <http://www.digitalcity.com>, a division of America Online, Inc., boasts the nation’s largest locally focused on-line network delivering locally targeted news and information, especially on “Entertainment, Shopping, People & More”. These digital cities are best described as ‘electronic brochures’, in terms of both their content and the conventional hypertext organization of their material into thematic ‘pages’. A few attempts to emulate the European model of focusing on public services rather than commerce can be found under the Aurora Partnership (<http://www.aurorapartnership.org>), a miscellaneous conglomeration of federal government agencies, universities, GIS vendors and other industrial partners, local authorities,

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nongovernmental organisations (NGOs), and so on. Although Aurora's mission is to facilitate "the development and use of spatial decision support tools, services and systems for place-based decision making and management", its focus is not specifically urban. With very few exceptions (for example, the town of Verona, Dane County, WI) the efforts described at the Aurora site can only tenuously be described as digital cities by any definition. A number of striking examples of technologically sophisticated digital cities are from Japan and are presented, along with European and some American case studies, in the seminal volume edited by Ishida and Isbister (2000). A more recent collection of papers from China also reveals that country's growing interest in the digital-city idea (Bing, 2001).

Reaching beyond the very considerable technical and practical issues raised by the digital-city idea (for an overview, see Goodchild, 2001. This paper explores its ideological and theoretical underpinnings. As with so many other manifestations of the digital age, the digital city and its broader urban telematics context have inspired volumes of both utopian and dystopian speculations. On one side are the starry-eyed technological utopians who see in the telematics revolution the brightening dawn of urban salvation. On the other side are the wailing Cassandras, for whom the digital cities' bright computer displays reflect only the deepening gloom and doom of the real 21st-century cities. On one side are those who see order, reason, community, democracy, friendship, solidarity, sustainability, global understanding, a better life for all; on the other side are those who see only chaos, inefficiency, segregation, inequality, riots, poverty, destruction, despair. This polarized rhetoric has been around for some time and much of it was spun around the presumed blessings and curses of the Internet more generally, which more than any other digital technology symbolizes the power of the digital age. It is remarkable how often the metaphor of the ancient Greek agora, with its connotations of ideal small-town democracy, recurs in the most upbeat of these pronouncements, as if the very globality of the Internet were feeding a yearning for its opposite—a smaller, simpler, more localized world where every person can make a difference. Thus: "What sorts of meeting places, forums, and markets will emerge in the electronically mediated world? What will be the twenty-first century equivalents of the gathering at... the Greek agora, the Roman forum, the village green, the town square, Main Street, and the mall?" (Mitchell, 2000, page 85). And also: "I foresee a new Athenian Age of democracy, made possible by the global information highway... It will allow us to exchange ideas within a community and among nations" (former US Vice President Gore, 1994; cited in Robins, 1999, page 45).

Note that the imagery of the global information highway bringing people together at the electronic agora is far from recent. Standage (1998) presents a wealth of quotations from the age of the telegraph that elicit an uncanny sense of *déjà vu*. Here are just a couple of examples: "The highway girdling the earth is found in the telegraph wires" (Tribute to Samuel Morse, the Father of the Telegraph, 1871). And: "It is impossible that old prejudices and hostilities should longer exist, while such an instrument has been created for the exchange of thought between all nations of the earth" (Briggs and Maverick, circa 1858; cited in Standage, 1998, page 83). One hundred and forty years later, Dertouzos echoes that very same sentiment: "A common bond reached through electronic proximity may help stave off future flare-ups of ethnic hatred and national breakups" (Standage, 1998, page 207). Global peace and brotherhood achieved by enabling people to sort out their differences 'face to face' at the digital forum of ideas: if that much can be achieved at the global scale, how much more efficient the place-based agora of the digital city could be, how much more compelling.

Countering these visions of salvation through technology are the modern-day Luddites who contrast these rosy forecasts with the present realities of a world deeply divided into relatively few haves and the growing masses of have-nots. Thus Robins (1999, page 47) writes:

“It seems to me that there is a stunning discrepancy between this ideal of virtual community and democracy, and the life experiences of most people in the world now. For them—the great majority who do not belong to the elite class of symbolic analysts—global transformation has brought profound upheaval and disruption.”

