By mapping artificial landscapes created by radio-frequency, MIT’s SENSEable City Laboratory creates a real-time census that will help optimising the management of the city’s resources.
Le tecniche di recente sviluppo per la mappatura delle radioradiofrequenze hanno aperto nuove possibilità strane alla rilevazione a parte la perdita del controllo della configurazione dinamica delle attività urbane. Da sempre, ovviamente, siamo immersi in un paesaggio di radiofrequenze: un vasto campo elettromagnetico con onde di varia frequenza e ampiezza esiste fin dal Big Bang. Ma, dato che non veniamo al mondo forniti di radiorecettori integrati, fino al XX secolo esso non è divenuto parte del nostro ambiente percepito. Poiché radiotrasmettitori e radiorecettori sono stati inventati contemporaneamente, la rilevazione e la prima mappatura di questo paesaggio coincidono con le sue prime costruzioni artificiali. Per i pionieri della radioastronomia, l’obiettivo era l’apertura sullo spazio cosmo della radiofrequenza naturale. Ma i pionieri della comunicazione senza fili venivano a qualcosa di molto diverso: produrre e rilevare strutture artificiali di onde radio dotate di utilità e di senso per l’uomo. All’improvviso, così, divenne reale l’imperativo di descrivere il nostro mondo d’arte e urbane. Un’impresa che richiede nuove forme di percezione, di manipolazione e di modellazione. 

I segnali radio che ci scorrono intorno sono divenuti un nuovo, effimero genere architettonico legato alla nostra città in tempo reale. La città in tempo reale è divenuta parte del nostro ambiente percepito. 

Ma, come ogni forma di rilevazione statistica, essa è divenuta oggetto di controllo sociale e sfera personale.

La città in tempo reale
William J. Mitchell
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Recently developed techniques for mapping the radio-frequence landscape have opened up exciting new ways of revealing and understanding dynamic activity patterns in cities. We have always, of course, inhabited a radio-frequence landscape — a vast field of electromagnetic waves with varying frequencies and amplitudes. It has been there since the Big Bang. But, because we don’t come equipped with built-in radio receivers, it did not become part of our perceived environment until the nineteenth century.

Since radio transmitters and receivers were invented simultaneously, the detection and initial mapping of this landscape coincided with the first artificial constructions within it. For pioneering radio astronomers, mapping the natural radio-frequence landscape at a cosmic scale was the interesting thing. But the pioneers of wireless communication wanted to do something quite different — to produce and detect artificial structures of radio waves that had human use and meaning. Suddenly, as a result of their efforts, a new, ephemeral kind of architecture emerged around proliferating antennas.

One of the earliest major production points was at Westley, Massachusetts, where Guglielmo Marconi first used radio waves to transmit a wireless telegraph message across the Atlantic in January 1905. Marconi’s apparatus was a massive construction of four 60-meter towers, a web of wires in the sky, a 20,000-volt power supply, and a noisy spark-gap rotor. From this point, spheres of messy electromagnetic disturbance expanded out into space at the speed of light, to be detected at Poitou in Cornwall.

Over the century since, radio apparatus has shrunk by orders of magnitude, so that we can easily carry portable transmitters and receivers in our pockets. We have become walking antennas. Wireless networks have blanketed the earth, and our surroundings are growing dense with tiny radio-frequency tags and sensors. The radio signals that flow around us have become increasingly varied and sophisticated. The artificial radio-frequency landscape now reaches to wherever there is human habitation. It plays an indispensable role in our everyday lives, and its configuration is increasingly closely correlated with our daily activity patterns.

Recently, Carlo Ratti and his colleagues, and a few other research groups scattered around the world, have begun to map this landscape, and to explore the complex ways in which it overlays built environments and urban areas. This enterprise demands considerable technical and theoretical sophistication. Sometimes it begins with field measurements, and in other cases it starts with databases that are by-products of the operation of wireless telecommunication systems. Using GIS (Geographic Information System) techniques, the sets of data points are analysed and the results are expressed in the form of computer-generated maps. When appropriate graphic conventions are employed, the results not only provide striking insights into architectural and urban activity patterns, they can also be very beautiful.

The simplest type of map to result from this process just shows signal coverage. Providers of cellular telephone service, for example, often produce maps showing where service is available. And there have been numerous efforts to map the distributions of Wi-Fi hotspots across urban and rural areas.

Sequences of these maps illustrate the growth — often dramatic — of wireless telecommunication infrastructure over time. When combined with other data, they can demonstrate the relationship of wireless service to demographic patterns and topography.

Another type of map shows user activity. Ratti’s maps of Graz, for example, are created from the logs of cellular telephone providers. They show where people are making calls at any particular moment during the day. Since many people carry cellphones and use them regularly, this provides a good (though not perfect) indication of where concentrations of population are at any moment. Arranged in time series or animated, these maps provide — for the first time — detailed illustrations of the daily flows of populations throughout the streets and buildings of cities.

Similar maps of the MIT campus (http://ispots.mit.edu), produced from the server logs of the computer network, show where members of the MIT community are logged in to Wi-Fi service. They vividly depict the flows of population back and forth, during a day, among dormitories, classrooms, laboratories, and dining and recreation areas. In principle, it should be possible to go a step further by analysing the detailed structures of the flows of digital information to and from particular service zones and detecting patterns characteristic of emailing, Web surfing, downloading music files, just sitting around doing nothing, and so on. This would begin to allow the mapping not only of fluctuating population densities, but also of changing patterns of work and recreation.

All this amounts to a new way of taking and presenting a census of a city — not at intervals of years or decades, but instantly. As the electronic devices that we carry become more sophisticated, as wireless networking becomes more ubiquitous, and as electronic tags and sensors proliferate, this sort of real-time census-taking will become finer-grained, increasingly accurate, and increasingly commonplace. It will open up extraordinary new possibilities for urban research and planning, and it will provide the foundation for responsive real-time management of city resources.

Like any form of census taking, it is also a potential threat to privacy, and it will need to be conducted within a carefully constructed framework of privacy safeguards. In the coming decades, it is likely to become a focus of fierce debate about the socially acceptable balance of surveillance and personal privacy.