STEWARDSHIP OF CYBERSPACE

DUTIES FOR INTERNET SERVICE PROVIDERS

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WHAT IS STEWARDSHIP IN CYBERSPACE?

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ABSTRACT

In today's interconnected world, the Internet is no longer a tool. Rather, it is a service that helps generate income and employment, provides access to business and information, enables e-learning, and facilitates government activities. It is an essential service that has been integrated into every part of our society. Our experience begins when an Internet Service Provider (ISP) uses fixed telephony (plain old telephone service), mobile-cellular telephony, or fixed fiber-optic or broadband service to connect us to the global network.[1] From that moment on, the ISP shoulders the responsibility for the instantaneous, reliable, and secure movement of our data over the Internet.

INTRODUCTION

ISPs come in many forms and sizes and go by many names: the phone company, the cable company, the wireless company, etc. They are the Internet stewards: planning and managing resources, providing reliable connectivity, and ensuring delivery for traffic and services. And while the communications infrastructure security as a whole is generally believed to be robust, recent events suggest that the networks and the platforms on which Internet users rely are becoming increasingly susceptible to operator error and malicious cyber attack. In 2012, we should therefore ask whether ISPs have additional duties to ensure the reliable delivery of an essential service.

In this article, we expose the gap between ISPs' written responsibilities and the unwritten, yet expected ones. Specifically, we define eight ISP duties:

1. Duty to provide a reliable and accessible conduit for traffic and services
2. Duty to provide authentic and authoritative routing information
3. Duty to provide authentic and authoritative naming information
4. Duty to report anonymized security incident statistics to the public
5. Duty to educate customers about threats
6. Duty to inform customers of apparent infections in their infrastructure
7. Duty to warn other ISPs of imminent danger and help in emergencies
8. Duty to avoid aiding and abetting criminal activity

[1] Services include: Public-switch telephone network (dial-up); Digital Subscriber Line (DSL) (usually copper), Asymmetric Digital Subscriber Line (ADSL); broadband wireless; cable modem (cable Internet); Fiber to the Premises (FTTx) (optical fiber); Integrated Services Digital Network (ISDN) (transmission of voice, video, data, and other network services over the traditional circuits); frame relay (wide-area network); Ethernet; Asynchronous Transfer Mode (ATM); satellite Internet access; and synchronous optical networking (SONET) (using lasers over fiber).

The latter duties are helpful in calibrating threats and funding responses to them.

The Internet is radically different from the plain old telephone service (POTS) that has provided voice communication since the nineteenth century. POTS established a "circuit" or path through the telephone network that remained constant during the communication session. The telephone network operated according to a strict, regimented set of processes and technologies that provided a highly reliable service, but adapted to change slowly. It did not have an application programming interface (API) to allow for third-party access and experimenting with telecommunication services was discouraged.

The Internet operates much differently. Long messages are decomposed into packets that move from source to destination following potentially different paths through the network. This is called packet switching. The Internet also provides a simple interface to communication networks that makes it easier for third parties to create innovative communication-based products to connect and access the Internet and providers to introduce a new generation of value-added services and applications. Yet, the Internet and the communications and services that ride on it rely on the integrity of routing and naming infrastructures. These two critical functions are essential to the proper functioning of the Internet.

ROUTING

The Internet is a network of networks. Networks consist of end systems, called hosts, and intermediate systems, called routers, connected via communication channels. Information travels through a network on paths chosen by a routing process that is implemented by routers. These paths automatically change many times a day, as congestion on one network might make an alternate path more attractive, or if a network has downtime – either intentional or not – so a new path is needed until the preferred path is restored.

Unfortunately, the technology in use today to ensure the Internet is operational is based on trust; it cannot give adequate guarantees that the expected network configuration is the one in place. As a consequence, one ISP can issue an update to another, whether by accident or by design, that will send Internet traffic to the wrong destinations. This lack of trust has resulted in major disruptions of Internet routing and can enable malicious activity, such as monitoring traffic, identity theft, and disruption of commerce.

NAMING

ISPs provide naming services to both their customers and other Internet users. Domain names are human-friendly names that are translated into Internet Protocol (IP) addresses, for example www.acme.com is a domain name, and 216.27.178.28 is its IP address. People like to use domain names and routers like to use IP addresses. Therefore, a system that converts one to the other was needed: the Domain Name System (DNS).

The DNS is the "telephone directory" that does this translation for the Internet. This "telephone directory" is implemented as a hierarchical collection of "servers." The DNS system was not designed to be inherently secure. When a request comes in to translate, a series of queries and responses occur until a mapping is found for the domain name in question. When a request is made, the requestor accepts the first response that it receives, and then uses it. Imagine asking a question to a room of strangers, and assuming that whoever answered the question first (regardless of accuracy) is truthful. This is what the DNS essentially does and this vulnerability can and often does result in end users being misdirected to fraudulent websites on the Internet.

The Domain Name System Security Extensions (DNSSEC) is a set of extensions to the underlying DNS protocol suite that was designed to address this problem, but it has not yet been widely implemented by ISPs. DNSSEC uses cryptographically signed messages to authenticate the sender, which ensures that only "authorized" entities can resolve a name to an IP address or answer the question.[2]

THE ROLE OF ISPS

Approximately twenty-five ISPs carry as much as 80 percent of all the Internet traffic.[3] They own and operate a critical infrastructure that facilitates the delivery of essential goods and services. As intermediaries and stewards of this infrastructure, they have an important role to play in fostering security.

When a new ISP connects to the Internet it implicitly agrees to certain terms concerning the transmission of packets, sharing of routing information, resolution of domain names, reporting on the status of the Internet, and handling emergencies.[4] Until now these understandings were not made explicit. But there should be an explicit duty to comply with technical aspects of Internet participation. Given the rapid rise in the Internet's complexity and the critical role the Internet has come to play in the global economy, providers should be obligated to be stewards of the global enterprise. We can no longer be one click away from an infection, disruption, or worse yet, no service.

DUTIES INCUMBENT ON ISPS

The major telecommunications providers and ISPs, collectively, have unparalleled access into global networks, which enables them, with the proper tools, to detect cyber intrusions and attacks as they are forming and transiting towards their targets. Today, some ISPs limit spam, notify customers of botnet infections, and partner with law enforcement to deny the distribution of child pornography.[5] Internationally, this collection of autonomously administered networks already adheres to common protocols, enables seamless global connectivity, and collaborates to ensure twenty-four/seven uninterrupted service. If nations worked together to define codes of conduct that all ISPs agree to follow, it would result in a more secure Internet infrastructure and service. Here are some duties to which ISP might subscribe.

[2] Cryptographic signing is a digital guarantee that information has not been modified, as if it were protected by a tamper-proof seal that is broken if the content is altered.

[3] Sriram Vadlamani, "The Top 25 Telecom Companies in the World, Based on Brand," Asian Correspondent.com, 12 April 2009, http://asiancorrespondent.com/515/top-25-telecom-companies-in-the-world-based-on-brand-value/. The Cooperative Association for Internet Data Analysis (CAIDA) show that the top twenty Autonomous Systems account for the majority of the IPv4 prefixes and addresses. http://as-rank.caida.org/ Also, DoubleClick AdPlanner for April 2011 show that the largest 25 of the top 1000 properties accounted for 80 percent of web traffic globally.

[4] A network that is under the administrative control of one organization is called an autonomous system (AS). There are approximately 40,000 ASes operating today. For the purposes of this paper, we treat the acronym ISP as a synonym for either ISP or AS. Routing within an AS is called intradomain routing whereas routing between ASes is called interdomain routing.

[5] A bot is a malicious form of software that could use your computer to send spam, host a phishing site, or steal your identity by monitoring your keystrokes. Infected computers are then controlled by third parties and can be used for cyber attacks.

1. Duty to provide reliable and accessible conduit for traffic and services

The Internet is a basic, ubiquitous, and essential communications tool for all of society. Governments around the world are adopting policies to facilitate citizen access to the Internet via a fast, reliable, and affordable Information Communications Technology (ICT) infrastructure. This vision is reflected in the Organisation for Economic Co-Operation and Development's (OECD) Internet Economy; Europe's Digital Agenda; the United States's National Broadband Plan; and in the International Telecommunications Union's (ITU) initiatives.[6] Economic progress, citizen access, and infrastructure quality are measured in terms of price, bandwidth, speed/quality of service, skills, content and language, and applications targeted to low-end users.[7] Progress is being made and these global initiatives are bringing faster broadband Internet access for every citizen to facilitate our information society needs and global e-commerce demands.

For example, Finland passed a law in 2010 legislating that every one of its citizens will have the right to access one megabit per second (Mbps) broadband connection, obligating twenty-six telecommunications companies to provide that quality of service.[8] Finland went on to amend their constitution to make broadband access a constitutional right. The United Kingdom promises to have a minimum connection of two Mbps to all homes by 2012.[9]

Government efforts to provide universal access at lower cost to consumers have been underway for decades. Telecommunications liberalization brought the promise of global income gains (economic growth) by making access to knowledge easier. The General Agreement on Tariffs and Trade (GATT) Uruguay Round (1986-1993) began the discussion among nations. It was further codified in the Marrakech Treaty in 1994, where the General Agreement on Trade in Services (GATS) principles called for the transparency of, access to, and use of public telecommunications transport networks (PTTN) and services "on reasonable and non-discriminatory terms." This included obligations for interconnection to PTTN (including private networks) as well as safeguards for public-service responsibilities (duty to warn) and to protect the technical integrity of the network (reliable service).