Given the runaway world urbanization, fuelled primarily by the poor and destitute, much of the critique along these lines contrasts the promises of the technocrats with the actual suffering and violence characterizing the contemporary city. Furthermore:

“The experience of pain is integral to urban living... precisely because conflict and antagonism are constitutive of urban culture. The crisis of contemporary urbanity is a crisis of dealing with this reality (allied with the fantasy of disavowing it through technological means)” (Robins, 1999, page 52).

And:

“Each city contains within itself the dynamics of the new world disorder—its dramatic contrasts of rich and poor, its polarizations and segregations, and its encounters and confrontations... the information and communication systems are ensnared and entangled in this urban anarchy” (Robins, 1999, page 54).

To summarize: there are major tensions between utopian and dystopian social visions of information technologies. These tensions often take the form of a clash of powerful metaphors stemming from society’s fascination with, and deep ambivalence about, the ‘world in the wires’ that is already so much a part of everyday life. Metaphors are not just figures of speech but active ideological constructs that “have important roles in shaping the ways in which technologies are socially constructed, the uses to which they are put, and the effects and power relations surrounding their development” (Graham, 2000, page 10). Related to these clashes of information-technology metaphors are more specific tensions between the benign visions of digital cities on the one hand, and the dark visions of cities of the digital age on the other. Table 1 juxtaposes some of the contradictions inherent in the developing rhetoric.

**Table 1.** Digital cities versus cities of the digital age.

Digital cities	versus	cities of the digital age
Inclusive	versus	exclusive
Integrated	versus	segregated
Democratic	versus	elitist
Ordered	versus	chaotic
Efficient	versus	inefficient
Timesaving	versus	time wasting
Accessible	versus	inaccessible
Virtual	versus	actual

The moral to be drawn from these strongly polarized perspectives is that there is more to the digital-city phenomenon than meets the eye (or the monitor, the screen, the user interface). The problems surrounding digital cities are not just technical and practical. Two issues stand out. First is the theoretical question of how digital cities might relate to the evolving real cities of the 21st century. Second is the significance of the clashing ideological undercurrents in all this, and the question of what to make of both the gung-ho enthusiasm and the abject revulsion expressed on either side

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of the issue. The simple message is that we need a careful road map to the digital city: the guidance of appropriate theory, the clarity of an explicit ontology, a hermeneutics for the translations back and forth between metaphors and facts. The remainder of this paper will begin to explore what such a road map might look like, following a closer look at what has been achieved to date, and what problems the critics have identified in several implemented efforts.

### 3 Who is the digital city? ...

“Who is the digital city? Does a digital city need digital universities and schools? Does a digital city need an e-business community? Does a digital city have only virtual architecture or a mix of virtual and physical spaces? Is the digital city only a communication tool or is it a new kind of institution? ...” Serra (2000, page 50)

#### 3.1 A rough typology of digital-city functions

The list of functions that digital cities are designed to perform keeps growing, with more complex and sophisticated options becoming possible all the time as the technology evolves. There is no single best way to classify these. It may be useful to distinguish functions that contribute to an interactive, participatory, potentially community-building experience for citizens, from those that build up the digital city as an integrative framework for urban data. Clearly, many of these informational functions must be available before the interactive ones can be supported. Thus the basic and still most common digital-city function is *information provision* about a specific urban area: maps, news, events, services, entertainment and commerce, accommodation, and so on. Simple services such as booking tickets or hotel rooms are also often offered in this format as an alternative to the telephone. In 1997 these ‘electronic brochures’ made up 56% of European city-related websites according to Aurigi (2000). That percentage is quite likely to be much higher in the USA given the dominance of commercial interests in digital-city development. Indeed, *electronic commerce* is one of the fastest-growing applications of Internet technology. Although one of the strengths of e-commerce is that it gives consumers access to a global marketplace, there are advantages both for consumers and for retailers in local bricks-and-mortar stores also developing and maintaining a web presence (Couclelis, in press). Provision of *specialized on-line services*, such as civic services (for example, filing for permits, filling out and submitting complex forms) or employment services (on-line interviews, skills-improvement courses), is a step up from simple information provision or Internet shopping. Technically these services are simple to provide but they do require considerable effort to set up and maintain. By contrast the *provision of real-time information* (and in some cases, short-term forecasts) about transportation conditions, weather, emergencies, and so on, requires considerable technological investment. In this case the digital city must be linked to an ‘intelligent city’ equipped with an extensive telematics infrastructure on the ground and coupled with appropriate high-resolution process models. It is only a small conceptual step from there to the digital city that can generate on-demand projection of its own future development (or reproductions of its past history), though this function may not be very different from that currently provided by several existing urban simulation models.

