Sensing the (IPv6) City

IPv6, the new internet addressing protocol, will soon allow virtually everything on the planet to have a unique IP (internet protocol) address. The old 32-bit system allocated a mere 4.3 billion addresses, while the 128-bit IPv6 protocol contains 40,282,366,920 billion billion billion potential addresses.[1] To put this figure in some perspective, consider that IPv6 will allow for a staggering 3,911,873,538,269,506,102

Jason Kelly Johnson
California College of the Arts

addresses per square meter on the surface of the Earth.[2] Glance at a square meter of space immediately in front of you and imagine that every object in sight is potentially addressable, networkable, and sentient. Each object might also contain billions upon billions of addressable sub-objects, all too small to be seen with a naked eye. Similarly, it has been forecasted that every word you have ever spoken, every object you have ever looked at, touched or smelled, and everything you have ever thought could some-day be retrieved by supercomputers capable of processing, comparing, and visualizing massive repositories of so-called "big data."[3] Combine this with the exponentially increasing power and miniaturization of computers, the radical scale and scope of the so-called IPv6 "internet of things" will fundamentally alter how we interact with the world.[4] While it remains to be seen whether these protocols will be utilized for even a fraction of their potential, it is clear that IPv6 will have an increasingly profound impact on the future. It will challenge and inspire any field concerned with theorizing, visualizing, or constructing the physical environment—including devices, buildings, and cities.

Since the 1960s an avant-garde group of urban theorists, activists, archi-tects, and artists has been exploring the political, social, ecological, and aesthetic dimensions of these emerging protocols. The influential work of theorists like Marshall McLuhan, collectives such as Archigram and Superstudio, and designers like Constant Nieuwenhuys, foresaw cities defined by these artificially intelligent information networks. A half cen-tury before IPv6 was even conceived, Marshall McLuhan (who famously coined the phrases "global village" and data "surfing") theorized that "the medium, or process, of our time - electric technology is reshaping and restructuring patterns of social interdependence and every aspect

of our personal life. It is forcing us to reconsider and re-evaluate practically every thought, every action, and every institution formerly taken for granted."[5] McLuhan, who critically explored the effects of media on our senses, was interested in how the human sensorium was fundamentally conditioned and extended by emerging technologies: "All media are extensions of some human faculty. . . the wheel is an extension of the foot; the book is an extension of the eye; clothing, an extension of the skin; electric circuitry, an extension of the central nervous system."[6] Today, the most visible manifestation of these extended protocols is the rapid emergence of sensor-packed smartphones and wireless devices enabling real-time geo-location, social networking, banking, navigating, voting, and more. In many ways the continuous and networked cities theorized in the 1960s are now manifest in how many government agencies now essentially resemble computing platforms, entire libraries are accessible virtually anywhere anytime via handheld devices, and the great trading floors of the New York Stock Exchange[7] have evolved into virtual interfaces guided by mathematical algorithms housed in remote data farms. With the emergence of IPv6, these manifestations will only be intensified.

We also now see massive corporations (IBM's Smarter Planet Initiative) and entire nations (China's State Grid Corporation) investing billions in IPv6 infrastructure and cloud-based "big data" technologies.[8] In an essay published in 2012, IBM described exactly how ambitious its investment is, and just how pervasive its technology has supposedly become: "Today we are capturing more data more quickly than ever before: about buildings, roads, cities; about people, our habits, passions, needs; about transactions, workflows, markets; right down to the temperatures, location and condition of a single item in the global supply chain… Nothing challenges an unexamined way of doing things like a daily rush of data and analytic insight."[9] IBM, like Google, Amazon, the U.S. Government (with its recent "Big Data" initiative) and others, are betting that data will eventually replace many human transactions, including everyday observations, decision-making, and even scientific method.

