

Addressing Infrastructure

Christian Sandvig (csandvig@illinois.edu)
University of Illinois at Urbana-Champaign

An incomplete draft paper that trails off into an outline, circulated to the 2008 Wharton Colloquium on Media and Communications Law.

Correspondence to: Christian Sandvig
166 Coordinated Science Laboratory
1308 West Main Street
Urbana, IL 61801-2307
Telephone: (217) 265-6287
FAX: (217) 244-2352
e-mail: csandvig@illinois.edu

Addressing Infrastructure

Christian Sandvig (csandvig@illinois.edu)
University of Illinois at Urbana-Champaign

ABSTRACT

Addresses used in communication include apartment numbers, e-mail addresses, phone numbers, names, call letters and more. Yet the way that the interlocutors in communication – whether they are people or devices – are categorized and addressed is rarely given particular analytical treatment in communication policy or system design. Specific technologies and institutions do receive attention, such as the Internet’s domain name system or radio frequency allocation for wireless communication. Other authors also address particular goals or problems, such as certain kinds of efficiency or the role of trademarks. This chapter argues for a broader approach: that addressing schemes across time, technology, and space (meant here to include names, numbers, and other forms of identification) often are structured in similar ways, have similar stakes for users and designers, and lead to predictable failures, controversies, and problems. In addition, it argues that the promulgation of new addressing systems is relatively common. It attempts to provide heuristics and examples useful for understanding and designing future addressing systems, mainly by focusing attention on recurring problems and emphasizing the interconnectedness of addressing schemes with other domains: including identity, routing, and others.

KEYWORDS: naming, routing, identity, trademark, communication

Addressing Infrastructure

Christian Sandvig (csandvig@illinois.edu)
University of Illinois at Urbana-Champaign

The US postal code “99705” is the address for an Alaskan town of only 1,700 people, yet the post office serving that address handles hundreds of thousands of additional pieces of mail each year that aren’t intended for any of the residents. This extra mail is sent from the continental United States, then it is intentionally routed through rural Alaska on its way to a destination back in the continental United States. This unusual routing is the result of two things: the town’s name and the post office regulations governing postmarks. It is the purpose of this chapter to explain that this sort of odd situation is normal in communication, and to use examples like ZIP code 99705 to understand the role of addressing in the design and use of communication systems generally.

The town’s name is North Pole, Alaska (a suburb of Fairbanks not located at the geographic north pole). One of the town’s slogans is “Santa’s ZIP Code is 99705.” As a little-known courtesy, the US post office will allow anyone to route their mail through rural Alaska for the price of one additional stamp,ⁱ while a small number of remailing businesses in North Pole, AK cater to those who wish to re-route mail in bulk.

Christmas cards and packages are routed through North Pole in order to obtain the North Pole, AK postmark. The law and post office regulations governing postmarks are strict. In the US, the postmark applied by the post must bear the name and ZIP code of the office where the mail was first accepted. Forging Santa’s postmark (or at least North Pole, AK’s) is punishable by up to five years in jail.ⁱⁱ What is strict now was once stricter. The postmark was invented in the UK in 1661 to discourage mail carriers from intentionally delaying mail, or to refute charges that they had.ⁱⁱⁱ Although their importance to the mail system is now somewhat reduced, a huge volume of regulations once governed the postmark when the US post office was a government department and it also served as a bank.^{iv} Postmarking stamps were logged

and checked out, they used special ink, the timestamp was changed hourly, and so on. Mail was marked when it entered the postal system, but postmarks were also used to track the routing of mailbags, postal trains, money, and internal paperwork. It is this legacy that makes the 99705 postmark valuable. In fact, the legacy of strict postmarking is valuable enough that the word “postmark” has now entered common speech to mean a trusted mark – the post offices of the world offer a timestamping service for electronic documents (technically, a cryptographic non-repudiation service) under the names “digital postmark” and “electronic postmark.”^v

To make it clear that this routing anomaly stems from the status of the postmark and not just the words “North Pole,” consider that there are many ways to get the words “North Pole” printed on a piece of mail besides writing it yourself. Some postal services sell advertising space in their stamp cancellation marks.^{vi,vii} Some postal services (including the US) allow you to print your own postage or design your own stamp. Private postage meters used by businesses can incorporate your own logo or message into your postage stamp for a fee. Any of these could be altered to include the words “North Pole” at Christmas, but none of these methods are a “City, State ZIP Code” postmark in the vernacular sense.

At first, it seems inefficient and even ridiculous to route thousands of letters through rural Alaska for these few drops of ink. The veracity of the postmark (the fact that you have to go to North Pole, AK to get those drops of ink) is what gives them this special value in the first place. One point of this chapter is that the integrity of the routing mark and the value of the words “North Pole” aren’t accidental or even as anomalous as they might first appear. They are the product of communication system design and the principles behind naming anything. The address “North Pole, AK 99705” didn’t accrue meaning in an exceptional way that distinguishes it from other addresses: instead the act of naming is itself about the attachment of meaning, and the design of a system of addressing (in this case, the postmark rules) shapes the path that communication will take through any system. In short: addressing matters.