The functions in the next group are more genuinely interactive and participatory in that individuals can affect the course of events within each function. *Social networking and communication*, though technologically very simple, is justifiably one of the most touted social potentials of the Internet. There is no end to the interest groups, special issues groups, neighborhood groups, local-politics groups, support groups, activist

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groups, etc, that can come and go in the real city, and all these can in principle be greatly supported and facilitated through appropriate digital-city organization. These would-be communities come together because of place as well as interest, in contrast to the placeless 'digital communities' that have existed for a long time. One of the best known European examples, Digital City Amsterdam (de digitale stad: <http://www.dds.nl/>), is primarily an urban social networking and communication engine, even though it was initially created for communication between the municipal council and citizens (Ishida, 2000). At the next level up, *participatory decision support* is a function requiring much more sophisticated organization and leadership, and potentially technical resources, than informal communication within groups. It is also the one that comes closest to the 'Athenian agora' ideal and is thus frequently mentioned in discussions of digital cities and digital democracy more broadly. Because of the prominence of spatial issues in urban decisionmaking, this is an area where planners and GIS experts have already made significant contributions (see Nyerges and Jankowski, 2001). Making these techniques web based in the context of a comprehensive digital-city structure is an obvious next step. Considerable additional technical sophistication is required to provide interactive *urban simulations* based on a model or several alternative models of urban change. A wide range of implemented urban process simulation models are available today (see US Environmental Protection Agency, 2000) but have not yet been integrated with other aspects of the digital city, for example with comprehensive or real-time, information provision or social-network support. Interactive virtual-reality models of the visual appearance of urban change (for example, in the case of planned large-scale redevelopment) would also be in that category. Next, *integrated urban simulation and public decision support* is another complex function that could become available in the foreseeable future if the digital-cities idea is taken seriously by governments and citizens alike (Brail and Klosterman, 2001). Finally, ongoing developments in *location-based services* (LBS) are likely to foster a wholly new range of advanced interactive digital-city functions within the next few years (Takahashi et al, 2000).

Different from, but not quite orthogonal to the functional digital-city typology is a typology of user interface designs and concepts. At the simplest level the contents are organized *thematically* in a hierarchical structure as in conventional hypertext web page design. This popular format is most appropriate for the electronic brochure function where the mapping from paper to electronic pages is straightforward. More ambitious is a design based on an abstract *city metaphor*, as in the case of Digital City Amsterdam. Here the digital city does not attempt to reflect the physical structure of the real city but to simulate some of the civic functions of its elements: its neighborhoods, plazas, public buildings, gathering places, shopping malls, and so on. This can lead to a very schematic visual organization of the elements (nested octagons in the case of Digital City Amsterdam) which, however, is intuitive enough to guide even unsophisticated first-time users. It would be interesting to compare the cognitive efficiency of the city-metaphor interface to that based on a straightforward thematic organization. The assumption is that the urban concepts and vocabulary used in these city metaphors help create a sense of place-based community that escapes designs based on simple textual links. *Clickable maps* linked to simple textual, or complex multimedia, annotations are an additional useful feature that can as easily be incorporated into that kind of format, as into many others. Clickable maps can, obviously, also stand alone as basic geographical interfaces to the digital city. Considerably more complex and computationally demanding are interfaces that try to look like the real city. Some cities have experimented with 3-D *iconic visualizations* and even with *immersive virtual reality* interfaces (Batty et al, 2001; Jepson et al, 2001;

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see also Virtual Los Angeles, <http://www.ust.ucla.edu/ustweb/projects.html>; Virtual Helsinki, <http://www.techweb.com/wire/news/1997/10/1024helsinki.html>). *Wearable computing* interfaces, possibly integrating voice, video, and data are just around the corner. Especially in conjunction with digital-city functions, which support location-based services, wearable-computing interfaces could lead to unimagined possibilities (Feiner, 2002). Indeed, the digital city may be seen as the ultimate location-based service, integrating all others (Couclelis, 2001). These are all very exciting achievements and prospects, but by pushing the envelope of current technology they run into other kinds of limitations. In fact, as critics have pointed out, there are multiple problems and challenges for digital cities of all kinds. These will be reviewed next.