In 1997, the World Trade Organization (WTO) adopted a Basic Telecommunications Agreement (BTA) to liberalize facilities-based international service and to allow foreign entities to own a majority interest in facilities used to provide international voice and data service.[10] Examples of the services covered by the agreement include voice telephony, data transmission, telex, telegraph, facsimile, private leased circuit services (i.e., the sale or lease of transmission capacity), fixed and mobile satellite systems and services, cellular telephony, mobile data services, paging, and personal communications systems.

[6] The International Telecommunication Union (ITU) is the United Nations' specialized agency for information and communication technologies.

[7] *Measuring the Information Society*, 2011 International Telecommunications Union, Geneva, Switzerland.

[8] "1 Mbit Internet Access a Universal Service in Finland from the Beginning of July,"Press Release, 29 June 2010, Finland Ministry of Transport and Communications, http://www.lvm.fi/web/en/pressreleases/-/view/1169259.

[9] "Government Reveals Super-Fast Broadband Plans," BBC News, 6 June 2010, http://www.bbc.co.uk/news/technology-11922424.

[10] "Report on International Communications Markets 2000 Update," prepared for Senator Ernest F. Hollings, United States Senate Committee on Commerce, Science, and Transportation, Federal Communications Commission, 4 May 2001, 3.

In addition to the basic agreement, fifty-five governments agreed to value-added services (or telecommunications for which suppliers "add value" to the customer's information by enhancing its form or content or by providing for its storage and retrieval, such as on-line data processing, on-line database storage and retrieval, electronic data interchange, e-mail, or voice mail). The World Trade Organization's director-general, Mr. Renato Ruggiero, stated that "information and knowledge, after all, are the raw material of growth and development in our globalized world."[11]

The rapid adoption of technology and growing migration of essential services to be delivered on Internet-based infrastructure demands a re-examination of whether ISPs should be classified as nondiscriminatory. That is, must they treat all customers equally in terms of service or can they "discriminate?" Can we really say that the Internet or those who provide information services over the Internet deserve a similar degree of explicit responsibility as that assigned to "telecommunications service providers?"

Internationally, most nations do not distinguish between basic services (traditional modes of communications) and enhanced services (Internet-based services). However, the United States has made that distinction. The Telecommunications Act of 1996 created separate regulatory regimes for companies providing voice telephone service, cable television service, and providers of information services (broadband). The law did not necessarily envision the convergence of voice, data, and video services and infrastructures. A year after this law was enacted, the United States agreed at the WTO to treat both value-added services (Internet) and traditional communications (voice) in a nondiscriminatory manner. The Federal Communications Commission (FCC) or Congress should clarify this contradiction. Why? Because the rapid adoption of technology and growing migration of essential services to be delivered on Internet-based infrastructure demands that broadband and other Internet-based services be classified as core telecommunications services. This obligates the providers to deliver a *reliable* service that contributes to the stability and resiliency of the global communications infrastructure.

The United States and other countries are pursuing deeper integration of critical infrastructures with Internet-based technologies, like the "smart grid," a computerized network that facilitates electricity and information flows between homes and electrical suppliers; computerized health records; public safety alerts (Voice Over Internet Protocol); and next-generation air-traffic management. However, these essential services may not be built to the same standards for which the traditional voice telephone system was built. Broadband network reliability and resiliency are vital for all services that traverse a network, including traditional communications services. Our reliance on the dependable operation of communications networks is growing. Therefore, it may be necessary to expand existing communications reliability and resilience programs, including best practices and associated outage reporting, as these services transition from traditional modes of communications to Internet-based technologies. Outage reports and other reliability data collected by regulators provide insight on the overall health of communications reliability and security of the critical infrastructure and, where necessary, enables regulators to work with individual entities or the industry as a whole to bring

[11] "WTO Telecom Talks Produce Landmark Agreements," World Trade Organization, paper 16, 15 February 1997, http://www.wto.org/english/res_e/focus_e/focus16_e.pdf.

about improvements.[12]

The FCC realizes that it "needs a clear strategy for securing the vital communications networks upon which critical infrastructure and public safety communications rely."[13] Europe is already moving forward with streamlining its regulatory process as part of the Digital Agenda for Europe. Europe recognizes that compliance monitoring and enforcement of a nondiscrimination policy allows for more choices, at affordable prices, underpinned by a higher standard of service.[14]

Many nations have recognized that it is in their national economic interest to enhance access to and participation in the Internet. ISPs provide an essential citizen service – the Internet – and they also provide the conduit upon which other essential services depend (e.g., Smart Grid). Therefore, it is their duty to serve as reliable and accessible conduits to Internet traffic and services.

2. Duty to provide authentic and authoritative routing information

Interdomain routing (from ISP to ISP) occurs primarily through the Border Gateway Protocol (BGP).[15] BGP has become a standard because of its simplicity and resilience. Under BGP, each ISP announces destinations that can be reached via it and the paths that packets will take to these destinations. (Think of this as a message that says I am open for business, I can route your information, and if you send it to me, it will pass through these ISPs.) These announcements propagate to neighbours and eventually to all routers on the Internet. BGP relies on trust among the operators of gateway routers—routers between ASes—to ensure the integrity of Internet routing information. However, this trust has been compromised on a number of occasions, revealing fundamental weaknesses in this critical Internet utility and service.

When BGP vulnerabilities are exploited, Internet traffic can be misdirected and misused. For example, in February 2008, Pakistan Telecom was ordered by the Pakistan telecommunications ministry to prevent its users from viewing certain YouTube addresses. Announcements of short paths to these addresses were designed to draw traffic from within Pakistan to the provider who then proceeded to discard the traffic. Unfortunately, these announcements leaked from Pakistan and made portions of YouTube inaccessible to about two thirds of all Internet users for about two hours.[16]

On 10 April 2010, BGP users received an alert regarding a possible prefix hijack by China's largest ISP, China Telecom. For approximately fifteen minutes, this ISP generated approximately 37,000 unique prefixes that were not assigned to them.[17] This is what is typically called a prefix hijack and while the hijack had modest to minimal impact on total Internet traffic volumes, China was ten times more affected than the United States. This event underscores the

[12] "Audit Report: The Department's Management of the Smart Grid Investment Grant Program," United States Department of Energy, Office of Inspector General, OAS-RA-12-04, January 2012.

[13] *Connecting America: The National Broadband Plan*, The United States Federal Communications Commission, 16 March 2010.

[14] "Commission Launches Public Consultation on the Application, Monitoring and Enforcement of Non-discrimination Obligations in Electronic Communications," European Commission, 28 November 2011, http://ec.europa.eu/information_society/policy/ecomm/library/public_consult/non_discrimination/index_en.htm.

[15] K. Butler, T.R. Farley, P. McDanier, and J. Rexford, "A Survey of BGP Security Issues and Solutions," Proceedings of the IEEE, 98, no. 1 (January 2010): 100-122.

[16] Declan McCullagh, "How Pakistan Knocked YouTube Offline." CNET News, 25 February 2008, http://news.cnet.com/8301-10784_3-9878655-7.html.

[17] "Chinese ISP Hijacks the Internet," BGP.mon blog, 8 April 2010, http://bgpmon.net/blog/?p=282.

vulnerability of the BGP routing infrastructure and reminds us that an intentional criminal could store, alter, or just throw away the traffic.[18]

In the Chinese case, given the brevity of the incident and the fact that no traffic was known to have been lost, the redirection may have been an accident. However, as we learned a few years ago, it is possible for an ISP to create path announcements that can deliberately move traffic to a particular ISP where a man-in-the-middle attack can be perpetrated. In such an attack, packets can be read, modified, or destroyed.[19]

The only way to solve the BGP trust problem is to develop and administer a system that allows each step in the process to be signed and certified. Routers should be able to affirm with high confidence that each routing announcement has not been modified in transit and that the sender is authorized to make such an announcement.

Of the many proposals that have been made to meet the trust requirements, Secure BGP (S-BGP) is the most secure.[20] Unfortunately, it has not been deployed, possibly because at the time the proposal was made, it was considered to be computationally demanding and its implementation requires a global public key infrastructure (PKI). Although the situation has changed, adoption of S-BGP will be challenging due to the large number of routers now in operation globally. Through simulation and analysis, Gill and colleagues have made a convincing argument that by seeding large ISPs with S-BGP and having them provide attestations for stub ASes (85 percent of all ASes are stubs), profits will drive ISPs to adopt it.[21]

Packets can still transit from IP to IP without the DNS.[22] However, without BGP, packets can't move at all. Regulators around the world have begun discussions with industry regarding the adoption of secure routing procedures and protocols based on existing work in industry and the research we described. ISPs need a process or framework for securing BGP announcements that includes specific technical procedures and protocols. The framework, if adopted by large ISPs (even the leading ten or fifteen companies), could go a long way toward making the Internet a more reliable, secure service.[23] Protocols and infrastructure are needed for everyday use of the Internet. ISPs have a duty to provide authentic and authoritative routing information. To us, this means they should adopt S-BGP or something equivalent.

3. Duty to provide authentic and authoritative naming information

As we mentioned, the Domain Name System (DNS) is the "telephone directory" for the Internet. This directory is implemented as a hierarchical collection of "servers." There are thirteen root zone servers that contain the names of the top-level-domain (TLD) name servers associated with suffixes such as .mil, .edu, or .com. Each of these servers contains the names of subdomain name servers, such as brown.edu, which resolve or translate universal resource locaters (URLs) into IP addresses. The root zone, top-level, and subdomain name servers are authorized by the Internet Corporation for Assigned Names and

[18] "Chinese BGP Hijack Putting Things into Perspective," BGP.mon blog, 21 November 2010, http://bgpmon.net/blog/?p=323.