The address North Pole, AK 99705 was no accident. In 1952 the former town of Davis, Alaska was re-named “North Pole” by a property development company—reportedly in the hope of attracting a toy manufacturer to locate there.^{viii} Local promotion of the address for economic development has had large effects. For instance, the postmaster general authorized the US Postal Service to accept letters to Santa Claus in 1912 – long before North Pole, AK existed as such.^{ix} Children’s letters to Santa are sent and answered all over the world, but after fifty years of promoting “Santa’s ZIP Code,” about 120,000 items of mail per year are explicitly sent to North Pole, AK 99705 due to that town’s distinctive name.^{x,xi} ZIP code 99705 argues that addresses always mean something, and how a system of addressing is designed to handle that meaning is a particularly useful framework to see how the design of an addressing system affects communication.

Defining Addressing

The meaning of the verb “to address” derives from two other words: to direct, and to name. General theories about addressing have a rich and varied intellectual history. Two helpful contrasts are computing and philosophy. The engineering of computers has a lot to teach about addressing, and a fairly well-developed vocabulary for discussing problems of addressing.^{xii}

Addressability in computing is deciding what can be named, or what ought to be named.^{xiii} For instance, deciding how many uniquely identifiable points can be named on a display surface and how they ought to be referred to is a discussion about “addressability.” What items of data can be named and retrieved in a computer system (often metaphorically referred to as the data’s “location”) is also a question of addressability. Computer science and data communications have a lot of experience some of the efficiency problems related to the design of a system of addressing. For instance, in their terminology the range of possible addresses for a given purpose is an “address space.”^{xiv} A frequently important distinction distinguishes addresses schemes that are arbitrarily related to what they identify (the way an ID

card number is arbitrarily related to your identity—called a “flat” addressing scheme) or they can be meaningfully related to how entities are connected to each other (the way that the first three digits of a US landline telephone number [the exchange number] can help you determine whether a telephone is physically near another telephone or not. This is called a hierarchical addressing scheme related to topology. A great deal of technique and discussion has gone into the way that addresses can refer to other addresses (called referencing), how to handle a system where addresses change very rapidly, and other more esoteric questions.

These examples from engineering are helpful because they can explain the importance of addressing in technical systems. Decisions about addressing cause (or at least partly cause) a variety of persistent problems that plague a very large number of technological systems. Five quick examples make this case: First, if data have been stored by a computer program but no addresses refer to those data, the data is unreachable and this can result in a memory leak, one of the most common errors in computer programming.^{xv} Second, in a variety of systems and circumstances, using complex addressing schemes takes scarce resources, and it can be vitally important to optimize the addressing scheme for particular purposes as much as possible. Longer or more complicated addresses can directly translate into communication capacity, battery life, or money. Third, in some data communication systems the nodes that are communicating move around frequently (think of using a mobile phone as you ride in a car). In these circumstances the degree of routing information that is attached to (or embodied within) the address can have a large effect on the performance of the overall system’s routing. Fourth, if all addresses have been used, but new entities still need to be addressed, the address space is said to be exhausted and new entities cannot be added. Fifth, in software engineering if the same data or object can be addressed (that is, named) in many different ways, this can lead to programming errors and can make source code harder to understand and maintain.

All this is to say that there are a lot of important reasons—usually classed as technical reasons—to pay attention to addressing. Decisions made in the design of an addressing scheme

can cause a communication system to be less reliable, can cause software to crash, or can make a network more expensive to operate.

Philosophers have been dealing with similar questions about addressing for centuries, although they usually use different words. It is a short step from the above problems of technical system designers to a question that has occupied many intellects: Is there a natural way to categorize the world? Philosophers of science have been particularly concerned with the question of natural classifications, or “natural” classifications.^{xvi} They have asked whether there are entities whose boundaries are obvious and external to human culture, or whether all of reality is a kind of undifferentiated goo where we have the option of drawing different sorts of distinctions between things.^{xvii} Is it necessary to classify atoms as containing protons, or to classify protons as composed of three quarks, or are there other ways to identify and organize these phenomena that might be even more useful?^{xviii} Technical system designers debate classifications in much the same fashion. They ask what categories ought to be used in addressing systems in different circumstances—they ask if the addressee in a system should be an object (such as “the computer”), how to identify the boundaries of the object being addressed (should it be “the network card,” or a particular memory register), and/or if the individual (the user) is the most useful addressee to specify. These continue to thrive in both fields: For instance, philosophers and computer scientists have often argued about whether the individual is a natural category to use in addressing.^{xix}

In the design of a technical system, addressing is often dealt with as just one of a larger set of functions or design tasks. With a few exceptions, there aren’t really addressing design specialists, and the problem of addressing is usually encountered in the context of some other goal. Property developers or municipalities assign addresses when they plan a new development, computer network engineers may worry about addressing when working on a related problem, such as routing. Still, the comparison of different engineered systems over time leaves the conclusion that there really aren’t that many different ways to do addressing. As noted above, the choices made in addressing have important consequences. Moreover,

addressing systems cause controversy, problems, and failure in similar ways, over and over again.

