TRACE: Mapping the Emerging Urban Landscape

Alison Sant

Introduction:

Wireless networks and mobile devices are radically reforming our contemporary notions of urban place. As the traditional architectural definitions of public and private are blurred by the infiltration of portable electronics and the invisible edges of wireless connectivity, the dynamics of the urban environment grow progressively more complex. Though these were once easily delineated through the shades of the Nolli Map,[1] they are now blurred by the technologies of text messages and cell phone calls that can reach us anywhere, the phenomena of camera phone peeping, and the interception of wireless transmissions.

In addition, as portable electronics become integrated into the ways in which we navigate cities, our relationship to place becomes one that is increasingly mediated. Network technologies are moving away from their hardwired roots, to a mobile computing model in which both the network transmitters and the technologies that access them are portable.[2] These advances activate a new urban dynamic that is no longer based on references to static landmarks, but on a notion of the city in which the events themselves become spatial references.[3]

Although they are not physically obvious, the boundaries of wireless technology have profound implications for our notion of the space of the city. They suggest a changing model of urban reference that is modified not only by patterns of communication but also by zones of connection and disconnection. Mobile phone connectivity, WiFi (Wireless Fidelity) access, and ad-hoc networks[4] generate a series of boundaries that continually reconfigure urban space. Such networks may create density in public spaces by overlaying free access or marginalize urban areas, as they become known as “dead zones” in the connective tissue of mobile communication.

TRACE [5] is a project that examines the layering of physical space with the on and off zones of the wireless network. The project seeks to blend the corporeal experience of the city with the invisible qualities of the network, creating a narrative mapping of the hybrid space between them. This mapping is one that challenges a purely static notion of public space to promote a temporal logic of the city that reflects the fluctuating character of the wireless network.

TRACE borrows from the conventions of cartography to produce a series of maps that visualize the Hertzian landscape. Each map responds to a different state of the wireless network, examining the binary qualities of being on and off the network, in locked or unlocked zones, and in areas of unique or default node names. State changes are triggered by participants’ routes through the city, which enact the relationship between the physical experience of the urban landscape and the network. As surveyors of this evolving landscape, they contribute to a collaborative mapping of this hybrid terrain. By making this topography visible, *TRACE* seeks to reveal the intersection of the physical and immaterial infrastructures of the city.

Section 1: Node Dynamics

Hertzian Footprints

Since the invention of radio transmission, in the late nineteenth century[6], the technologies of wireless electronics have increasingly crowded the airwaves of the city. The relay of satellite television, radio broadcasts, cell phone transmissions, and WiFi hotspots fill the electromagnetic spectrum, creating an invisible Hertzian space that overlaps with the physical infrastructure of the city. Although unseen, this landscape has its own physical contours created by transmission ranges, signal strengths, and frequencies. In addition, as Hertzian space interacts with the physical landscape of the city it creates a hybrid space of shadows and hotspots that conform to the topography, architecture, and weather patterns of the space it overlays.[7]

Hertzian space has a significant effect on the way we occupy the physical space of the city. Avoiding dropped calls in tunnels, finding locations with strong signal to use a cell phone, or a WiFi hotspot to check e-mail are familiar examples. As our notions of physical space become increasingly informed by the fluctuations of wireless technology, our traditional points of urban reference also shift.[8]

Current projects in spatial annotation--the process of inscribing space with an electronic tag--offer examples of this changing orientation.[9] These projects utilize location-sensing technologies, including GPS (Global Positioning Systems) and wireless networks, to augment physical space with its digital double of media annotations. An annotation might be a collaborative map, documenting one’s memories or associations with a site.[10] Alternatively, advertisers may use this space to broadcast a nearby restaurant or an item on sale in a neighborhood store. In addition, data on current traffic patterns, weather conditions, or crime rates may also be used to mediate one’s journey through the city.

Generically, these examples can be qualified as temporal data. Spatial annotation includes media that may be revised by the day, hour or minute. In turn, our understanding of the city may become increasingly informed by temporary references. When compared with the time scale of architecture, a building constructed as a landmark to last decades or centuries, this raises questions about the structure of urban space. Do these changing references begin to undermine a more permanent architectural framework, including the iconic landmarks of the clock tower, or church steeple? As electromagnetic fields increasingly become the

carriers of data that inform our notions of space, will they become new reference points to the urban landscape, creating the Hertzian equivalent of the landmark?

