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Access to Infrastructure

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Abstract

Access to infrastructure is a perennial issue in the field of communication, which started in the era of postal services and continues to the present era of broadband networks. As infrastructures, or large-scale systems, information and communication technologies (ICTs) are central to citizens' political, economic, and social lives. Historically and today, a variety of factors such as political and regulatory decisions impact access to infrastructure. Current concerns about equitable access include the network neutrality.

Keywords: access, communication and public policy, history of media and communications, information and communication technology, media convergence, media law and policy, media regulation.

Main Text

Access to infrastructure is the means as well as the opportunity to use the basic physical and organizational structures required for the operation of society. Infrastructures are the large-scale public systems, services, and facilities of a country or region that are necessary for commerce and social activity. All businesses and individuals depend on them to participate in all aspects of social, economic, cultural, and political life. Traditionally, states have provided infrastructures or regulated them heavily due to their central role in economic and social functions. There are several reasons for this: people, businesses, and governments all rely on infrastructures; they have significant externalities or indirect effects on activity; and they require large capital investments. States created government-owned postal, telegraph, and telephone monopolies to ensure access to infrastructure for their populations. Additionally, governments built infrastructure such as railways, currencies, and electrical systems. In cases such as the United States where the government did not choose to have a state monopoly over communications infrastructure, corporations historically built and maintained infrastructures and provided them on a monopoly basis and in return, the state has required them to fulfill public service obligations.

There are several dimensions of access to infrastructure in communication and information technologies (ICTs). These include physical access to the infrastructure, regulation of the infrastructure, ability to access end user services, access to equipment with which to use the infrastructure and/or service, digital literacy skills or the capacity to use the technology, access to content, and access to governance

or the ability to have a say in decision-making around the ICTs (Gillett, 2000; Clement & Shade, 2000). Geographical factors as well as socio-cultural factors, such as age, (dis)ability, and gender also impact access to, and use of, information and communication technologies. Access to infrastructure concerns two groups, those desiring access for the purpose of sending information and those needing access for the purpose of receiving informational content.

In communications, governments historically have separated access to infrastructure and associated policy making into two distinct groups, telecommunications and broadcasting, which have received different treatment. A central issue, discussed below, is the crumbling of the distinctions between these separate spheres, which impacts access to infrastructure in the digital era. In the following, access to infrastructure is decoupled from content and end user services, such as the internet, which are beyond the scope of this piece. The central focus will be on physical access to infrastructure by senders of information and the laws, policies, and regulations that influence this access.

HISTORY OF ACCESS TO INFRASTRUCTURE

Postal Systems

Postal monopolies were the first centralized network systems in communication. Postal systems in Europe originated in the early 16th century in the Hapsburg Empire, where monarchs granted exclusives privileges to private companies. Later postal systems became state-run monopolies. At first, postal systems catered exclusively to official state and military communications and were transmitted over a limited range (Starr, 2004; Noam, 1987). In the early 1600s both France and Britain opened their postal systems to the public. Although Britain's Royal Mail opened to the public in 1635, it was a non-uniform system that was expensive to use. The Royal Mail adopted postal reforms in 1840 that featured a uniform rate of one penny for mail under one half an ounce regardless of the distance the letter traveled within the country. The rate reform greatly increased the volume of mail sent through the Royal Mail.

In the 1600s, the British post interconnected to the continental network. International postal services were a complex problem and became more so in the mid-1800s when improvements allowed for more rapid transportation and demand grew. In the early 1860s, delegates from the European and United States postal services met to simplify procedures for transmitting mail between systems. Work continued for over a decade and in 1875, the group established the General Postal Union, the precursor to the Universal Postal Union (1878) governed by the Universal Postal Convention. The body became an agency of the United Nations in 1948.

Postal systems are common carriers, they carry letters, newspapers, periodicals, and parcels without discrimination at just and reasonable rates. As state-owned monopolies, however, at times authorities used the postal system to surveil opponents and censor contentious material. For example, in 1835 in the U.S. state of South Carolina, U.S. postal officials removed abolitionist newspapers from the mail despite having sworn an oath to expeditiously transmit all mail without discrimination (John, 1995). Thus, postal services have not always upheld their obligations as common carriers.

The post office operated as a central government department and the Postmaster General sat in the Cabinet, the decision-making body of the British government's executive branch. In the 1960s, the government considered converting the post office into a nationalized industry. In 1969, the Post Office Act passed and in October of that year, the Post Office department became the Post Office Corporation. The Royal Mail endured a privatization attempt between the 1980s and early 1990s, but the government

decided against the change. In October of 2013, however, the government sold sixty percent of the Royal Mail in a public offering in an effort to increase the system's competitiveness and its access to private capital.

Telegraphy and Telephony

The electric telegraph entered the communication scene in the 1840s and the telephone over thirty years later in the 1870s. For nearly a century, traditional telegraphy and telephony were centralized network systems operated by a monopolist. In most of the world, the operator was a government administration, commonly called a post, telegraph, and telephone (PTT) authority. In Britain, private companies originally provided electrical telegraph service. The British government nationalized the telegraph in 1870 in response to business and press anger over increased rates levied by the private telegraph companies and it became a part of the British Post Office. The post office slashed rates and operated the telegraph as a social utility which vastly increased the number of messages the telegraph system handled, but this program eventually retarded the growth of telephony due to system deficits accrued from low telegraph rates (Hochfelder, 2000). In contrast, in the United States and Canada, private companies operated the centralized network system with the approval and oversight of government regulators.