Alternatives in Addressing

Some Western authors have emphasized differences between national street address systems as fundamental markers of difference. For instance, they have been said to exemplify different ways of thinking or different kinds of spatial experience.^{xx} Despite the evocative differences between some different addressing systems, there are more commonalities than differences. In some fashion an address is associated with an addressee: we could say it is “indexed” in that it comes to stand for something else.^{xxi} Addresses can be predefined as a set (such as a range of numbers or words: computing’s “address space”) and parceled out, they can result from a relative specification like a coordinate system (Cartesian space, latitude and longitude) or they can be derived as an algorithm or series of steps relating different addressees together (4th Street = the fourth street). Indeed, sometimes they are all of these at once—a Cartesian coordinate system can be thought of as a notation for a series of steps to find a location, and it specifies (if abstractly) the set of possible addresses, and it relates different addressees together mathematically.

Examples of particular kinds of street address systems illustrate these building blocks. An addressing system requires effort and resources, even though in some schemes these can be so widely distributed that they aren’t noticed. For the case of street addresses, consider that it is likely that the majority of urban dwellers on Earth have no street address in the sense meant in the developed world. While people will obviously name or otherwise identify the places they inhabit without any centralized help or requirement to do so, without a central index or a system comprehensible to outsiders it is very difficult for strangers to visit unfamiliar areas (to make deliveries, for instance). Economic development authorities have argued that without a street address infrastructure, other infrastructures suffer.^{xxii} Centralized tax collection, water and power service, and communication all become much more costly and difficult. By a 2005

estimate, it cost about US \$0.60 per capita to introduce a centralized, indexed street address system in African cities where none previously existed.^{xxiii} (Most of the expense comes from street signs.) While any particular place could be referenced by an addressing system (for instance, latitude and longitude can specify any point on the globe), this connection isn't useful if no one knows about it. It might be tempting to think that an address like "4th street" exists independently of whether there is a street sign or not, but even without a street sign, a particular street is only 4th street by implication if you understand the pattern of numbering and are aware that there are three earlier streets. (In 2007 the World Bank funded an initiative to develop board games that teach basic concepts about centralized street addressing.^{xxiv})

Even with similar fundamentals, small decisions and emphases in addressing systems can produce systems that are much harder to use for some purposes than others. Tokyo addresses have been described as "made for postmen, but few others,"^{xxv} but it isn't clear that Tokyo's addresses were even made for postmen. Despite defining the topic of this section as *street* addresses, most Tokyo streets do not have names, as in Dakar, Huancayo (Peru) and many other places in the World. In Japan, the street name is not a component of most addresses. Tokyo has a very old, centralized street address system. Addresses are organized into hierarchies of ever-smaller geographic units. A translation of these might be "ward, area, district, block, building." Building numbers were originally assigned in the order that the buildings were constructed, meaning that it was not likely that buildings that are next to each other will be numbered consecutively. However, a revision of the system in most areas led to building numbers that proceeded clockwise on each block. To make things harder (for non-locals, anyway) Tokyo does not have a grid street system. In comparison, Kyoto has a grid system but it is not addressed in a way familiar to residents of grid-patterned American cities. Traditional Kyoto addresses are given as relative distances from well-known intersections. (Since there are many well-known intersections, there are several equivalent ways to refer to a single location.) Japanese street addresses have fascinated many Western writers (and tourists).^{xxvi}

Anne Whiston Spirn has argued that Japanese street addresses are designed to emphasize blocks (or places) while American cities emphasize streets (or movement).^{xxvii} Whether or not this is true, it is clear that the decisions made in the traditional addressing system profoundly advantage some purposes over others. The Kyoto approach is very convenient for someone who already knows the locations of major landmarks, while the oldest Tokyo addresses create serious difficulties for strangers, as the pattern of numbering can vary on each block. While the numbering carries information, learning the number order for one place confers no advantage when you cross the street. The large differences in the way an addressing system functions for some purposes vs. others is common to all systems, not just street addresses.