[19] Joel Hruska, "Gaping Hole Opened in Internet's Trust Based BGP Protocol," http://arstechnica.com/security/news/2008/08/inherent-security-flaw-poses-risk-to-internet-users.ars.

[20] See "Secure BGP Project," http://www.ir.bbn.com/sbgp/.

[21] Gill. P., Schapira, M, and Goldberg S. "Let the Market Drive Deployment: A Strategy for Transitioning to BGP Security," Proceedings of SIGCOMM 2011, 15-19 August 2011.

[22] Joel Hruska, "Gaping Hole Opened in Internet's Trust-based BGP Protocol."

[23] Ibid.

Numbers (ICANN) to provide name resolution. Thus, these servers are said to be authoritative.

For efficiency reasons, ISPs maintain DNS caches.[24] If a user asks for a translation that is not in the cache, the ISP finds it and inserts it into the cache. These entries have a time-stamp associated with them and are refreshed when the "time-to-live" limit is reached.

The DNS system may be designed for efficiency but not security. For example, when a computer or a DNS cache asks for the resolution of a domain name, a series of queries and responses to a root zone server, top-level-domain server, domain and subdomain server occur, in that order, until a mapping for the URL in question is found. When a request is issued at each stage of the transaction, the initiator accepts the first response that it receives to its query. This provides an opportunity for a man-in-the-middle attack in which a malicious agent can insert a response that directs the initiator to a nonauthoritative server. The DNS also provides a key function for IP applications such as VoIP. In some cases, when a user makes a call with VoIP, the user's machine will contact a DNS server to get the IP address of the called number. However, if the DNS cache is poisoned, the calls could be misdirected to somebody else who could then obtain the user's personal and confidential information.

Several dramatic abuses of the untrustworthy DNS system have occurred. Two recent examples demonstrate its vulnerability. In November 2011, the Federal Bureau of Investigation (FBI), working in cooperation with Estonian authorities and others, dismantled an international cybercrime ring that infected millions of computers worldwide by downloading a malicious piece of software (i.e., a Trojan) called DNSChanger.[25] This piece of malware changed the IP address of the DNS cache used by various computer operating systems so that instead of using a local, and presumably honest cache, it redirected the compromised machine to a compromised DNS cache. Not only could this Trojan evade the proscriptions of the recently introduced pieces of legislation of Stop Online Piracy Act (SOPA, H.R. 3261) and Protect Intellectual Property Act (PIPA, S. 968)—it also misdirected users to sites where they participated, unwittingly, in "click fraud." Clicks that appeared legitimate generated millions of dollars in income for the fraudsters. A recent report claims that DNSChanger continues to infect computers at half of the Fortune 500 companies and half of all federal agencies in the USA.[26]

A second example involves VeriSign, an American firm that operates two root servers, and three top-level domains (TLDs) namely the .com, .net, and .name domains. VeriSign announced that it had been repeatedly hacked in 2010 but that it does not believe that its DNS database servers were breached.[27] If their system was breached, trust in their management of key components of the DNS database would be seriously damaged.

The security extensions to DNS (DNSSEC) we mentioned were developed by the Internet Engineering Task Force (IETF) and are designed

[24] A cache is a file that holds copies of the mappings of domain names to IP addresses.

[25] "Operation Ghost Click: International Cyber Ring That Infected Millions of Computers Dismantled," FBI website, http://www.fbi.gov/news/stories/2011/november/malware_110911, 9 November 2011, accessed 5 February 2012.

[26] Brian Krebs, "Half of Fortune 500s, US Govt. Still Infected with DNSChanger Trojan" Krebs on Security, February 2012, http://krebsonsecurity.com/2012/02/half-of-fortune-500s-us-govt-still-infected-with-dnschanger-trojan/.

[27] VeriSign Annual 10-K Corporate Filing. See also, Joseph Menn, "VeriSign Hacked: Security Repeatedly Breached at Key Internet Operator," Reuters, 2 February 2012.

to address the vulnerabilities with DNS.[28] They rely on digital signatures to certify that the parties requesting updates to DNS mappings are authorized by a central trust anchor to make those changes. The bottom line is that DNSSEC is intended to improve data integrity on DNS connections through the authentication process. However in order for DNSSEC to work, it must be supported at every level of the DNS hierarchy, from root server to browser. A chain of trust must be established from the information producer to the information consumer. Without this unbroken chain of trust, opportunities for exploitation remain.

Today, most of the root servers are implementing DNSSEC and many of the TLDs are deploying DNSSEC. ISPs need to upgrade their systems and increase their technical knowledge to deploy DNSSEC deeper into the infrastructure. Accelerating the deployment of DNSSEC will help eliminate BGP vulnerabilities and bring a higher level of service quality to their customers. Because customers need assurance that their traditional voice, VoIP, email, video, or other service is going to get to its correct destination and maintain its integrity along the way, ISPs have a duty to provide authentic and authoritative naming information as part of their service.

4. Duty to report anonymized security incident statistics to the public

A major impediment to calibrating the scope and scale of security threats to the Internet is the paucity of public data. Some ISP customers are reluctant to have incident data concerning their enterprises or infrastructures reported out of concern for their reputations as responsible guardians of data being tarnished.[29] This lack of transparency limits the security product industry's ability to deliver products that perform with higher assurance levels. It also limits the research community's access to data that could facilitate idea creation and innovative solutions that increase security across the entire architecture.

ISPs should have a duty to report data sets, including but not limited to the (1) volume of spam in transit; (2) estimated number of compromised machines owned by customers of an ISP; (3) remediation steps proposed to customers by an ISP and actions the ISP has taken; (4) frequency, intensity, sources, and targets of distributed-denial-of-service attacks; (5) location, frequency, and duration of network outages and route disruption; and (6) the frequency, source, and target of cache-poisoning attacks, to facilitate solution development. It would also be helpful if the ISP reported event data that exceeded predetermined thresholds similar to their responsibilities when there is a disruption of communications service.

Initially it may suffice for only the largest ISPs to report such data. They have more resources at their disposal and they service the largest percentage of compromised machines.[30] Reporting incident data may either be encouraged

[28] Internet Engineering Task Force overview of DNSSEC, http://www.dnssec.net/rfc.

[29] Recent guidance issued by the Securities Exchange Commission (SEC) notes that all public companies have existing obligations to disclose material risks and events on their public filings (13 October 2011). A risk or event is material if it is important for the average investor to know before making an investment decision. The clarifying guidance states that "material risks can include cyber risks and material events can include cyber breaches, including the theft of intellectual property/trade secrets, penetrations which compromise operational integrity, etc." See http://www.sec.gov/divisions/corpfin/guidance/cfguidance-topic2.htm.

[30] According to Michel van Eeten, and others, in 2009 60 percent of all infected machines were in the top 200 of all ISPs. ("The Role of Internet Service Providers in Botnet Mitigation: An Empirical Analysis Based on Spam Data," OECD Science, Technology and Industry Working Papers, 2010/05.)

by national or transnational authorities or prohibited by law. For example, the European Parliament and Council of Ministers reached an agreement on pan-European telecommunications reform that is being transposed into national laws.[31] Section 13(a), "Security and Integrity of Networks and Services," of the Regulatory Framework for Electronic Communications in the European Union outlines a number of duties for ISPs. Among them is the duty to "notify the competent national regulatory authority of a breach of security or loss of integrity that has had a significant impact on the operation of networks or services; and where appropriate, the national regulatory authority concerned shall inform the national regulatory authorities in other Member States and the European Network and Information Security Agency (ENISA)."[32] The directive goes on to say that the regulators can ask the ISPs to "inform the public when it determines that disclosure of the breach is in the public interest."[33] Finally, the directive requires that "once a year, the national regulatory authority concerned shall submit a summary report to the Commission and ENISA on the notifications received and the action taken in accordance with this paragraph."[34]

In the United States, by contrast, many attorneys interpret the Electronic Communications and Privacy Act of 1986, along with the Telecommunications Act of 1996, as limiting ISPs' ability to share this data.[35] Aggregate threat data is collected by commercial security firms, such as Symantec and McAfee, which make it available to customers for a fee.

Because ISP customers are reluctant to have data released about their enterprises, their cooperation may require that safeguards be put in place, including keeping data private while allowing useful statistics based on the data to be computed. Such safeguards have been the holy grail of statistics since at least the 1970s.[36] In 2006, two papers emerged that provided a basis for showing how it is possible to give highly accurate responses to queries on statistical databases while minimizing the probability of identifying individual records.[37] The authors made a key observation—that privacy comes from uncertainty. Using this observation they defined the concept of differential privacy, which is based on query functions that use random numbers to generate results.

A randomized query function is said to offer differential privacy if the probability that it produces an outcome when a single element is in the data set is within a constant multiplicative factor of the probability that it produces the same outcome when the element is not in the data set. Thus, a differentially private query function behaves approximately the same whether

[31] "Regulatory Framework for Electronic Communications in the European Union," European Parliament Council, 2009. Specifically, see directive 2009/140/EC of the European parliament and of the council of 25 November 2009 that amends directives 2002/21/EC on a common regulatory framework for electronic communications networks and services, 2002/19/EC on access to, and interconnection of, electronic communications networks and associated facilities, and 2002/20/EC on the authorization of electronic communications networks and services.

[32] "Regulatory Framework for Electronic Communications in the European Union," European Parliament Council, 2009, p. 55.

[33] Ibid., p. 55.

[34] Ibid., p. 55.

[35] The Telecommunications Act of 1996. Pub. L. No. 104-104, 110 Stat. 56. Electronic Communications Privacy Act of 1986, Pub. L. No. 99-508, 100 Stat. 1848 (1986). Lawyers for the ISPs interpret the ECPA to prohibit the voluntary provision of customer data.