Thousands of WiFI hubs are installed in residential and commercial spaces every week, each of which further disintegrates the traditional architectural boundaries between public and private space. A typical WiFi hub may have a signal radius of 150 feet. Some of these hubs extend intentionally and unintentionally into public space, creating an invisible front porch to the houses, apartments and businesses where they are installed. This spatial phenomenon has produced new urban practices in which neighbors or passers-by access unlocked private networks to borrow bandwidth. As private space is extended into the public realm, the margins of the built infrastructure become increasingly eroded by the use patterns that penetrate them. Current debates over whether these WiFi signals are part of the public commons or are the wireless equivalent of stealing private property are especially illustrative of the confusion between public and private space.

As the traditional structures of urban reference are intersected by the dynamics of an unseen landscape, how are new means of orientation created? In his essay entitled "Thinking About Cities as Spatial Events," Urban Planner, Michael Batty proposes that **" It is possible to conceive of cities as being clusters of 'spatial events'…"**[11] He argues for a temporal understanding of the life of the city as a means for appreciating the profound effects of events that take place in cities over short periods of time. Batty examines examples as benign as pedestrian patterns at a carnival to the significant chaos in Manhattan on September 11, 2001, and proposes that, as a discipline, urban planning focus on these temporal events.

In addition, as both the corporeal and Hertzian experiences of the city are examined as temporal events, they reconfigure our notions of space from the static to the temporary. This hybrid landscape, and the urban patterns it creates, are a further example of what Batty would refer to as "spatial events." His model of the event as a reference for urban activity offers a context for understanding the dynamics of the emerging wireless landscape and its impact on city life. By focusing on the city as an ever-changing experience, we may begin to register its' ephemeral dynamics as significant mechanisms in the creation of urban space.

"Space as a Practiced Place"

If, as Batty suggests, the city is considered as a system of spatial events, then space can be reexamined as a construction of the actions of its inhabitants. In his book *The Practice of Everyday Life*, Michel de Certeau defines urban space according to the patterns of those who use it. He suggests that **"…space is composed of intersections of mobile elements. It is in a sense actuated by the ensemble of movements deployed within it . . . In short, space is a practiced place."**[12] As described, walkers inscribe a logic to the city through their daily movements and intersections. In turn, space is delineated by their itineraries.

De Certeau's notion of the city can also be extended to the dynamics of Hertzian space. For example, as wireless networks are overlaid onto the urban itinerary, one's everyday movements enact a series of ad-hoc networks as Bluetooth devices collide,[13] registering the proximity of strangers.[14] In addition, as the WiFI infrastructure grows organically out of the use patterns of their administrators and users, they similarly inscribe a logic to the city.

The decision to leave a WiFI node locked or unlocked or to rename a base station communicates a bias to those that "see" these nodes through wireless devices. In addition, WiFI node names and encryption states become vehicles to express disparate attitudes about public access. An inflammatory declaration of privacy like "Go Away!," may be opposed by an open invitation to logon in the form of a web site address "go http://192.168.168.4/airport."[15] In addition, companies like ZRNet[16] and "Surf and Sip,"[17] which offer paid public access to the Internet in cafes differ from free community networks like Manhattan's New York City Wireless[18], San Francisco's SFLAN[19], and the UK's consume.net[20] and free2air.org.[21] Cumulatively, these independent dispositions create a spatial hegemony, which informs patterns of collective activity.

Our understanding of physical space becomes complicated by traces of electronic signals, the way they are formatted, and the information they project to us. The wireless network suggests a new subtext to urban space. In turn, these transmissions change our fundamental understanding of location. Instead of responding purely to the physical space around us, we also become engaged with the fleeting qualities of wireless signal. These "states" of the network begin to inform and direct our interactions with the urban landscape as significantly as the material landmarks on city maps.