Addressing is Naming

The examples of addressing given so far have emphasized addresses organized as hierarchies (like Building, Street, City, State, Country [USA] or Prefecture, City, County, District, Block, Building [Japan]) or coordinates (40.116291, -88.252139). As briefly mentioned above, textbook discussions of addressing in data communications have distinguished between address schemes that are hierarchical vs. “flat.”^{xxviii} In practice it is very difficult to think of non-hierarchical addresses. Some computing textbooks give the example of US Social Security Numbers as a flat addressing system.^{xxix} By this they mean that an address is composed of items (numbers) drawn from a single group, and that the address (that is, the number) doesn’t imply anything about geography or connectedness, or anything else. Yet Social Security Numbers are a terrible example – they are extremely hierarchical and not flat at all. First, they are numbers. Sequence is a hierarchy and Social Security Numbers are given out sequentially. The number then implies something about the year that it was first issued (and therefore it also implies your age).^{xxx} Social Security Numbers have the format NNN-NN-NNNN where the first grouping is number is known as “area,” the second, “group,” and the third is “serial.” From 001-585, the area numbers were given out from East to West (002 is New Hampshire, 570

is California), so the number also has an association to geography—most people die near where they were born, and live most of their lives in the same place. Even stranger and less obvious categories are embedded in the addressing system: due to differences in pension systems, railroad workers had different and identifiable sequences of numbers before 1964.^{xxxii} So the hierarchy in a Social Security Number before 1964 could be expressed as “railroad worker?, location, age.”

Social Security numbering is unpacked here because it illustrates the idea that when an addressing scheme appears to be “flat” this may imply ignorance of the scheme, rather than a truly non-hierarchical address. System designer want to distinguish between “flat” and hierarchical addressing so that they will know how to (or whether to) take into account the additional information in the hierarchy, which could be useful when assigning addresses or when reading them. Calling an addressing system “flat” is then a way of saying that the relation between the address and the addressee is arbitrary and can’t be used for other purposes like routing. Yet the relationship between address and addressee almost never arbitrary, and misperceiving it as arbitrary leads to many of the problems with addressing systems that recur across technologies and history.

Could the parents of any Kimberley have changed their mind and instead christened a Gertrude or a Lulu? While with language (as opposed to numbers) it is clearer that no two addresses are ever equal. That is, equal in the sense that the symbol “Thomas” can’t be said to be meaningfully equivalent to “Clem” or “Hephaestus.” Even if proper names each carry a unique connotation and history, they could be a “flat” system of addressing if the relationship to the addressee is arbitrary. Names in Thailand, to choose one case, are obviously not flat, as they are typically derived in a series of steps from a child’s date of birth.^{xxxiii} But American names like “Kim” or “Mary” aren’t flat either. Studies in the US and UK have shown that even though an individual set of parents are free to choose any first name that they want, overall this decentralized naming produces very regular patterns related to uniqueness, class, race, geography and year.^{xxxiii} Although these relationships are expressed probabilistically that is no

reason to disregard them. Even though assignment is decentralized, there are also patterns related to uniqueness: When one name becomes too frequent its popularity wanes. The popularity of many names varies by income, and the popularity of each name generally moves down the socioeconomic scale as the name ages. Of course names are usually organized in an explicit hierarchy with other names (“first” name, surname, etc.) and they provide information about descent, marriage, language, place of birth, and so on.

Given these examples, it is a puzzle as to why so much technical and even policy practice takes it for granted that addresses have no particular meaning, or that they should have no particular meaning. Practitioners often take for granted that the ideal scenario in designing a system of communication is to choose an address space that is free from connotation, or that connotations can be controlled, with meaning isolated in some particular part of the address system. The designers of addressing systems rarely leave a record of their thoughts and motivations, but one instance where they did so is at the birth of the domain name system. Postel and Reynolds wrote in 1984 that their initial decisions about addressing were intended to produce names which were “free of undesirable semantics.”^{xxxiv} It is a very difficult problem to predict what meanings are desirable, or what meanings will be desirable in the future. Reducing the available meanings to the desirable ones is straightforwardly impossible. But it is easy to conclude that meanings will accrue, and that people will care about these meanings. This is the way that addressing should be conceptualized.

The Accrual of Meaning in Addressing Systems

As a thought experiment one might try to specify a truly “flat” addressing architecture to see if such a thing is possible. An attempt might be: To create an address, assign a random sequence of numbers. Some current numbering systems produce approximately this user experience, even if the actual way that addresses are assigned is not random. For instance, new landline telephone numbers given out in old telephone exchanges may seem random to subscribers who recently move to the area. As addressed above, we know that they are not

random: the first three digits are part of a geographic hierarchy. In some exchanges all addresses (phone numbers) have already been assigned at some point in the past, so there is not an obvious sequence to new numbers that are handed out, the issued number will be the next vacant number, not the next number. Even if vacant numbers are assigned in order, sequential vacancies are rare so that a subscriber requesting two new telephone lines will probably get two very different numbers.^{xxxv}