[36] Tore Dalenius, "Towards a Methodology for Statistical Disclosure Control," *Statistik Tidskrift* [Statistical Review] 15 (1977): 429-44.

[37] Cynthia Dwork, "Differential Privacy," in *Proceedings of the 33rd International Colloquium on Automata, Languages and Programming* (ICALP), 2: 1-12 and Cynthia Dwork, Frank McSherry, Kobbi Nissim, and Adam Smith, "Calibrating Noise to Sensitivity in Private Data Analysis," in *Proceedings of the 3rd Theory of Cryptography Conference* 2006, 265-284.

the element is in the data set or not. Functions of this kind have been developed for a large number of useful queries.[38]

If ISPs assumed the duty to report anonymized statistics on security incidents to the public, it would likely lead to the emergence of a standard of care or best practices for all ISPs to follow. It would also spark the development of innovative solutions and the deployment of better capabilities for enterprise and infrastructure protection.

5. Duty to educate customers about threats

Most ISPs deploy advanced technologies that detect malicious and harmful activity. They have unique insights on the scope and scale of cyber threats and incidents affecting our homes, businesses, and infrastructures. As such, they can also play a unique role in educating their customers about the threats. Customers who are able to recognize a threat and are presented with user-friendly resources/tools are capable of enhancing their security, and as a result are better poised to protect themselves. Government and industry educational resources are emerging in every corner of the world, many of which have an ISP as a critical component of the education campaign.

For example, in December 2011 a coalition of twenty-eight service providers, network operators, and equipment suppliers in the European market began working together to make a better and safer Internet for children ("Coalition").[39] The Coalition is a cooperative voluntary effort aimed at making it easier to report harmful content, ensuring privacy settings are age-appropriate, and offering wider options for parental control, reflecting the needs of a generation that is going online at an increasingly young age. European Commission Vice President Neelie Kroes said, "this new Coalition should provide both children and parents with transparent and consistent protection tools to make the most of the online world. The founding Coalition members are already leaders in children's safety online. Working together we will be setting the pace for the whole industry and have a great basis for fully empowering children online."[40]

In the United States, two projects have emerged worth noting. The first is a web-wide partnership entitled GetNetWise.[41] It is a public service funded and developed by Internet industry corporations and public interest organizations to help ensure that Internet users have safe, constructive, and educational or entertaining online experiences. The GetNetWise coalition wants Internet users to be just "one click away" from the videos, educational materials, and other helpful hints they need to make informed decisions about their and their family's use of the Internet. The service is facilitated by the Internet Education Foundation, a nonprofit organization dedicated to educating the public and policymakers about the potential of a decentralized global Internet to promote communications, commerce, and democracy.

The second program is the National Cyber Security Alliance (NCSA). Its sponsors include AT&T, Verizon, Microsoft, Google, McAfee, Symantec,

[38] Cynthia Dwork and Adam Smith, "Differential Privacy for Statistics: What We Know and What We Want to Learn," *Journal of Privacy and Confidentiality*, 1, no. 2 (14 January 2009): 135-54.

[39] Founding Coalition members are: Apple, BSkyB, BT, Dailymotion, Deutsche Telekom, Facebook, France Telecom-Orange, Google, Hyves, KPN, Liberty Global, LG Electronics, Mediaset, Microsoft, Netlog, Nintendo, Nokia, Opera Software, Research in Motion, RTL Group, Samsung, Sulake, Telefonica, TeliaSonera, Telenor Group, Tuenti, Vivendi, and Vodafone.

[40] "Digital Agenda: Coalition of Top Tech and Media Companies to Make Internet Better Place for Our Kids," Press Release, 1 December 2011, European Commission. http://europa.eu/rapid/pressReleasesAction.do?reference=IP/11/1485.

[41] GetNetWise, http://www.getnetwise.org/about/

Cisco, ADP, and many others. The organization's purpose is to educate and therefore empower a digital society to use the Internet safely and securely at home, work, and school, protecting the technology that individuals use, the networks they connect to, and shared digital assets. It develops and disseminates educational materials for home, classroom, and business use.

Australia commissioned a study to understand the depth of education initiatives around the world. The research report by Galexia documents more than sixty-eight different initiatives and highlights the different techniques used to educate consumers on the basics of cyber security.[42] The study notes that many of these initiatives help fight illegal and harmful online content and conduct while at the same time promoting the safer use of both the Internet and other communication technologies.

Other innovative activities include the fielding of video games to educate the public. In the United States there is a partnership between i-SAFE (a non-profit organization dedicated to educating and empowering youth (and others) and Carnegie Mellon University to safely, responsibly, and productively use Information and Communications Technologies (ICT). They are integrating an on-line game called "MySecure-Cyberspace" into thousands of K-12 programs across the United States.[43] Children play the game in a digital "city" and learn to secure key infrastructures and critical services. Children become aware of online security and privacy issues as they interact with the game's Carnegie Cadet characters in a virtual world. Similarly, the United Kingdom has launched an on-line virtual reality game entitled "Smokescreen" that guides teenagers through the dangers of social networking.[44] The game has over thirteen "missions" that place teenagers in situations that force them to ask themselves "what would I do if it happened to me?" What if ISPs promoted innovative educational materials like these? In a secondary educational campaign, the Ministry of Defense aired a number of television commercials alerting citizens of their responsibility for on-line security. The commercials present scenarios in which criminals, terrorists, and predators review personally posted data on YouTube, Twitter, Facebook, etc., to achieve their nefarious purposes.[45]

The cyber-security problem space is growing faster than the solution space. If ISPs undertake the duty to educate their customers about the threats, then our respective government leaders will be able to engage in a broader conversation about all of the solutions that can be brought to bear to address the problem comprehensively.

6. Duty to inform customers of apparent infections in their infrastructures

Media headlines throughout the past year have been rife with high-profile cybercrime events, confirming that insecure computers are being infected every day. Criminals have shown that they can harness bits and bytes with precision

[42] *An Overview of International Cybersecurity Awareness and Educational Initiatives*: A Research Report, Australian Communications and Media Authority, May 2011. http://www.acma.gov.au/webwr/_assets/main/lib310665/galexia_report-overview_intnl_cybersecurity_awareness.pdf

[43] "Cyber Education," Carnegie Mellon University, http://www.carnegiemellontoday.com/pdfs/news_pdfs/CMSecurity_Cyber-Education.pdf and the game is accessible on the web at www.mysecurecyberspace.com.

[44] The game is accessible on the web at http://www.smokescreen-game.com/ and "Smokescreen —A New Resource for Promoting Saftey Online." https://blogs.glowscotland.org.uk/glowblogs/ISRU-News/2010/05/06/smokescreen/.

[45] United Kingdom, Ministry of Defense Online Security Campaign. See "Personal Security Online" videos on YouTube at http://www.youtube.com/watch?v=hpKiIrYDLxg; http://www.youtube.com/watch?v=-UziYBdnQhk; http://www.youtube.com/watch?v=1UyWN0uREfk; and http://www.youtube.com/watch?v=qXZSzs-P2kQ.

to deliver spam, cast phishing attacks, facilitate click fraud, and launch distributed-denial-of-service (DDoS) attacks. The increasing frequency of these events in recent years and the scale of those affected have been alarming. Some estimates suggest that, in the first quarter of 2011, almost 67,000 new malware threats were seen on the Internet every day. This means more than forty-five new viruses, worms, spyware, and other threats were being created every minute – more than double the number from January 2009. As these threats grow, security policy, technology, and procedures need to evolve even faster to stay ahead of the threats.[46] A recent Symantec report suggests that these trends will continue.[47] Between 2010 and 2011 the numbers were discouraging.

- There were 286 million unique variants of malware that exposed and potentially exfiltrated our personal, confidential, and proprietary data;
- Each data breach exposed, on average, 260,000 identities;
- There was a 93 percent increase in web-based attacks (compromised/hijacked websites where the visitor would become infected);
- The underground economy paid anywhere from $.07 to $100 for each of our stolen credit card numbers; and
- Realizing that mobile payments and mobile platforms (e.g., smart phones and iPads™) would be the newest vector of technology adoption, there was a 42 percent increase in mobile-operating-system vulnerabilities and subsequent exploitation.

While consumer education is necessary, recent efforts have shifted toward having the ISPs act as the intermediary or control point for impeding the spread of infection and eradicating the malicious activity.[48]

Australian ISPs are showing the world that industry can organize and implement a consistent approach to help inform, educate, and protect their customers in relation to cyber security.[49] Thirty leading ISPs serving over 90 percent of the Australian market have opted in to providing a four-pronged security service, including: (1) a notification/management system for compromised computers, (2) a standardized information resource for end users, (3) a comprehensive resource for ISPs to access the latest threat information, and (4) a reporting mechanism to CERT Australia to facilitate a national high-level view of threat status. Australian customers are notified about suspicious activity, their ISP assists them stopping the infection, and if need be, the ISP quarantines them so that the computers cannot browse the wider web until they have been repaired. “The Australian experiment has been stunningly successful,” said Michael Barrett, chief information security officer for PayPal. “We will see more countries adopting this model.”[50] The Australian model is now promoted by the OECD, which found that

[46] Cybersecurity Green Paper, United States Department of Commerce, Internet Policy Task Force, June 2011, ii.

[47] “Symantec Internet Security Threat Report: Trends for 2010,” Volume 16, April 2011.