Section 2: Mapping the City as a Space of Events

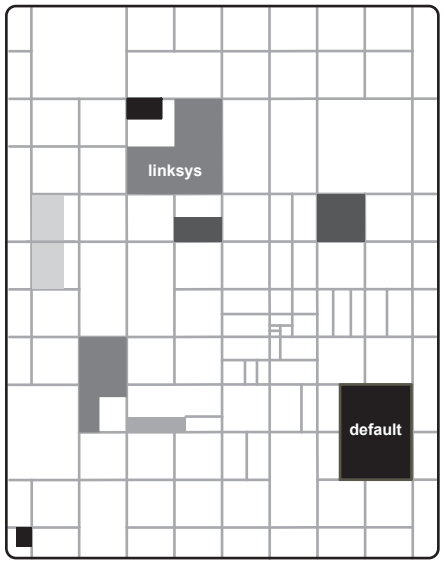
TRACE: project description

TRACE is a project that examines the interplay of wireless networks with the corporeal experience of the urban landscape. The project challenges purely static notions of the city to promote an alternative perception that recognizes both the fluctuating character of the network as well as the ephemeral aspects of urban space. In turn, the project seeks to understand the events of the city through the spaces and experiences they construct.

Borrowing from the conventions of cartography, *TRACE* produces a series of maps that visualize the wireless landscape. These maps are generated by a software program that runs on a WiFi enabled PDA. Each map responds to a different state of the network,

A_on

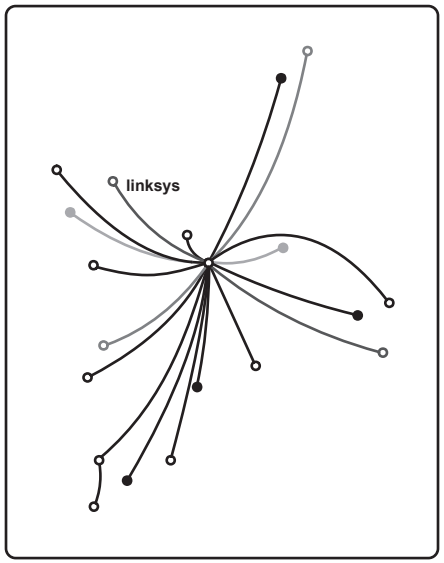
wifi nodes: mostly locked with
mostly default node names



(***figure 1***)

B_on

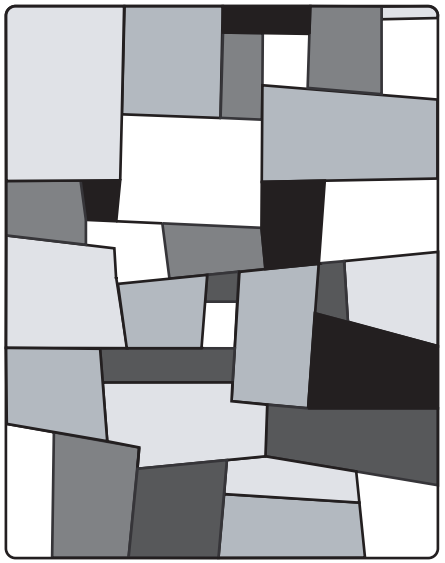
wifi nodes: mostly unlocked with
mostly default node names



(***figure 2***)

C_on

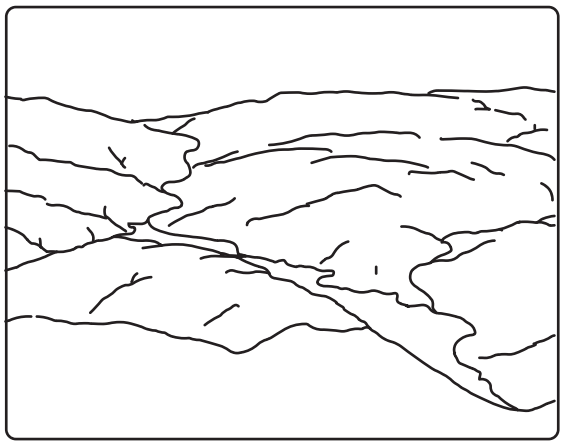
wifi nodes: mostly locked with
mostly unique node names



(***figure 3***)