When confronting the apparently-random address assignment, one of the first things a person does is to try to add meaning to it. One strategy is to superimpose another representation—trade letters for numbers, as they are already linked on telephone keypads. A variety of services help people search a different address space (e.g., the English language) and superimpose it on their seemingly random telephone number.^{xxxvi} Some number sequences approximate words without translation.^{xxxvii} Even without superimposing address spaces, the individual numbers themselves have value and meaning. Telecommunications carriers in some Asian countries mark up number assignments that include numerologically-significant sequences, and stores may display their best telephone number assignments in the front window along with their new models of phones.^{xxxviii} In some countries the most valuable number sequences are reserved and auctioned for charity (such as a number consisting of all 8s).^{xxxix} This is a global phenomenon and is not restricted to cultures we associate with an enthusiasm for numerology. Many countries (such as the UK) that use random alphanumeric as vehicle license plates have been forced by popular demand to add regulations that govern a secondary market for number plate trading. A small industry of “professional number plate transferring services” have been created to support the desire of the UK population to make a randomly assigned alphanumeric non-random, or to realize the value in a number randomly assigned to them.^{xl}

Beyond semantics, seemingly-meaningless address sequences can have important consequences for a variety of other reasons that are no less important. When addresses are re-used, the new holder of the address may receive communications for the previous addressee

(back to semantics: they may also find the address more valuable if it was once used by someone of note). Any address sequence also provides unique relationships with other nodes on the network for less obvious reasons. Research in psychology and human-computer interfaces has demonstrated that there are enduring patterns in mistyping that result in decisions about user interfaces (sources of error here include adjacent key substitution or mispositioning of fingers on the keypad). Human memory also seems better able to cope with some sequences of numbers vs. others.^{xlii} Some alphanumerics are easily confused – zeros are frequently dialed instead of the letter “O” when dialing a vanity number like 1-800-HOLIDAY, and the lowercase letter “l” is often typed for the numeral one, and so on. Most people know someone who have been assigned a telephone number that has some association with another number (for which they frequently receive “wrong number” calls).

Designing Addresses as Though Engineers Were People

Most of the difficulties related to addressing that have been related here occur when people interact with a technological system that wasn’t designed to support what they wanted to accomplish (such as to express their identity with their license plate).^{xliii} In most of the examples above an engineered technology interacts with human memory, human desires, human language, human identity, and so on, in a way that produces results that are undesirable or at least unexpected from the perspective of the designers of the addressing scheme. Examples like these have caused engineers to spend some effort distinguishing addressing problems that involve humans with ones that don’t, and this has been a serious mistake. In computer science a distinction is frequently made between addressing systems that are meant to be used by humans (often users) and those that are not, such as the IP Address 192.168.10.1 vs. the host name (sandvig or sandvig.cu.volo.net).^{xliiii} Yet all sorts of addresses never meant to be seen by human eyes or retyped by human hands end up being the work of humans for a variety of reasons.

The MAC address (Media Access Control) or Ethernet Hardware Address is a pool of 281 trillion numbers that was originally intended to uniquely identify every Ethernet card ever made.^{xliv} It is usually represented in six hexadecimal octets separated by dashes (00-0C-F1-56-98-AD). These addresses now must be typed so often by network administrators that mistyped characters have become a serious problem. On new networking products MAC addresses are represented by machine-readable barcodes printed on stickers on the back in order to encourage network administrators to purchase barcode scanners and avoid mistyping. Users now have to type them too. Partly due to a shortage of IP addresses (another address space) the MAC address is often used by Internet service providers to identify customer equipment. As the MAC address indicates, there is a substantial leakage of addresses never meant to be seen by users into user tasks—as of this writing, anyone who purchases a new router or cable modem may have to type the 12-digit MAC address during setup. As addresses become larger, so too does the difficulty of representing them for humans if there is no easily understood meaning.^{xlv}

Even disregarding the leakage of addresses intended for machines into user tasks, the design decisions that technical system designers make about long arbitrary strings used for addresses depend upon the idea that engineers aren't human. While engineers and technical support staff may indeed have specialized training, this doesn't make long strings of numbers and letters easier to type or remember, nor does it make it less likely to make meanings with codes. Much effort in software engineering has gone into handling similar situations of confusing meaning, mistyping, and so on.

The Prevalence of Addressing, and New Address Spaces

Only a few prominent addressing systems occupy popular attention as such: these are things like phone numbers and street addresses. Addressing systems are much more common than this perception. In fact, every new communication arrangement must grapple with addressing. Often the problem of addressing is handled by re-using an address and an address space that already exists, or combining address spaces in some way. (My username on several

computer systems is the same, and it is assembled from parts of my name.) Every new communication protocol and technology has an addressing strategy.