[48] According to a recent report by the OECD, “Internet intermediaries bring together or facilitate transactions between third parties on the Internet. They give access to, host, transmit and index content, products and services originated by third parties on the Internet or provide Internet-based services to third parties.” See “The Economic and Social Role of Internet Intermediaries,” OECD, 2010. Available online at www.oecd.org/dataoecd/49/4/44949023.pdf.

[49] “Internet Service Providers Voluntary Code of Practice for Industry Self-Regulation in the Area of Cyber Security,” Internet Industry Association (Australia), 1 June 2010, http://iia.net.au/images/resources/pdf/iiacybersecuritycode_implementation_dec2010.pdf.

[50] Joseph Menn, “US Starts to Tackle Hacking Curse,” *Financial Times*, 12 October 2011.

ISPs represent nearly 87 percent of the total market (service) in forty nations.[51] They also recognize that peer pressure among the ISPs is an important incentive that contributes to security and opting in to an overall program.

In Japan, more than seventy Internet service providers, representing 90 percent of the customer base, have assumed the duty to inform their customers of infections. ISPs notify consumers if their machines appear to be part of a botnet infection and offer government-funded tools offered through Cyber Clean Center (CCC) to clean the computers.[52] This voluntary program has shown remarkable reduction of infection rates. From 2007 to 2011, ISPs have reduced the rate of botnet infection from about 2.5 percent of personal computers to just 0.6 percent.[53]

In the Netherlands, Dutch ISPs signed an anti-botnet pact and jointly launched an initiative to fight malware-infected computers and botnets. The effort involves fourteen ISPs and represents 98 percent of the consumer market. ISPs are sharing information to obtain better coverage and reduce response times. They have accepted the responsibility to notify their victimized users and quarantine the infections until assistance can be provided.[54]

In Germany, the German Federal Office for Information Security (BSI) has mandated that its ISPs track down infected machines and provide advice to users on how to clean their computers.[55] Telefonica has taken this initiative further. It recently launched customer protection insurance against online fraud at a cost of five euro per month. "The customer and up to six family members are covered against data misuse, fraudulent online payment practices and theft or damage of the Telefonica Germany DSL router, modem or surf stick. Telefonica claims to be the first network operator to offer a customer protection insurance."[56]

And in the United States, Comcast is a market leader and early adopter of the duty to inform and protect its customers. Through its service known as Constant Guard, Comcast proactively contacts its customers via an email "service notice" if Comcast believes one or more of its customers' computers is infected with malicious software (e.g., it is a bot). Comcast's efforts in this regard have received the attention of the Federal Communications Commission (FCC).

Service providers, network operators, and equipment suppliers are working together as part of the FCC's Communications Security, Reliability and Interoperability Council (CSRIC) to propose a set of agreed-upon voluntary practices that would constitute the framework for an opt-in implementation model for ISPs to conduct botnet remediation. [57] This initiative is modelled after the Australian iCODE Project and, if widely adopted in the United States, could make a sig-

[51] "The Role of Internet Service Providers in Botnet Mitigation: An Emperical Analysis based on Spam Data." STI Working Paper, May 2010, Organisation for Economic Co-operation and Development, Directorate for Science Technology and Industry, 12-Nov-2010, p. 41.

[52] "Botnets: Detection, Measurement, Disinfection and Defence," European Network and Information Security Agency (ENISA), 2011, p. 98.

[53] Joseph Menn, "US Starts to Tackle Hacking Curse," *Financial Times*, 12 October 2011.

[54] Gadi Evron, "Dutch ISPs Sign Anti-Botnet Treaty," Dark Reading, 29 September 2009, http://www.darkreading.com/blog/227700601/dutch-isps-sign-anti-botnet-treaty.html.

[55] John Leyden, "German ISPs Team up with Gov Agency to Clean up Malware," The Register, 9 December 2009.

[56] "Telefonica Germany Offers Internet Insurance," Telecom Paper, 9 February 2012, http://www.telecompaper.com/news/telefonica-germany-offers-internet-insurance.

[57] CSRIC's mission is to provide recommendations to the FCC to ensure, among other things, optimal security and reliability of communications systems, including telecommunications, media, and public safety.

nificant difference in ensuring the health of their Internet backbone.

These examples show that ISPs are already assuming the duty to inform customers of apparent infections in their infrastructures principle. Some ISPs might participate strictly for business purposes—to reduce fraud, infections, and unnecessary bandwidth use. Others may engage for more altruistic purposes: they may wish to assume responsibility for the safety of the Internet and their users, perhaps at their own expense. Either way, “it is important that ISPs collectively battle this problem and protect their customers as well as prevent nuisance to the rest of the Internet,” says Albert Vergeer, director of Internet for KPN, XS4ALL, and Telfort.[58]

7. Duty to warn other ISPs of imminent danger and help in emergencies

ISPs have a unique view of the malware and activity transiting their infrastructure. They also have a responsibility to provide uninterrupted service to their customers. As we see more organized and semiorganized groups disrupt services and infrastructures in support of the “cause of the day” using DDoS or similar malware, ISPs may have to adopt and practise Good Samaritan behaviour.

Good Samaritan laws more typically apply in countries in which the foundation of the legal system is English common law.[59] In many countries that use civil law (i.e., the legal system inspired by Rome) as the foundation for their legal systems, the same legal effect is more typically achieved using a principle of duty to rescue.[60] Perhaps one of the best internationally recognized of these laws is the use of the SOS.[61] When a threatened party uses SOS, it triggers a duty to assist (DTA) that marshals available resources to help victims avoid or recover from harm. Similar duties to assist exist in both domestic and international contexts, such as a nuclear accident or a pilot’s Mayday call. Duncan Hollis has called for the creation of an e-SOS, a duty to assist in the case of cyber emergencies.[62] Even the North Atlantic Treaty Organization’s (NATO) has article 4, which is a consultation and information-sharing arrangement that activates when a member nation perceives its territorial integrity, political independence, or security is threatened.[63] Even the Telecommunications Act of 1996 contains a Good Samaritan provision to protect ISPs from liability when they act in good faith to block or screen offensive content hosted on their systems.[64]

To effectively defend the information infrastructure requires that private and public parties identify threats quickly and mitigate their impact effectively. As at sea, the timing and scale of some cyber threats can overwhelm the

[58] Gadi Evron, “Dutch ISPs Sign Anti-Botnet Treaty,” Dark Reading, 29 September 2009, http://www.darkreading.com/blog/227700601/dutch-isps-sign-anti-botnet-treaty.html

[59] Hyder Gulam and John Devereaux, “A Brief Primer on Good Samaritan Law for Health Care Professionals,” *Australian Health Review* 31, no. 3 (2007): 478–82.

[60] A duty to rescue is a concept in tort law that arises in a number of cases, describing a circumstance in which a party can be held liable for failing to come to the rescue of another party in peril.

[61] SOS is not an acronym, but a specific Morse Code, represented as “. . .---. . .” It was adopted as the standard distress signal in 1912 by the London International Telegraph Convention. G.E. Wedlake, SOS: The Story of Radio-Communication (Newton Abbot, UK: David & Charles 1973).

[62] Duncan Hollis, “An e-SOS for Cyberspace,” Harvard International Law Journal, 52, no. 2 (Summer 2011): 37.t

[63] The North Atlantic Treaty, 4 April 1949, North Atlantic Treaty Organization, http://www.nato.int/cps/en/natolive/official_texts_17120.htm.

[64] The Telecommunications Act of 1996. Pub. L. No. 104-104, 110 Stat. 56. The 1996 Telecommunications Act included a “Good Samaritan” provision to protect Internet Service Providers (ISPs) from liability when they act in good faith to block or screen offensive content hosted on their systems. Id. § 230(c).

most sophisticated individuals, groups, and even states. For example, in July 2009, the United States and South Korea fell victim to a DDoS attack against thousands of computers and major government, media, and financial websites. The attacks were launched from at least five different control hosts in multiple countries, including the United States. The United States government turned to industry to determine the origin and character of the threat and asked the ISPs to shut down the operations and restore services.

In Germany, the Anti-Botnet-Advisory Center helps customers remove botnet threats and other malicious software from their computers. The centre is supported by a group of ISPs that informs affected customers of their infections and then assists with specific tools to help the customer eliminate or eradicate the infection.[65] The centre is working with Norton, Kaspersky, and Avira to provide tailored software that "cleans" customer computers of malicious software. Similarly, the Finish Communications Regulatory Authority (FICORA) directs network operators to disconnect the infected machines of its customers from the Internet until the machine is disinfected.[66]

In late January 2012, the Polish government experienced multiple attacks targeting websites under the gov.pl domain. Most of the attacks were DDoS based, attributed to Anonymous, which declared radical protests after the Polish government revealed plans to sign the ACTA treaty on 26 January. Websites of the Polish Parliament, Ministry of Foreign Affairs, and Internal Security Agency were among the victims of these attacks. Organizers enjoy the fact that DDoS attacks are simple and efficient. You press a button and within seconds the targeted website stops responding. Minutes later news portals report about the incident. Collateral customers are then affected, including banks, media, telecommunications companies, and Polish Railways.[67] Governments like Poland turn to their ISPs to assist in the defence of their infrastructure, and work proactively to establish countermeasures and incident response plans to mitigate and minimize the potentially devastating impact of a determined and well-resourced opponent.

As more of industry moves its services to an Internet-based infrastructure, one could envision a digital crisis similar to the ash clouds over Iceland that halted air traffic around the world for days in the spring of 2010. While US laws focus on shielding from liability those who choose to help in a situation they did not cause, European laws criminalize failure to help in such a situation.[68] What if, for example, the e-ticketing of several major airlines and train systems was taken off-line? The duty-to-assist obligation could be demanded to help restore that service so that passengers could be ticketed and tracked, and packages moved. This is not an impossible hypothetical situation because a reservation systems breakdown for United Airlines in fact stranded thousands of passengers and disrupted flights around the United States in January 2006.