### 3.2 Some problems and challenges

The problems and challenges of developing digital cities range from the mundane to the profound. Major technical problems of data modeling and accuracy arise in any effort to merge widely disparate data sources into a single integrated product. Similarly, the privacy issues raised by comprehensive, high-resolution geographical databases can be severe (Goodchild, 2001). Beyond these general problems there are many others more specific to the digital-city idea. Shiffer (1999), one of the pioneers of community-oriented, place-based software development, mentions a long list of such issues. Keeping the digital-city site up to date after the initial development effort is a tedious, time-consuming, and costly task that is often underestimated at the outset. Also, people will often divert the site from its original purpose, using it, for example, to sell items and circulate jokes rather than for community support and networking. Another dilemma is how to balance an attractive design with ease of use: generally, the more sophisticated the graphics, the harder it will be for users lacking the latest hardware to take advantage of the possibilities the site offers. Further, because a digital city is intended to promote networking and cooperation among citizens, it needs to gain a critical mass of users to be sustainable. This may be hard to achieve considering how much competition there is for people's time and attention—from the ever-expanding glut of Internet content. Related to the critical-mass issue is the risk that a digital city may be taken over by a few narrowly focused interest groups having some specific axe to grind. This can alienate general users and again undermine the usefulness of the site as a community resource.

Aurigi's (2000) critique goes beyond the practical problems of building and maintaining a successful digital city, arguing that the relatively narrow perspectives from which most digital cities have been developed, to date, do not bode well for their success as broadly based, widely used community resources. Aurigi notes that digital cities are usually the result of a 'technology push' and are shaped according to paradigms familiar to computer scientists and bureaucrats. As a result, they are rarely integrated with successful traditional strategies and methods of community development and decisionmaking. More generally, attracting an appropriate amount and quality of citizen participation is widely considered both the key measure of success for a digital-city site and a major challenge for its designers and administrators. Some critics doubt the digital city's ability to sustain, let alone create, a healthy community. "The virtual community demands a real one prior to it in order to function successfully" writes Stallabras (cited in Aurigi, 2000, page 43). Hanson (1998) in addition fears the potential for loss of 'social capital' when people who would normally be networking in person turn instead to the convenient but lifeless medium of computers. She also warns of the dangers of fostering 'one-dimensional Internet identities' as people will tend to network with those who are most like themselves, escaping the socially necessary tensions of being immersed in the human diversity of the real urban environment. Others speak of the growing gap in social opportunity between a technologically savvy



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elite and the rest of humanity as basic services such as banking, shopping, and traditional transportation and telecommunications are increasingly withdrawn from the real city and replaced by digital-age alternatives (Graham, 2000). Many of these sites are privately owned and controlled and may be seen as the cyberspace counterparts of gated communities and upscale shopping malls, reproducing urban segregation in virtual space by effectively excluding all undesirables. Ironically, the more successful and efficient a digital city becomes, the higher the risk that basic practical and social aspects of urban life may migrate from space to cyberspace, where they will surely be beyond the reach of many. To what extent this loss may be balanced by a gain in access by the handicapped and homebound, is likely to remain a hotly debated issue.

It is no wonder that the critique from social theory, which often sees the pervasive intrusion of computers into social life as a dark and ominous development, is pungent. These quotes are telling: “The virtual city is a simulacrum into which real life is migrating. The temples of commodity capitalism are not only realized in glass and steel, they are forming everywhere and nowhere in the virtually realized arcades of cyberspace...” And: “...some critics wonder if it isn’t the moral equivalent of the neutron bomb: the city emptied of all lived human experience” (cited in Aurigi, 2000, page 43). Clearly there are profound ideological divisions in how different people may view the digital-city phenomenon, based on radically divergent views of both the role of computer technologies in society and of the 21st-century city itself.