Any addressing scheme that is designed as opposed to grown represents a situation in which similar questions were asked and decisions were made. There must be an address space. If it isn't specified, it is implied, but there is still an address space. The restrictions on allowable addresses, if they are explicit, must be formulated. If a new address space is designed, some information is embedded into the address via decisions about how addresses are linked to addressees. One of the most important considerations is the question: Who gets to answer these questions? (That is, who gets to decide the relationship between address and addressee? Who gets to decide the rules of the address space? And so on.) The question of "who" is critical here because the address scheme is inevitably better at some tasks than others, and the designers often do not imagine the users very successfully.

Traumatic Addressing System Crises That Frequently Recur

Communication law and policy is particularly awash in address schemes and spaces. Consider: KQED, <http://whitehouse.com/>, 1-800-HOLIDAY, 98.5 FM, 2001:0db8:3c4d:0015:0000:0000:abcd:ef12, Channel 7, 90210, 73136.3232@compuserve.com, W8OK, E05631Ac56BD0000, and 209.185.108.1.

Address space exhaustion and renumbering. Example of telephone exchanges, area codes. IP addresses, MAC addresses, IPv6 transition. Hoarding. Black markets.

Retrofitting the address system to take meanings or value into account when no provision was made for it initially. British postal system "named houses" example. Trademark examples. Examples of different ways of handling errors/value related to meaning.

Changing the object being addressed to another kind. Changing the object of telephone numbering from place to person to object. Changing the number of addressees (that is, changing the object of an addressing scheme from a person/object to a group of them).

Friction between overlapping address spaces. Since addresses are usually built from other addresses and address schemes (keys) often shared and combined across many systems and technologies, this builds in interdependencies that aren't obvious. Privacy examples. Identity theft. Another problem occurs when one address system is accidentally made equivalent to another, but they have different purposes. Trademark and domain names. Trademark and everything else.

Addressing as Everything, Everything as Addressing

Very diverse sets of controversies can be understood as addressing problems, and it is helpful to understand them that way. Spam (and fraud) using email can be said to be about trust, identity, authentication, jurisdiction, the rule of law, etc. But it can also be understood as an addressing design problem related to email addresses.

While the particularities of each context and technology are still important, the value in trying to see any communication technology as probably featuring addressing problems is that you will be able to foresee problems.

The traumas related to addressing are not “problems” in the sense that they are “unsolved problems.” Some say that when faced with the problem of address scarcity you should respond by designing a larger address space. The more generalizable solution to this problem has been to exhort software engineers to design more scalable systems on their first attempt. However, there are important reasons why they will not design scalable systems in the first attempt. It might be better to expect the problem (and solution) as a recurring pattern in address infrastructure, rather than complain about (and be surprised by) the inevitable.

Conclusion

Addressing woes aren't a byproduct of bad system design: addressing *is* system design. In a communication system, deciding who can be hailed and how is fundamental. If you start there, this implies the organization of everything else.

The issue also isn't getting the technical to listen to the non-technical.

Addressing has high stakes because identity is always implicated in an addressing system. This won't go away.

Return to North Pole, AK 99705.

Odds and ends: Street names,^{xlvi} Radio station call letters,^{xlvii} telephone mnemonics and trademark,^{xlviii} domain names as compared to radio station call letters, telephone mnemonics, and frequencies^{xlix}

Notes

ⁱ In fact, users of the mail system can route their postal mail anywhere. To do so, put an item of mail in another envelope (with the proper postage) and address it to “Postmaster” at the ZIP code the mail should visit. Some postmasters suggest adding a note that reads “please mail.” It will receive that postmark.

ⁱⁱ 18 USC Sec. 503.

ⁱⁱⁱ It was called the Bishop’s Mark after London postmaster Henry Bishop. See: Post Office Advertisement. (1661, June 27.) *Mercurius Publicus No. 26*

^{iv} For example, search for “postmark” in *Postal Laws and Regulations*. (1913). Washington, DC: Government Printing Office.

^v See Universal Postal Union standard S43-3 and: The Digital Postmark. (n.d.). Berne, Switzerland: Universal Postal Union. Retrieved November 10, 2008 from

http://www.upu.int/news_centre/documents/en/brochure_the_digital_postmark_security_for_cyberspace_mail_en.pdf

^{vi} Postmark Advertising is Halted by Protests. (1926, November 14). *The New York Times*. pp. XX22.

^{vii} Postmark Advertising. (n.d.). Singapore Post. Accessed November 20, 2008:

http://www.singpost.com/singpost_02_04_05postmark.htm

^{viii} North Pole History. (n.d.). North Pole, Alaska: City of North Pole. Retrieved November 10, 2008 from

http://northpolealaska.com/index.php?option=com_content&task=view&id=54&Itemid=58

^{ix} (1912, December 6). Lifts Ban on Santa Claus: Hitchcock Will Let His Mail Go to Charitable Institutions. *The New York Times*. p. 9. Santa Claus is the only addressee to which the U.S. Postal Service will legally deliver mail without postage.