Given the integrated and global nature of the Internet and the central role played by the large ISPs, it is incumbent on them to honour the duty to assist other ISPs both to warn of imminent danger, such as an emerging attack, and to

[65] Safer Internet Surfing—Remove Threats, https://www.botfrei.de/en/ueber.html.

[66] Finnish Communications Regulatory Authority, http://www.ficora.fi/en/index/saadokset/ohjeet.html.

[67] "DDoS Against Polish Government Websites," http://www.cert.pl/news/4856/langswitch_lang/en.

[68] Nancy Benac,. "Good Samaritan Laws Common in Europe but Rare in America," *Wisconsin State Journal* (1997-09-05): 7A, ISSN 0749405X, Retrieved 2010-01-07. (Registration Required)

help when an attack or outage occurs that seriously injures or disables a neighbour ISP. ISPs could deploy a hotline phone system, like the Inter-Network Operations Center Dial-By-ASN (INOC-DBA), that connects "Network Operations Centers (NOCs) and Security Incident Response Teams (IRTs) of Internet infrastructure providers, operators of Internet exchanges, critical individuals within the Internet security, policy, emergency-response, and governance community, and equipment vendors' support personnel." [69]

8. Duty to avoid aiding and abetting criminal activity

The recent settlement by Google with the United States Department of Justice underscores a new responsibility for ISPs—that they have a duty to avoid aiding and abetting criminal activity. From 2003 to 2009, Google permitted online Canadian pharmacies to place advertisements through Google's largest advertising program called AdWords. This service facilitated the unlawful importation of controlled pharmaceuticals into the United States. In the settlement agreement, Google admitted to its knowledge of, and participation in, unlawful advertising.[70] It is unlawful[71] for pharmacies outside the United States to ship prescription drugs to customers in the United States.[72] "The Department of Justice will continue to hold accountable companies who in their bid for profits violate federal law and put at risk the health and safety of American consumers," said Deputy Attorney General Cole. "This investigation is about the patently unsafe, unlawful, importation of prescription drugs by Canadian on-line pharmacies, with Google's knowledge and assistance, into the United States, directly to US consumers," said US Attorney Neronha. "It is about holding Google responsible for its conduct by imposing a $500 million forfeiture, the kind of forfeiture that will not only get Google's attention, but the attention of all those who contribute to America's pill problem."[73]

The Google case study suggests that as soon as the ISP or host becomes aware that a content or activity is unlawful, it could be found guilty of aiding and abetting the offence if it does not take immediate action to prevent the activity.[74] In 1999, the District Court, The Hague found that an access provider was liable for having maintained a link which connected to a site containing counterfeit material and

> declares it to be the law that by having a link on their computer systems which when activated brings about a reproduction of the works that CST (the plaintiff) has the copyright to on the screen of the user, without the consent of the plaintiffs, the Service Providers are acting unlawfully if and insofar that they have been notified of this, and moreover the correctness of the notification of this

[69] INCO-DBA Hotline Phone Q&A, Packet Clearing House, https://www.pch.net/inoc-dba/docs/qanda.html (last visited 6 March 2011).

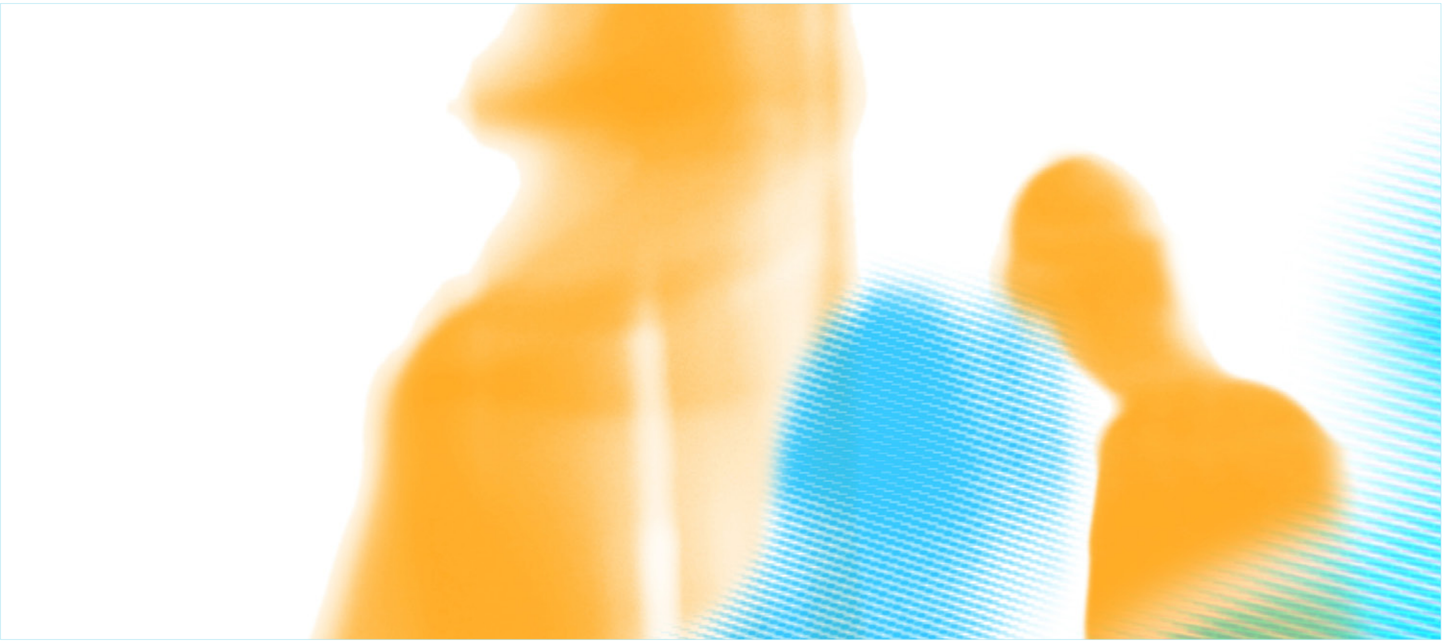
[70] Non-prosecution Agreement, http://googlemonitor.com/wp-content/uploads/2011/05/Google%20Agreement.pdf.

[71] These activities violate the Federal Food, Drug, and Cosmetic Act; Title 21 United States Code, section 331(a) and (d) (Introduction into Interstate Commerce of Misbranded or Unapproved Drugs). Where these prescription drugs are controlled substances, such conduct also violates the Controlled Substances Act, Title 21 United States Code, section 952 (Importation of Controlled Substances).

[72] Google Non-prosecution Agreement, http://googlemonitor.com/wp-content/uploads/2011/05/Google%20Agreement.pdf and "DOJ Pharmacy Investigation Undermines Google Credibility," http://betanews.com/2011/08/28/doj-pharmacy-investigation-undermines-google-credibility/

[73] "Google Forfeits $500 Million Generated by Online Ads and Prescription Drug Sales by Canadian Online Pharmacies," http://www.justice.gov/opa/pr/2011/August/11-dag-1078.html.

[74] On aiding and abetting, see the article by Sébastien Canevet, "Fourniture d'accès à l'Internet et responsabilité pénale" (Provision of access to the Internet and criminal liability).



> fact cannot be reasonably doubted, and the Service Providers have then not proceeded to remove this link from their computer system at the earliest opportunity.[75]

These cases can be extended to other forms of illicit or illegal behaviour conducted by customers or subscribers of those service providers. Other areas of the law substantiate this. For example, landlords can be held liable if they take inadequate precautions against criminal activity that harms tenants.[76] Entrepreneurs may be held liable if criminals use their premises to sell counterfeit or grey market goods.[77] Still others see it as a risk to their reputation. In March 2011, Microsoft decided that the Rustock botnet, the largest generator of spam in the world, was causing an Internet nuisance because it was damaging Microsoft products as well as its reputation. Accordingly, Microsoft turned to the courts to address the issue. On 16 March 2011, US Marshals accompanied employees of Microsoft's digital crimes unit into Internet hosting facilities in five US cities.[78] Using a federal court order, they seized the command-and-control servers that were responsible for manipulating an estimated one million computers worldwide.

Microsoft was not alone in its efforts to take down the Rustock infrastructure. The effort required collaboration between "industry, academic researchers, law enforcement agencies and governments worldwide."[79] Microsoft worked with pharmaceutical company Pfizer, the network security provider FireEye, Malware Intelligence Labs, and security experts at the University of Washington, each of whom attested in court to the dangers posed by Rustock and the impact

[75] "Legal Instruments to Combat Racism on the Internet," European Commission against Racism and Intolerance, http://www.coe.int/t/dghl/monitoring/ecri/legal_research/combat_racism_on_internet/Internet_Chapter3_en.asp; see details of the case on http://www.juriscom/net/elaw/e-law11.htm.

[76] See, for example, Sharp v. W.H. Moore, Inc., 796 p. 2d 506 (Idaho 1990); and Doug Lichtman and Eric Posner, "Holding Internet Service Providers Accountable," *John M. Olin Law & Economics Working Paper* no. 217 (July 2004): 9.

[77] See, for example, Fonovisa v. Cherry Auction, 76 F.3d 259 (9th Cir. 1996) and Doug Lichtman and Eric Posner, "Holding Internet Service Providers Accountable," 9.

[78] Bruce Sterling, "Microsoft Versus Rustock Botnet," *Wired*, 28 March 2011. http://www.wired.com/beyond_the_beyond/2011/03/microsoft-versus-rustock-botnet/.