D_off

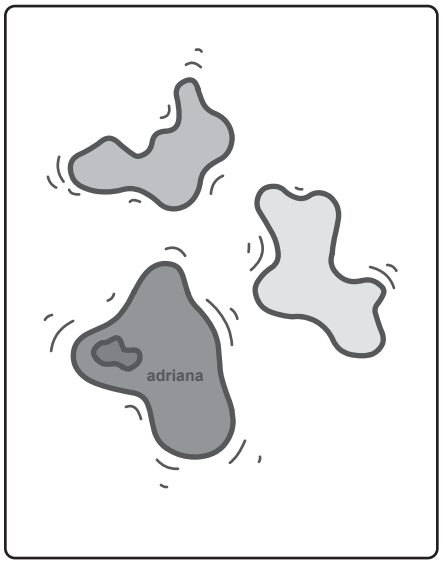
wifi nodes: no nodes detected



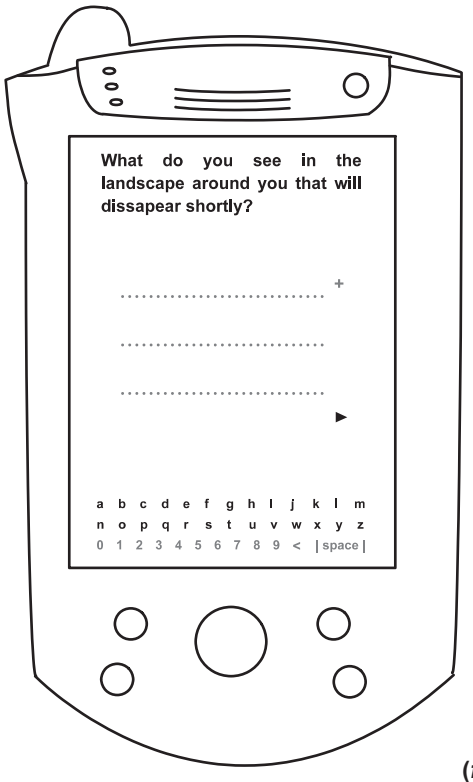
(***figure 4***)

E_on

wifi nodes: mostly unlocked with
mostly unique node names



(***figure 5***)



(***figure 6***)

examining the binary qualities of being in and out of WiFi range, in locked or unlocked zones, and in areas of unique or default node names **(see figures 1-5)**. State changes are triggered by participants' routes through the city, which enact the relationship between the physical experience of the urban landscape and the network.

TRACE maps the "state" of the wireless network over the geographic point as a means for understanding the evolving urban landscape. Inspired by the notion in ancient Greek maps of space as a system of relations, rather than an inventory of locations,[22] the project examines states as the focus of the map. Although each node is independently recognized within the project's software, these points are mapped according to the conditions of the majority of nodes. TRACE examines these nodes as related events that contribute to a landscape, rather than as discreet incidences. In turn, the project becomes a register of the collective wireless landscape as it is impacted by the discreet events of individual decisions.

Temporal Maps

By investigating the urban landscape through the concept of the state, *TRACE* interprets the city as a dynamic space that is perceived through one's subjective route. The project employs the graphic conventions of mapping to illustrate each state, and extends them over time to create an evolving animation that characterizes fluctuations in the wireless landscape. The project borrows from the cartographic traditions used throughout the history of mapmaking. Broadly, these include the devices of projection, orientation, a key or legend, naming, and field conditions illustrations. In addition, specific maps draw from the graphic conventions used in boundary, topographic, aerial, and panoramic maps.