^x (2006, December 11). North Pole, Alaska, flooded with Letters to Santa. *USA Today*.

http://www.usatoday.com/news/offbeat/2006-12-11-santa-mail_x.htm

^{xi} Other post offices play their part, too: such as North Pole, CO; Christmas, MI; and Santa Claus, IN. See: United States Postal Service. (2004, December 2). Holiday-Themed Postmarks. Washington, DC: United States Postal

Service. http://www.usps.com/communications/news/press/2004/pr04_087.htm

^{xii} As has been pointed out by Stefan Bechtold, an inspiration to this chapter. See: Bechtold, S. (2003). Governance in Namespaces. *Loyola of Los Angeles Law Review* 36.

^{xiii} For an example of one of the earliest uses of this term in this way according to the Oxford English Dictionary, see: Chapin, Ned. (1968). 360 Programming in Assembly Language. New York: McGraw-Hill, p. 17

^{xiv} Or namespace, if it contains names.

^{xv} Or at least in programming using languages that require the programmer to explicitly handle memory allocation and de-allocation.

^{xvi} For an excellent overview, see: Hacking, Ian. (1999). *The Social Construction of What?* Cambridge: Harvard University Press.

^{xvii} For an overview, see: Rodriguez-Pereyra, Gonzalo. (2008). Nominalism in Metaphysics. *Stanford Encyclopedia of Philosophy*. Stanford, California: Center for the Study of Language and Information.

<http://plato.stanford.edu/entries/nominalism-metaphysics/> and Mallon, Ron. (2008). Naturalistic Approaches to Social Construction. *Stanford Encyclopedia of Philosophy*. Stanford, California: Center for the Study of Language and Information. <http://plato.stanford.edu/entries/social-construction-naturalistic/>

^{xviii} Pickering, Andrew. (1999). *Constructing Quarks: A Sociological History of Particle Physics*. Chicago: University of Chicago Press.

^{xix} Many other relevant fields could be mentioned here, particularly semiotics, cognitive psychology, and science and technology studies. See: Bowker, Geoffrey C. and Starr, Susan Leigh. (2000). *Sorting Things Out: Classification and its Consequences*. Cambridge: MIT Press.

^{xx} For instance, on Japanese addresses see: Barthes, Roland and Howard, Richard (trans.) (1983). *Empire of Signs*. New York: Hill and Wang.

^{xxi} Indexing here is used in the sense meant in linguistics and semiotics. We could also say (after computer programming) that an addressee is “referenced” when an address is associated with it.

^{xxii} More precisely, we might say that centralization suffers, or centralized infrastructures administered by strangers suffer.

^{xxiii} This cost estimate refers only to a basic naming of major streets and buildings (about 8%). See: Farvacque-Vitkovic, Catherine; Godin, Lucien; Leroux, Hugues; Verdet, Florence; and Chavez, Roberto. (2005). *Street Addressing and the Management of Cities*. Washington, DC: The World Bank.

^{xxiv} For instance, “I need a sign” (Uganda) is “a fast-paced, straightforward and fun game for 3 to 9 players where players use tiles to define the city map, collaborate while developing the street addressing program, and compete to get the highest score by being the best at giving and following directions through the city as they guide service vehicles -police, firemen, ambulances, waste collection, etc.- to the places where their help and service is required.” See: World Bank Institute Game Design Winners Announced. (2007, April 3). Washington, DC: The World Bank. <http://go.worldbank.org/6VMBIHXS0>

^{xxv} Describing the work of artist Aleksandra Mir, who assigned all streets of Tokyo imaginary names. See: Simpson, Bennett. (n.d.). Aleksandra Mir: ‘Naming Tokyo (Part III).’ <http://www.aleksandramir.info/texts/simpson.html>

^{xxvi} “This city can be known only by an activity of an ethnographic kind: you must orient yourself in it not by book, by address, but by walking, by sight, by habit, by experience; here every discovery is intense and fragile, it can be repeated or recovered only by memory of the trace it has left in you: to visit a place for the first time is thereby to begin to write it: the address not being written, it must establish its own writing.” Barthes, Roland and Howard, Richard (trans.) (1983). *Empire of Signs*. New York: Hill and Wang. p. 36.

^{xxvii} See: Spirn, Anne Whiston. (1998). *The Language of Landscape*. New Haven: Yale University Press, p. 76.

^{xxviii} “Flat addresses use a single field with no particular relationship to geography or other hierarchy.” Irvine, James and Harle, David. (2002). *Data Communications and Networks: An Engineering Approach*. New York: John Wiley and Sons, p. 99

^{xxix} Dubendorf, Vern A. (2003). *Wireless Data Technologies*. New York: John Wiley and Sons, p. 95.