The technology writer Chris Anderson explores this notion in his controversial article, "The End of Theory: The Data Deluge Makes Scientific Method Obsolete." He wrote: "This is a world where massive amounts of data and applied mathematics replace every other tool that might be brought to bear. Out with every theory of human behavior, from linguistics to sociology. Forget taxonomy, ontology, and psychology. Who knows why people do what they do? The point is they do it, and we can track and measure it with unprecedented fidelity. With enough data, the numbers speak for themselves."[10] As Anderson implies, every field will be destabilized by these emerging protocols. Similarly, in a recent paper entitled, "Sensors and Sensibilities," the University of Pennsylvania Wharton School professor and technology analyst Kevin Werbach wrote that this focus on data and analytic insight will fundamentally "challenge hidden assumptions in a bewildering array of doctrinal fields."[11] Architecture, built upon thousands of years of aesthetic doctrine and technical knowledge, is one of the fields

ENDNOTES

1. Quoting figures from the IPv6 Knowledge Base website: http://www.ipv6.sltnet.lk/know2-whatis.html

2. Ibid.

3. For more detail on this subject see: Ray Kurzweil, The Singularity is Near. (NY, NY: Penguin Books, 2006).

4. For more detail on this subject see: William J. Mitchell, M++: The Cyborg Self and the Networked City (Cambridge, MA: MIT Press, 2003).

5. Quoting Marshall McLuhan, The Medium is the Massage: An Inventory of Effects (Corte Madeira, CA: Gingko Press, 1967)

6. Ibid.

7. Based on the research by: Kazys Varnelis, "Space Finance and New Technologies" in Sentient City, ed. Mark Shepard (Cambridge, MA: MIT Press, 2011), p. 200.

8. For more detail on this subject see: "Sensors and Sensibilities: A Smarter World Faces Many Hurdles." Economist Magazine Special Report on "Smart Systems," published Nov 4, 2010: http://www.economist.com/node/17388338

9. IBM, "The More We Know The More We Want to Change Everything". Published in 2012 exclusively on the internet: www.ibm.com/smarterplanet/

10. Chris Anderson, "The End of Theory: Big Data Makes Scientific Method Obsolete." Published in Wired Issue 16.07 and online on 6/23/08: http://www.wired.com/science/discoveries/magazine/16-07/pb_theory

11. Quoting Kevin Werbach from the article: "Sensors and Sensibilities: A Smarter World Faces Many Hurdles." Economist Magazine Special Report on "Smart Systems," published Nov 4, 2010: http://www.economist.com/node/17388338

12. Quoting Omar Khan, "Interaction Anxieties" in Sentient City, ed. Mark Shepard (Cambridge, MA: MIT Press, 2011), p. 164.

13. Ibid. p. 164

14. Quoting Sanford Kwinter, "Soft Systems," in Culture Lab, ed. Brian Boigon (Princeton, NJ: Princeton Architecture Press, 1993) p. 227.

that will increasingly face these challenges. Architect Omar Khan, in his essay "Interaction Anxieties," speculates that "as our devices, buildings and cities become interactive, we will need to address the possibility that they may require little or no involvement from us to carry out their functions… One can imagine a self-regulating city."[12] He goes on to discuss and question the coming autonomous communication that will be possible between objects independent of human observation or input. "Human participation in the exchange would be minimal… How are we to understand our own agency in the coming Internet of Things and the Sentient City?"[13] Increasingly we will have to address the shifting role humans will play in the design, construction, and maintenance of these devices, buildings. and cities. How much agency will humans be willing to relinquish?

As our contemporary design tools such as CAD and parametric models increasingly become informed by both IPv6 protocols and big data, what role will human subjectivity play in design? How do we ensure that the less linear and unpredictable aspects of design practice are not lost in a world defined by artificially intelligent networks and machines? As theorist Sanford Kwinter has expressed, "a type of world emerges whose material, technical, and architectural manifestations—no longer simply objects, structures or 'buildings' but indeed electro-material environments at all scales—manifest themselves in a soft, perhaps insidiously holographic, manner, a world where everything flows together in real time."[14] How can we render these real-time invisible flows and processes of the city visible, meaningful, and perhaps tangible? How can we encourage citizens to participate in the making, marking, and activation of urban space with emerging technologies, social media, big data and more? How can architectural education and contemporary design processes become catalysts for critically engaging these diverse and rich collections of data? When the IPv6 enabled city truly becomes *sentient* and is woven with artificial intelligence, how will architecture become an active participant? ◆