Most generally, projection in *TRACE* is used to describe the binary state of being on or off the network. While the vertical plan is used for maps within range of WiFi zones, the panoramic or perspective map is used for being out of range, or in dead zones. The plan view is an official and precise means of orientation. It is an "objective" view, created through exact measurements. As a survey of space, it is common to the official depiction of geographic location. As a result, it is a visual convention that is used to describe features including sanctioned boundaries, lot sizes, property lines and streets. *TRACE* adopts this projection as a means for representing the data detected about each node including signal strength, node name, and encryption status. In addition, by choosing a generic view, the project removes geographic orientation while remaining familiar to common forms of representation. This evokes the idea of Hertzian space as a landscape, and the participant as a surveyor of it. In comparison, the panoramic or perspective map conveys a looser interpretation of space. Generally an interpretive illustration, not drawn to scale, it suggests a subjective view of the landscape characteristic of late 18th century maps.[23]

Survey

Inspired by the poetic questionnaires created by Yoko Ono, and other Fluxus artists in the 1960's, *TRACE* employs the device of the survey as a tool for understanding the hybrid space created between the Hertzian state and the physical landscape. As one uses *TRACE*, encountering new states in the wireless landscape, their journey is punctuated by a series of questions about the city around them. These questions create parallels between the fluctuations of the wireless network and the ephemeral qualities of the city. They are formulated to gather responses to urban events that are both unmapped and temporary **(see figure 6)**.

Conclusion

Hertzian space is radically reforming our relationship to the physical landscape. Wireless technologies undermine the traditional boundaries of architectural space and create new margins of public and private, on and off, lost and located. The implications of this erosion have profound effects on the ways in which we orient ourselves to the city as well as the ways in which we conceive of the construction of space. As our points of urban reference are complicated by the fluctuations of the Hertzian landscape, we have the opportunity to reconsider the city as a temporal system, shaped by spatial events. *TRACE* is a project that maps the dynamics shaping this emerging urban landscape. By examining the intersection of the physical and immaterial landscapes, *TRACE* aims to provoke new ways of understanding the contemporary life of the city.

References

Notes:

[1] See Giambattista Nolli's 1748 figure-ground map of Rome entitled "New Map of Rome" in which he delineated public space as white and private space as black. Published online at <http://www.lib.berkeley.edu/EART/maps/nolli.html> (accessed August 2005).

[2] See William Mitchell's discussion of wireless transmitters in William Mitchell, *Me++* (Cambridge: MIT Press, 2003), p. 49-52.

[3] See Michael Batty's discussion of the city as clusters of spatial events in Michael Batty, *"Thinking About Cities as Spatial Events," Environment and Planning B: Planning and Design* l29, no. 1 (January 2002) p. 1-2. See also Anthony Townsend, "Wired/Unwired: The Urban Geography of Digital Networks," <http://urban.blogs.com/research/dissertation/index.html> (accessed August 2005), p. 119-133. See also Mitchell (2003), p. 120-127.

[4] Ad-hoc networks are formed when two wireless devices, equipped with a transmitter and receiver, come within range of one another. As opposed to fixed networks, they do not require a base station, the network is established between peers.

[5] See project web site <http://www.tracemap.net>.

[6] In the late nineteenth century, the technology of radio transmission was defined by physicists and inventors such as James Clerk Maxwell, Heinrich Rudolph Hertz, and Guglielmo Marconi.

[7] See Anthony Dunne and Fiona Raby. "Tunable Cities," *Architectural Design* 68, no. 11/12 (November-December 1998) p. 78-79. Dunne and Raby describe Hertzian space by observing that,". . . [H]ertzian space is actual and physical even though our senses detect only a tiny part of the electromagnetic spectrum. Images of footprints of satellite TV transmissions in relation to the surface of the earth, and computer models showing cellular phone propagation in relation to urban environments, reveal that hertzian space is not isotropic but has an 'electroclimate' defined by wavelength, frequency and field strength. Interaction with the natural and artificial landscape creates a hybrid landscape of shadows, reflections, and hot points."

[8] William Mitchell, *Me++* (Cambridge: MIT Press, 2003), p. 120. William Mitchell points out in his book *Me ++* that "The most profound effect of electronic tracking, inscription, and interrogation techniques is, in combination and on a large scale, to change the fundamental mechanics of reference – the ways in which we establish meaning, construct knowledge, and make sense of our surroundings by associating items of information with one another and with physical objects."

[9] See current projects and open source code created by the Locative Media Lab <http://locative.net> (accessed August 2005).