[79] Ibid.

on the Internet community. Additionally, Microsoft also worked with the Dutch High Tech Crime Unit within the Netherlands Police Agency to help dismantle part of the command structure for the botnet operating outside of the United States. Moreover, Microsoft worked with China's Computer Emergency Response Team (CN-CERT) to block registrations of domains in China, a pro-active approach aimed at preventing the stand-up of future command and control servers. Finally, Microsoft's digital crimes unit worked with global ISPs and CERTs around the world to remediate the infections.

Microsoft demonstrated that a multinational corporation can and should be responsible for discriminating against the illegal activity operating on service provider infrastructures. The global cooperation that it enjoyed during the takedown of the Rustock botnet suggests that others may follow suit with a duty to avoid aiding and abetting criminal activity.

Because ISPs are a platform for global access they can also become an instrument for illicit or illegal activity. Individually, law enforcement agencies will never be able to defeat the clever tactics and agile criminal infrastructures. Therefore, ISPs must have a duty to avoid aiding and abetting criminal activity and must play an important role in addressing and deterring illegal activity, fraud, and misleading and unfair practices conducted over their networks and services. Internet-based activities should comply with the law and all parties have responsibility to improve the safety and stability of the Internet of the future, including individuals, providers, ISPs, and judicial authorities.

CONCLUSION

The Internet is both a critical infrastructure in itself and a key component of other forms of critical infrastructure, underpinning economic and social activity at a global level. This paper exposes the gap between ISPs' written responsibilities and the unwritten, yet expected ones. As our examples illustrate, precedents are emerging around the world for ISPs to shoulder more responsibility for the stewardship of the Internet. The first three duties contain the basic functions, the expected services that an ISP should undertake as part of their participation in the global internet: (1) duty to provide a reliable and accessible conduit for traffic and services; (2) duty to provide authentic and authoritative routing information; and (3) duty to provide authentic and authoritative naming information. Networks and the platforms on which Internet users rely should not be susceptible to operator error or cyber attack. We can no longer be one click away from an infection or worse yet, no service. As such, many countries are turning to their regulatory authorities to apply pressure on their ISPs to facilitate the adoption of these core functions.

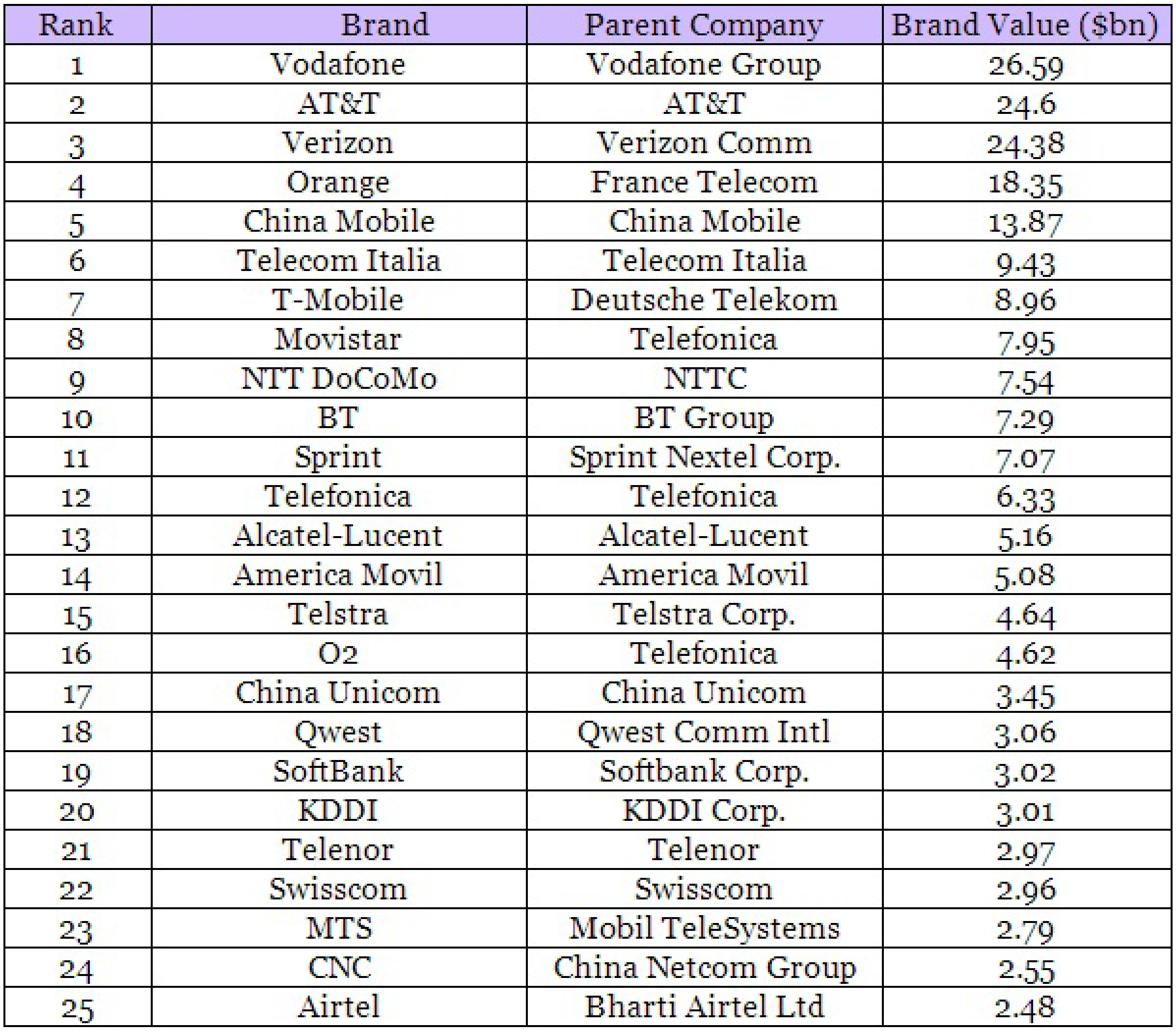
The next four duties usually fall outside of a regulatory regime, yet in many ways fall within our unwritten expectations or ISPs' social responsibility to maintain the security and integrity of the Internet as a global platform for communication and commerce. These duties are echoed in a recent OECD communiqué entitled, "Principles for Internet Policy Making."[80] The four duties of (4) duty to report anonymized statistics on security incidents to the public; (5) duty to educate customers about the threats; (6) duty to inform customers of apparent infections in their infrastructures; and (7) duty to warn other ISPs of imminent danger and help in emergencies, complement each other and help the Internet community to work together to stem the tide of the proliferating malicious activity that poisons our Internet experience and infects our Internet infrastructure. Today, some ISPs limit spam, notify customers of botnet infections, and partner with law enforcement to deny the distribution of child pornography. Some ISPs might participate strictly for business purposes— to reduce fraud, infections, and unnecessary bandwidth use. Others may engage for more altruistic purposes, like brand enhancement or a differentiated "secure" service by assuming responsibility for the safety of the Internet and their users, perhaps at their own expense.

Finally, while the Internet knows no specific geography, it facilitates activities between law-abiding nations. ISPs have a duty to avoid aiding and abetting criminal activity. Internet-based activities should comply with the law and all parties have the responsibility to improve the safety and stability of the Internet of the future, including individuals, providers, ISPs, and judicial authorities.

ISPs have an unparalleled access into and view of global networks, which gives them the proper tools to detect cyber intrusions and attacks as they are forming and transiting towards their targets. There are a limited number of ISPs that provide the world's Internet service (basic communication and enhanced services). If the leading fifteen or twenty companies were to become early adopters and market leaders for the eight duties of stewardship, they could make a significant difference in the overall security and resilience of the Internet. (The top twenty-five companies in 2009 by brand value are listed in Table 1.)

[80] "Communiqué on Principles for Internet Policy Making,"
Delivered at an OECD High-Level Meeting, The Internet Economy: Generating Innovation and Growth, 28-29 June 2011, Paris, France.