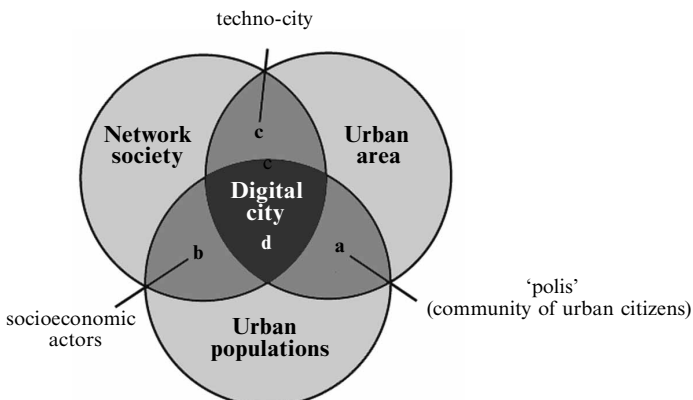
#### 4 Towards a theory of the digital city

Mirror-world types of metaphors beg the question of what the digital city may mirror. Is it the looks, the knowledge, the functions, the feel, the life, or the spirit of a real city? Should it mirror a sense of place, a sense of belonging, a sense of exploration and discovery, or just a sense of being able to get some practical things more efficiently done? Moreover, mirror-world metaphors can mislead by focusing too much on the reflection itself and not nearly enough on the potentially transforming relationships between the image and its subject. A cautionary note is struck by the failure of some attempts that took the digital-place metaphor too literally. According to Kenney and Curry (2001), for example, efforts to recreate the suburban shopping mall in cyberspace failed because the reasons for clustering a number of unrelated stores at one physical location (stemming from considerations of travel costs, parking, convenience, personal safety, and the enhancement of the social and recreational quality of the shopping experience) simply did not apply on the Internet, where shoppers have access to a potentially global marketplace devoid of physical constraints (and physical opportunities) of the above kind. The problem with the e-mall concept is that it was meant to offer a digital substitute for the experience of shopping at the actual mall (and a poor substitute at that), without taking advantage of the strengths of information technology to enhance the nature of that experience or to transform it in some creative way.

Studies of technology adoption recognize that successful innovations work at three different levels: first, they substitute for current ways of carrying out activities; second, they enhance, reinforce, and amplify these activities; and, third, they eventually contribute to the transformation of the original activities including the physical settings where these occur (Mokhtarian and Meenakshisundaram, 1999). Therefore, as a technological innovation, the digital city may play several roles. It may allow the *substitution* of certain new ways of doing some things for more traditional, presumably less efficient, ways. Downloading forms and applying for permits online may save a couple of trips in addition to saving time and hassle to the public, and is likely to lead to more timely and accurate processing of the applications themselves. Or it may reinforce and *amplify* functions already present (or latent) in the real city, as when the digital city succeeds in fostering

the development of active citizen networks. Alternatively, the digital city may lead to the *transformation* of important urban activities, and thus eventually contribute to the reconfiguration of the physical city itself. The theoretical framework of *coevolution*, outlined in Graham (2000), promises to address these complex processes of mutual adaptation and transformation linking new information technologies with space, place, and change in the real world. A proper theory of the digital city should thus go beyond the issues of city building within cyberspace, challenging though these may be, to encompass theories of the evolving actual city. The following is a sketch offered in the hope of stimulating debate on what such a theory of the digital city might look like.