[10] Many of the first forays into collaborative mapping projects, including Urban Tapestries <http://www.proboscis.org.uk/urbantapestries/>, Annotate Space <http://www.panix.com/%7Eandrea/annotate/>, and PDPal <http://www.pdpal.com> draw from digital data sets to present basemaps that illustrate the geographic features of the city; including road systems, public transport routes, and district names, as a datum upon which to annotate information. Although many collaborative mapping projects undermine their own basemaps by layering them with communally defined concepts of space--including participants' emotions, itineraries and memories--these annotations are inextricably linked to the predefined foundations of the map the overlay. Common digital datasets, like the U.S. Census Bureau's TIGER databases, are an expression of a singular notion of urban space – one that favors the street over the route, the static over the temporal, and the formal over the subjective. The basemap promotes an understanding of the city founded on a purely geographic categorization of urban space, defined by the Cartesian coordinate, the road system, and the block plan. As contemporary projects are created that build upon the datum of common basemaps, they are structuring a collaborative notion of space within this predefined conception of the city. For a further discussion of the basemap see Sant, Alison "Redefining the Basemap" in *Acoustic Space: Trans Cultural Mapping* (Riga: The Center for New Media Culture RICX, 2004) p. 153-156.

[11] Batty (2002), p. 1.

[12] Michel de Certeau, *The Practice of Everyday Life* (Berkeley: University of California Press, 1984), p.117.

[13] Bluetooth is a specification for the use of low-power radio communications to wirelessly link phones, computers and other network devices.

[14] See Eric Paulos and Elizabeth Goodman, *Familiar Stranger Project: Anxiety, Comfort, and Play in Public Places* in which "familiar strangers" are detected on mobile devices via Bluetooth networks and visualized as an ambient landscape. <http://berkeley.intel-research.net/paulos/research/familiarstranger/> (accessed August 2005).

[15] From author's stumbler logs in San Francisco, June 2004.

[16] ZRNetService, <http://www.zrnetservice.com> (accessed August 2005).

[17] Surf and Sip Network, <http://www.surfandsip.com> (accessed August 2005).

[18] Anthony Townsend is an urban planner and founder of NYC wireless. His thesis outlines a project for Manhattan's Bryant Park, one of the first outdoor public places to provide for 802.11 wireless access. He continues to work toward providing free public wireless Internet service to mobile users in public spaces throughout the New York City metropolitan area. See New York City Wireless, <http://www.nycwireless.net> (accessed August 2005).

[19] SFLAN, <http://www.sflan.com> (accessed August 2005).

[20] Consume.net, <http://www.consume.net/> (accessed August 2005).

[21] free2air.org, <http://www.free2air.org/> (accessed August 2005).

[22] Christian Jacob, "Mapping the Mind" in ed. Denis Cosgrove, *Mappings* (London: Reaktion Books, 1999), p. 40-41. In Christian Jacob's essay, he describes Erosthenes' third century BCE world map as an example of a map as networked space: "If Ptolemy's regional maps were a catalog of positions, Eratosthenes' world map was perhaps more like a relational database: a device wherein a given place was meaningful and relevant only as an element within a system of relations. . . Erosthenes was interested in the structure rather than the inventory. His map relied on a set of notable points, each defining its unique meridian and parallel. These lines were not organized into a systematic grid, and the aim of the map was not to locate points, but to organize a space of *summetria* (commesurability). . . It established a set of mathematical correspondences between places that were not interrelated. . . . Thus it allowed new kinds of journeys – analogical and syllogistical ones…It was thus possible to travel through the inhabited world in an abstract and geometrical way, thanks to this network of lines creating non-empirical relationships between remote places."

[23] For a broader discussion of planar and perspective maps see Christine Boyer, "Topographical Travelogues and City Views" in *The City of Collective Memory: Its Historical Imagery and Architectural Entertainments* (Cambridge: MIT Press, 1998), p. 203-291.