^{xxx} The Social Security numbering scheme is riddled with exceptions, but then again, most addressing systems are.

^{xxxi} Social Security numbering is in fact riddled with information and tradition. For instance, the two digit group number is sequenced so that odd numbers 01-09 are assigned first, then even numbers 10-98, then even numbers 02 to 08, then odd numbers 11 to 99. This means “96, 98, 02, 04” is a valid sequence, arranged in order. See: *The Social Security Number Verification Service Handbook*. (2008). Washington, DC: United States Social Security Administration.

^{xxxii} Snae, Chakkrit. (2006). Constructing a Rule Based Naming System for Thai Names Using the Concept of Ontologies. Paper Presented to the Workshop on Learning Structured Information in Natural Language Applications, 11th Annual Meeting, European Chapter, Association for Computational Linguistics, Trento, Italy. <http://www.aclweb.org/anthology-new/W/W06/W06-2612.pdf>

^{xxxiii} The most compelling literature deals with racial and gender discrimination. See: Bart, Barbara; Hass, Marsha; Philbrick, Jane; Sparks, Martha; and Williams, Craig. (1997). What's in a Name? *Women in Management Review* 7: 209-308. Bertrand, Marianne and Mullainathan, Sendhil. (2003). Are Emily and Greg More Employable than Lakisha and Jamal? Field Experiment Evidence on Labor Market Discrimination. NBER Working Paper No. 9873. Fryer, Roland G. and Levitt, Steven D. (2004). The Causes and Consequences of Distinctively Black Names. *The Quarterly Journal of Economics* 119(3): 767-805.

^{xxxiv} See: Sandvig, C. (2004). Welcome to 1927: The Creation of Property Rights and Internet Domain Name Policy in Historical Perspective. IN: P. Day & D. Schuler (eds.), *Community Practice in the Network Society: Local Action/Global Interaction*. New York: Routledge, p. 57.

^{xxxv} Although the first three digits (the exchange) would probably match.

^{xxxvi} My telephone number spells “snob ear.” See: What Does Your Phone Number Spell? (n.d.) <http://www.phonespell.org/>

^{xxxvii} For instance, consider “leetspeak,” e.g.,: The 133t Sp34K g3N3r4t0r v. 1.2. (n.d.) <http://ryanross.net/leet/>

^{xxxviii} Lee, Jennifer. (2001, January 16). Betting Your Heart on a Cell Phone Number.

<http://query.nytimes.com/gst/fullpage.html?res=9B02E6DE133DF935A25752C0A9679C8B63>

^{xxxix} Xinhua News Agency. (2003, August 19). Lucky phone number auctioned for 2.33 million yuan. *China Daily*. http://www.chinadaily.com.cn/en/doc/2003-08/19/content_256178.htm

^{xl} How to Sell a Personal Number Plate in the UK. (n.d.) http://www.ehow.com/how_4477741_sell-personal-number-plate-uk.html

^{xli} For an introductory review, see: Salthouse, Timothy A. (1986). Perceptual, Cognitive, and Motoric Aspects of Transcription Typing. *Psychological Bulletin* 99(3): 303-319.

^{xlii} I mean this sentence in the spirit of Actor-Network Theory, and in the sense of much writing in Technology Studies. See, e.g., Latour, Bruno. (2005). *Reassembling the Social: An Introduction to Actor-Network Theory*. New York: Oxford University Press.

^{xliii} Consider discussions of hashing (“name” or “key” vs. “value”), the use of the terminology of “names” vs. “numbers” in data communications, and so on.

^{xliv} It is sometimes called the “physical address,” although it is related to the link layer.

^{xlv} For instance, an IPv6 address: 2001:0db8:3c4d:0015:0000:0000:abcd:ef12

^{xlvi} Faraco, J. Carlos Gonzalez and Murphy, Michael Dean. (1997). Street Names and Political Regimes in an Andalusian Town. *Ethnology* 36, 2. <http://www.jstor.org/pss/3774079>

^{xlvii} Branson, Christie L. (2001). Was \$7.5 Million a Good Deal for Business.com? The Difficulties of Obtaining Trademark Protection and Registration for Generic and Descriptive Domain Names. *Santa Clara Computer and High Technology Law Journal* 17: 285-314.

^{xlviii} McKinney, David R. (1999). Telephone Mneumonics and Complementary Numbers: A Review of Trademark and Unfair Competition Law and Policy. *Brigham Young University Law Review*: 435-478.

^{xlix} Burk, Dan K. (1995). Trademarks Along the Infobahn: A First Look at the Emerging Law of Cybermarks. *Richmond Journal of Law and Technology* 1(1). <http://law.richmond.edu/JOLT/v1i1/burk.html>