The digital city may be understood as lying at the intersection of three domains: a physical urban area, the people who live and work in that urban area, and the nexus of technological, socioeconomic and cultural possibilities, and phenomena studied under the rubric of the information society (figure 1). The partial intersections are also meaningful: the notions of an urban area and an associated urban population overlap to give the 'polis', the community of urban citizens, including the various subcommunities of neighborhoods and place-oriented local interest groups that make up the city (a in figure 1). Urban populations and network society meet in the numerous stable or fluid groupings of occupation, lifestyle, or culture that play distinct though interrelated roles within the context of the broader socioeconomic changes underway in the early 21st century city (socioeconomic actors, b in figure 1). Finally, the physical city and the network society intersect in the growing variety of digital technologies that become embedded in the urban fabric: the so-called 'intelligent' urban technologies that help manage traffic, monitor and regulate environmental conditions, provide location-based services to individuals, groups, local agencies and businesses, and so on (techno-city, c in figure 1). Each of these intersections represents a distinct thrust that can be pursued independently in different digital-city realizations. First is the networking, community-building, democratizing role emphasized in the growing number of applications aimed at increasing community support for specific groups or at improving conditions for citizen participation in public decisionmaking. Notable among these latter efforts are the web-based GISs and virtual-city projects designed to facilitate public input into the planning process. These tend to emphasize the visual and sometimes auditory aspects of proposed developments in an effort to increase the public's understanding of what is being debated (Batty et al, 2001; Hamilton et al, 2001; Shiffer, 2001). The second thrust leads to a broad range of different roles for the digital city, whereby a wide variety of functions, services, activities, practices, and institutional arrangements of the 21st-century real city may be supported on the web. Many of the



**Figure 1.** The digital city at the intersection of three domains.

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functions outlined in section 3.1 belong here. Beyond the provision of all kinds of local information these include simple things such as applying for permits, more complex activities such as shopping, long-term interactive and collaborative activities such as education or work, as well as multimedia experiences such as visits to virtual museums and concert halls, and virtual city tours. The third thrust is the most heavily technology oriented, linking GIS-based urban representations with real-time data tracking supported by networks of sensors and wireless technologies on the ground. This is a fast-moving new frontier thus far characterized more by hype than achievements, but that is likely to yield interesting practical developments within the next few years.

Clearly, most of these functions, especially those in the first and second thrusts, are increasingly available on-line independent of any digital-city implementation. It could be argued that the digital city is just an additional level of software, redundant except as an attractive interface for the geographically minded. But this would be to overlook the fact that the strength of the digital city, just like the real city, does not lie in any of the individual services that may be provided through it but in the integration of the civic, functional, and field aspects represented by the triple overlap area of *d* in figure 1. It is the many possible synergies among these aspects, in both their actual and digitally mediated versions, that fuel the techno-utopian urban speculation of writers such as Mitchell (1995) and Horan (2000). According to these authors it is the seamless merging of the physical and the digital that will produce the 'recombinant architecture' and 'recombinant landscapes' of our not too distant digital-age urban futures. Their arguments clearly parallel the notion of coevolution that Graham (2000) advocates, whereby urban space, urban life, and digital technology undergo continuous, mutually adaptive transformations. There are no value connotations there: transformations may be positive, negative, or anything in between. The theoretical question for the digital city as a technological innovation may thus be posed as follows: which of these many aspects of the real city can the digital city amplify (or dampen), or more significantly, help reconfigure—for the better, one hopes? Wherein lies the true vocation of the digital city? What mix of civic, service, and field-oriented digital urban functions would best enhance actual urban life—and for whom? How will the digital-city idea itself evolve in response to what is happening on the ground? Answering these kinds of questions presupposes a more thorough understanding of the real 21st-century city than we currently have. More likely, there will continue to be radically different, conflicting answers, corresponding to the many radically different, conflicting ideologies that cities in free societies have always nurtured.

Finding suitable models for the citizens and communities of the 21st-century city may be even more challenging. Much has been said about the coming generations of cyborgs, humans physiologically and psychologically fused with the latest technology. Even more has been written about the fast-growing millions of miserable and illiterate urban masses around the world that do not have access to a telephone, let alone the means to find out and enjoy what a digital city has to offer. No single model or theory of urban dwellers can deal with such a range of conceptions. A number of scholars have examined with interest the writings on 'actor-network theory' (ANT) by the French school of sociologists surrounding Bruno Latour. ANT has been defined as a relational and process-oriented sociology where

"the social is nothing other than patterned networks of heterogeneous materials. This is a radical claim because it says that these networks are composed not only of people, but also of machines, animals, texts, money, architectures—any material that you care to mention. So the argument is that the stuff of the social isn't simply human. It is all these other materials too" (Law, 1992).

Or, in the worlds of Latour (1997):

“Actor–Network Theory claims that modern societies cannot be described without recognizing them as having a fibrous, thread-like, wiry, stringy, ropy, capillary character.... It is utterly impossible to understand what holds the society together without re-injecting in its fabric the facts manufactured by the natural and social sciences and the artifacts designed by the engineers.”