Illustration Credits:

figure 1 Alison Sant, *TRACE: Map A* (Flash Animation 180 x 240 pixels, 2004-05)
The organizing grid used in map A draws from the rural grid divisions of the American Land Ordinance Act of 1785 in which land was systematically surveyed into six-mile square townships, which were then subdivided into thirty-six sections equaling one square mile each. Map A evokes this constrained grid to describe the state in which most nodes are locked and have mostly default node names. The lines of the grid are at ninety-degree angles, and all set as a scale of the primary dimension, 20 x 20 pixels. As a node appears, it is rendered according to these dimensions, and grows in proportion if new nodes with the same name are added. The mapping evokes the constraints of the grid and a lack of customization, as the majority of node names are factory-assigned.

figure 2 Alison Sant, *TRACE: Map B* (Flash Animation 180 x 240 pixels, 2004-05)
Map B, predominately unlocked nodes with default node names visualizes the idiosyncrasies of stumbler programs in which identical WiFi node names are recognized as a common network. Map B borrows from aerial maps in which an itinerary is illustrated as a set of connecting destinations. As new nodes with the same default node name are added, they contribute to a growing array of interconnected points. The pattern that is formed is unique to each participant's journey and is unconstrained, to suggest their unlocked status.

figure 3 Alison Sant, *TRACE: Map C* (Flash Animation 180 x 240 pixels, 2004-05)
Map C, extends the metaphors used in Map A, but distorts them as it applies to mostly locked nodes with mostly unique names. Although the grid is still present, the shapes are uniquely suited to each node and are at varying angles. The map suggest customization, but within the constraints of a fixed system. Map C also borrows from US county maps in which boundary lines are modified around cultural, political, and geographic features as well as Sanborn maps in which property lines are set, but unique to the specific footprint of a building and lot size it occupies.

figure 4 Alison Sant, *TRACE: Map D* (Flash Animation 180 x 240 pixels, 2004-05)
Map D**,** is a map describing the "dead zone." It is uniquely horizontal, requiring the user to turn the PDA on its side to view it, and is the only map drawn in perspective. The use of perspective in Map D suggests a subjective and unmeasured view appropriate to the dead zone as it is a state in which WiFi detection is unavailable. The mapping is derived from cartographic conventions, typical of the methods of panoramic maps. Generally not drawn to scale, they show the landscape as a pictorial representation, emphasizing the subjective view of the map-reader.

figure 5 Alison Sant, *TRACE: Map E* (Flash Animation 180 x 240 pixels, 2004-05)
Map E, mostly unlocked nodes with mostly unique node names, draws from the conventions of topographic contour drawings in which a boundary line articulates uniform heights in a geographic area. Each shape is highly unique, conforming to the specific landscape it is derived from. The contours in Map E reinterpret this graphic form to suggest unconstrained access and unique node names. Each node illustration is derived from the number of characters in its name, producing a variety of shapes. As additional nodes, with the same node name are added to the map, they build upon the original node, creating more complex shapes. The field is unconstrained by the grid, evoking open access.

figure 6 Alison Sant, *TRACE: Question* (Flash Animation 180 x 240 pixels, 2004-05)
TRACE employs the device of the survey as a tool for understanding the hybrid space created between the Hertzian state and the physical landscape. As one uses *TRACE*, encountering new states in the wireless landscape, their journey is punctuated by a series of questions about the city around them. These questions create parallels between the fluctuations of the wireless network and the ephemeral qualities of the city. They are formulated to gather responses to urban events that are both unmapped and temporal.

Project Website:

www.tracemap.net

Author Bio:

Alison Sant is a media artist, with a background in digital media and architecture. Her work explores the city as both a site for investigation and intervention and has often focused on the hidden dynamics of the urban landscape. Her most recent work, uses media technologies to both capture the temporal events of the city as well as to examine the ways in which these technologies reform our notions of the urban landscape. She has exhibited nationally and internationally including the San Francisco Museum of Modern Art, VIPER Basel, and ISEA.

Sant teaches classes in new media at the San Francisco Art Institute, Mills College, and the California College of the Arts. She has been awarded artist residencies at the Djerassi Resident Artists Program in 2001, Headlands Center for the Arts in 2000, and the Tryon Center for Visual Art in 1999. Sant is also a recipient of a 2003 Creative Work Fund Grant and is currently an artist in residence at UCSF Mount Zion. She received her BFA from New York University in 1993 in the Departments of Photography and Interactive Telecommunications and received her Masters in Design at the College of Environmental Design, University of California Berkeley in 2004. Sant is currently an Artist in Residence at the San Francisco Exploratorium.