TABLE 1: TOP 25 TELECOM COMPANIES IN THE WORLD, 2009



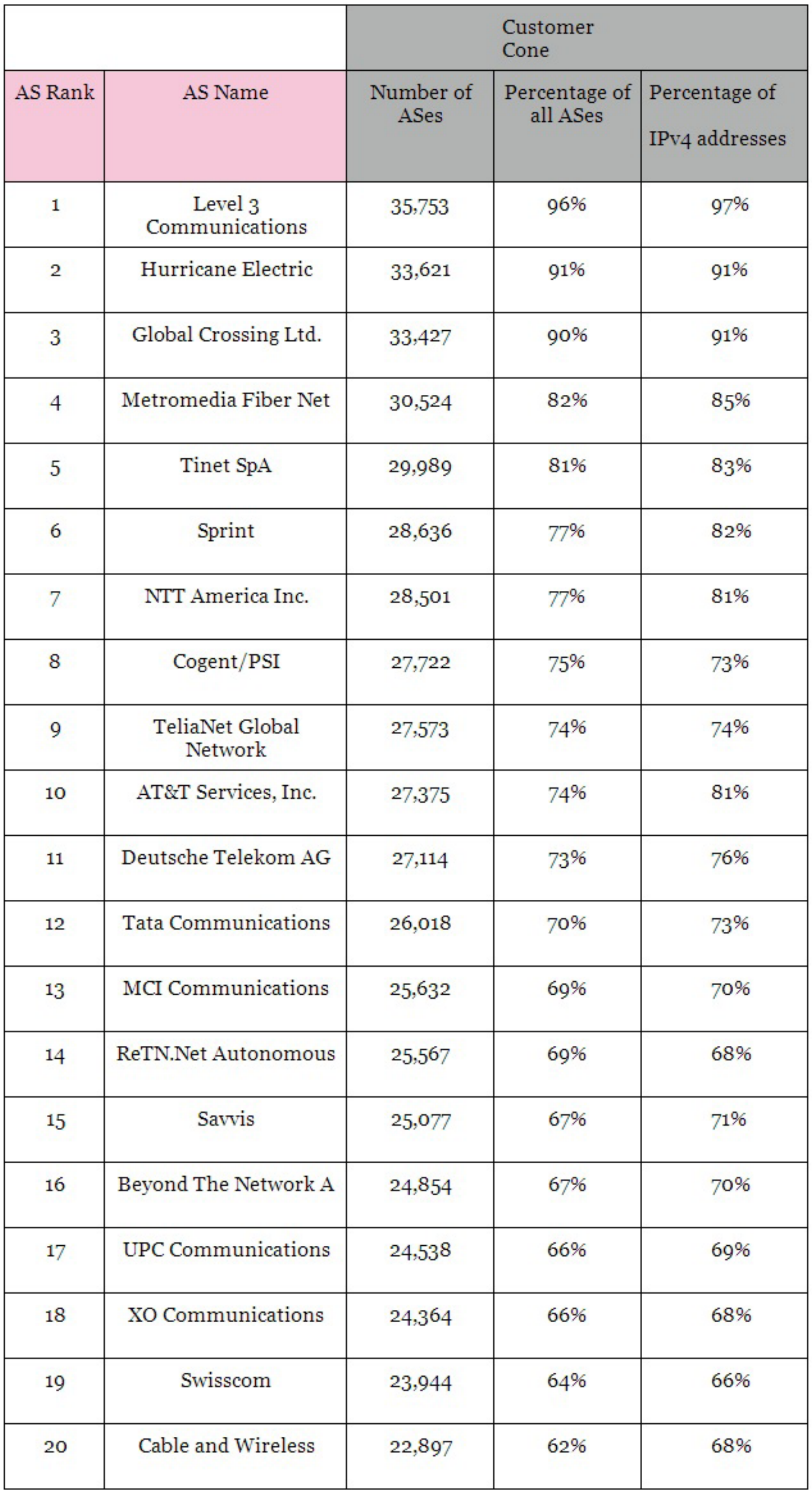
Rank	Brand	Parent Company	Brand Value ($bn)
1	Vodafone	Vodafone Group	26.59
2	AT&T	AT&T	24.6
3	Verizon	Verizon Comm	24.38
4	Orange	France Telecom	18.35
5	China Mobile	China Mobile	13.87
6	Telecom Italia	Telecom Italia	9.43
7	T-Mobile	Deutsche Telekom	8.96
8	Movistar	Telefonica	7.95
9	NTT DoCoMo	NTTC	7.54
10	BT	BT Group	7.29
11	Sprint	Sprint Nextel Corp.	7.07
12	Telefonica	Telefonica	6.33
13	Alcatel-Lucent	Alcatel-Lucent	5.16
14	America Movil	America Movil	5.08
15	Telstra	Telstra Corp.	4.64
16	O2	Telefonica	4.62
17	China Unicom	China Unicom	3.45
18	Qwest	Qwest Comm Intl	3.06
19	SoftBank	Softbank Corp.	3.02
20	KDDI	KDDI Corp.	3.01
21	Telenor	Telenor	2.97
22	Swisscom	Swisscom	2.96
23	MTS	Mobil TeleSystems	2.79
24	CNC	China Netcom Group	2.55
25	Airtel	Bharti Airtel Ltd	2.48

Alternatively, the top twenty Autonomous Systems (ASes) by customer cone size[81] could also assume broader responsibility for the health and hygiene of the Internet. These twenty ASes described in Table 2 (next page), which approximately map to ISPs, represent the broadest coverage of direct and indirect customer reach.[82]

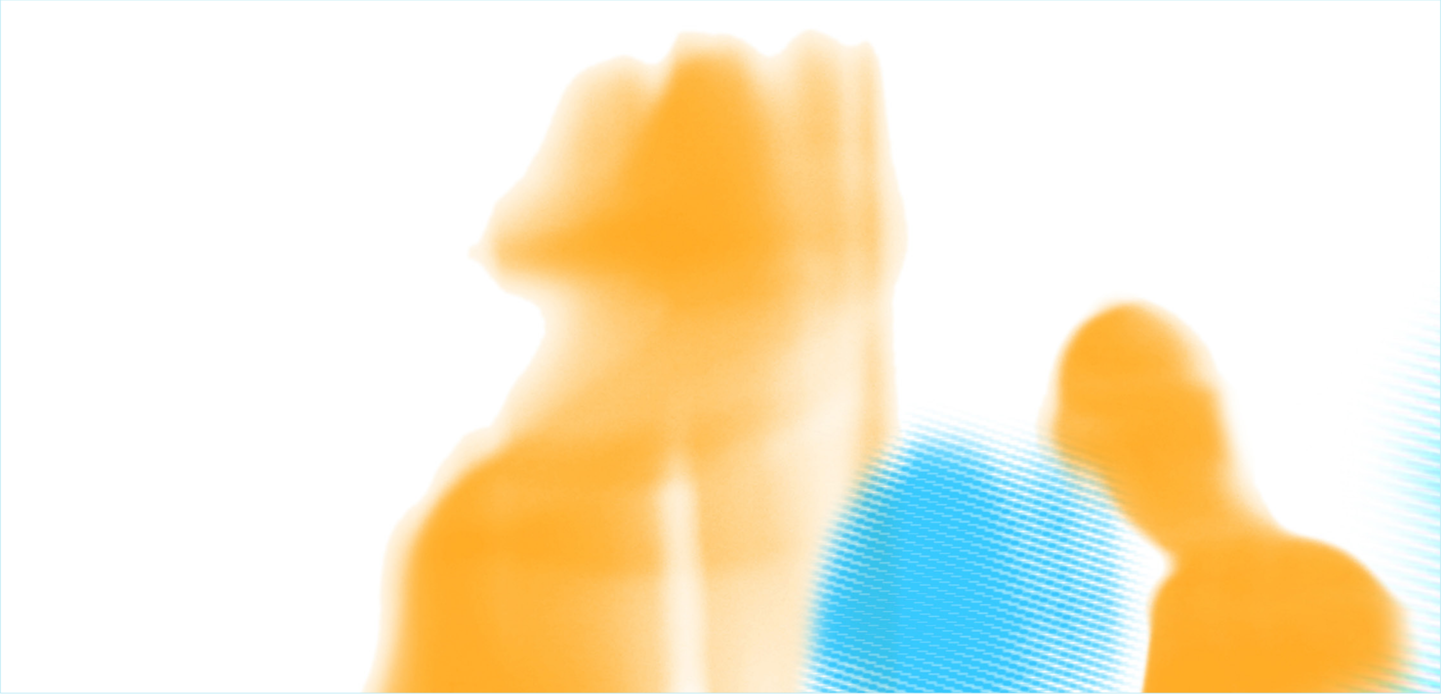
[81] Customer Cone refers to the set of ASes, IPv4 prefixes, or IPv4 addresses that can be reached from a given AS following only customer links.

[82] The Cooperative Association for Internet Data Analysis (CAIDA) shows that the top twenty Autonomous Systems account for the majority of the IPv4 prefixes and addresses (http://as-rank.caida.org/).

TABLE 2: TOP TWENTY ASES BY CUSTOMER CONE



		Customer Cone		
AS Rank	AS Name	Number of ASes	Percentage of all ASes	Percentage of IPv4 addresses
1	Level 3 Communications	35,753	96%	97%
2	Hurricane Electric	33,621	91%	91%
3	Global Crossing Ltd.	33,427	90%	91%
4	Metromedia Fiber Net	30,524	82%	85%
5	Tinet SpA	29,989	81%	83%
6	Sprint	28,636	77%	82%
7	NTT America Inc.	28,501	77%	81%
8	Cogent/PSI	27,722	75%	73%
9	TeliaNet Global Network	27,573	74%	74%
10	AT&T Services, Inc.	27,375	74%	81%
11	Deutsche Telekom AG	27,114	73%	76%
12	Tata Communications	26,018	70%	73%
13	MCI Communications	25,632	69%	70%
14	ReTN.Net Autonomous	25,567	69%	68%
15	Savvis	25,077	67%	71%
16	Beyond The Network A	24,854	67%	70%
17	UPC Communications	24,538	66%	69%
18	XO Communications	24,364	66%	68%
19	Swisscom	23,944	64%	66%
20	Cable and Wireless	22,897	62%	68%



Regardless of the methodology chosen (i.e., market penetration or by topographic connectivity) a small number of ISPs could lead the way in ensuring the reliability, integrity, and security of the Internet as a critical infrastructure and thereby put pressure on the rest to follow. ISPs do come in many forms and sizes and go by many names: the phone company, the cable company, the wireless company, etc. They have become the stewards of the Internet: planning and managing resources, providing reliable connectivity, and ensuring delivery for traffic and services. In 2012 we should ask the ISPs to assume the explicit and implicit duties outlined in this paper to ensure the reliable delivery of an essential service—the Internet. Upon implementing these eight duties they will likely recognize one more unstated duty that is in the best interest of their business: to use their purchasing power to design and deploy the next generation of technology that protects users and accounts for security at the onset. After all, meeting tomorrow's demands for network capacity, new applications, and an expanding base of users requires extending and investing in the infrastructure. Anticipating the next-generation security requirements up front makes perfect business sense.

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