ANT could perhaps yield an appropriate model for the network society; a society that fuses the social networks of traditional sociology with the local and global networks of technology, knowledge, money, material flows, influence, terror, and so much more. Digital cities could be important nodes in such networks. What kind of model for 21st-century citizens would come from that? There is ample room here, it seems, for both utopian and dystopian imaginations.

## 5 Conclusions: some choices for digital-city builders

“The great public square known as the Agora was the living heart of ancient Athens, where citizens met formally to administer civic affairs, and informally to trade or discuss politics or to take part in religious processions and athletic displays.”

Camp (*The Athenian Agora* 1992, page 2)

A central premise of this paper has been that ‘there is more to the digital-city phenomenon than meets the eye (or the monitor, the screen, the user interface)’. In the preceding section I adumbrated some of the deeper conceptual problems underlying a seemingly straightforward and benign domain for the application of information and communication technologies. It is not the sole responsibility of digital-city designers to solve such problems. Still, to the extent that digital cities will continue to be built, questions will have to be answered and choices will have to be made on a case-by-case basis. The dilemmas are many because the digital city is a multilayered entity that is several different things at the same time. It is a *tool*, providing new capabilities for doing things in the real city; it is a new *medium*, providing specific kinds of experiences to urban users; it is a *social actor*, playing an active role in urban life; it is an *ideology*, embodying particular views of urban society. GIS practitioners on both the ‘systems’ and the ‘science’ side of the field will clearly be key players in the development of future digital cities and will be called to make important choices within realms well beyond their immediate areas of expertise.

One early choice may be implicit but could set the tone for all the other choices down the road. In addition to developing appropriate theoretical visions of the evolving real city, and its citizens, we also need to consider what are the most useful models or metaphors for the technologies that define the information age. What terms do we use for the technologies, developments, and phenomena that make the digital city possible? Cyberspace? Global data space? Information superhighway? Communication engine? The space of flows? The worldwide web? The world in the wires? The electronic frontier? Mirror Worlds? The Digital Earth? Virtual reality?... Each one of these metaphors has different connotations, different images associated with it, constraining and expanding our imagination in different ways. They entail different assumptions and expectations as to how the technologies may relate to both tangible and intangible aspects of the urban. A digital city built upon the premise of a global data space will have a different feel and purpose from one focused on flows and connections, or one attempting to recreate a virtual urban reality in all its messy dynamics and surprises. Clearly there are many possible choices there to suit several different ideologies. Other choices may appear more tangible but in the context of a coevolving virtual and real city they too may reflect some significant ideological dilemmas. Here is a partial list

**Table 2.** Some choices for digital city builders.

Where:	local versus global
When:	currency versus significance
How much:	detail versus comprehensiveness
How:	representation versus content
What:	community versus commerce
Who:	technocrats versus democrats
For whom:	all versus a few individuals or groups
With whom:	techno-bureaucrats versus citizens
What for:	asty versus polis

of such choices facing digital-city builders, some of which appear mundane, but all of which can have considerable implications regarding not just the practical success of an ingenious piece of software but perhaps even the evolving character of the actual city itself (table 2).

Beyond adopting an appropriate guiding ideology, as well as trying to determine the right mix of civic, service, and field-oriented functions for the digital city, there will be many additional questions begging for answers in each particular case. For example, how does one balance the desire to create a place-oriented resource against the need to be part of the global community? How much emphasis should be placed on the current and transitory as against the enduring and significant? Should one aim for depth or breadth of representation? How much effort should be allocated to the digital city's appearance relative to its content? How does one design a truly community-oriented resource without renouncing the material benefits of serving commercial interests? Should this be a resource for everyone or for a targeted few? Who should set the agenda for the digital city's design: the technocrats who know the computers' possibilities, or the democrats who know the peoples' needs? And also: will we be building the digital 'asty' or the digital 'polis'—that is, a reflection of the physical city, or of its noblest emergent property, the citizens' agora? As we go along making these and many other choices, there is one principle that does not admit of any alternatives: digital cities are built for analog, flesh-and-blood citizens. We are not, cannot, and never will be our avatars!

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