A foundational concept to access to centralized network systems, the common carriage principle, has a long history. Originally developed in English common law to regulate overland carriers, legislators adopted the principle into telegraph and telephone policy. As common carriers, telephone and telegraph companies had to allow fair and equitable access to the means of transmission at prices that were both just and reasonable. Common carriers in the transportation realm were liable for the goods they transported. Telecommunications providers, in contrast, had only limited liability for messages sent.

The first requirement of common carriage, that common carriers had to provide non-discriminatory access to the telegraph and telephone lines, meant that the companies could not refuse to transmit messages due to the content of the message nor the identity of the sender. Additionally, an important outcome of common carriers' obligation to provide non-discriminatory access to their services meant they had to interconnect their lines with those of other carriers, including competitors. As such, a company could not refuse to send messages to connecting lines, even when operated by competitors (Horwitz, 1989). This requirement is important because it meant that telecommunication companies did not have editorial control over the messages they transmitted. To ensure telegraph and telephone companies faced no conflicts in this matter, governments and regulators viewed telecommunication companies as conduits and forbade them from owning or investing in content. The second requirement of common carriage is that common carriers had to provide access at just and reasonable prices.

Most European countries, including Austria, France, the German Empire, and Switzerland viewed the telephone as an extension of their postal-telegraph monopolies and most had nationalized the provision of telephony by 1900. In Britain, telephony was introduced in 1870 with the General Post Office providing the trunk lines, or those running between cities, and private companies providing local service. In 1912, however, Britain nationalized the local telephone lines creating a public monopoly operating under the purview of the post office. When the post office became a corporation, telecommunications remained under the post office. The telecommunications arm of the post office, Post Office Telecommunications, was renamed British Telecom in 1980.

The British Telecommunications Act of 1981 changed the structure of telephony in Britain. First, the act separated British Telecom from the Post Office and it became a corporation on its own. Additionally, the act introduced competition into the UK telecommunications industry. The Secretary of State for Trade and Industry became responsible to license operators to establish telecommunications systems. Also, the Secretary of State worked on standards for third party telecommunications equipment and required BT to connect approved devices to its network. The following year, the Secretary of State licensed Cable & Wireless, a multinational telecommunications company based in the UK, to provide domestic telecommunications through a subsidiary, Mercury Communications. These changes are called liberalization, the process of opening up a market to competition.

Following the liberalization of the telecommunications market, the government started to privatize British Telecom, by selling over half of the company's shares to private investors. The Telecommunications Act of 1984 provided the legislative consent for the privatization and that same year, the government sold shares to the public. In 1991 and 1993, the government sold its remaining shares in the company. In the liberalized market, British Telecom no longer had a monopoly and it had to secure a license like other telecommunications providers. In 1991, government policy changed to further open telecommunications and allow for competing providers.

Following the privatization of British Telecom, the government created a regulator, the Office of Telecommunications (OfTel), to regulate competition. In late 2000, OfTel required BT to provide local loop unbundling, allowing competing telecommunications firms to use BT's infrastructure. The Office of Communications (Ofcom) replaced OfTel following the Communications Act of 2003. The act changed the way telecommunications were regulated and outlined conditions to offset the substantial market power of dominant telecommunications carriers which could include the requirement to interconnect with other network operators, be non-discriminatory, and submit to price controls. BT retains its universal service obligations for the United Kingdom which include connecting customers to the wired telephone network, providing for customers with special social needs, and providing public telephones.

Radio Broadcasting

Access to radio and television broadcasting infrastructure differs substantially from access to telecommunications. While telegraph and telephone companies are common carriers, broadcasters operate on a contract carriage system where they allow access to their networks on a discretionary basis. They are permitted editorial control; broadcasters choose which content to air and which to decline. Broadcasters negotiate private contracts with content providers, and can charge different programmers different amounts for access. Radio and television have barriers to access to the infrastructure due to the high cost of establishing a traditional radio or television station and the policies and regulations in place restricting which entities could broadcast.

Radio in Britain began with wireless telegraphy. In 1904, the government passed the Wireless Telegraphy Act, requiring wireless transmitting stations and receivers to have a license from the Post Office. British broadcasting began with a handful of amateur broadcasters but the General Post Office closed these stations and sought to limit broadcasting to two entities, despite interest from several more. To determine the structure of radio broadcasting, in 1921, officials from the Post Office met with radio manufacturers. The result of the meetings was the creation of one manufacturer-owned corporation that was owned by the manufacturers, the British Broadcasting Company (BBCo). By late 1922, the BBCo broadcast from London, Manchester, Birmingham, and Newcastle. The company received a two-year license from the Post Office in 1923. The Post Office charged a license fee on radio

receivers which provided funding for broadcasting operations. As the BBCo broadcast, committees were charged to investigate the future form of radio broadcasting in Britain. As a result of these committees, in 1927 the BBCo became a public corporation, the British Broadcasting Corporation (BBC), with a royal charter to be operated on a principle of public service (Starr, 2004; Winston, 1998). The BBC was to be independent of government control, although the Post Office retained control over broadcasting hours, wavelengths, and the power of the stations. The BBC had to fulfill certain public service obligations, including the requirement that it inform, educate, and entertain the public. A board of governors oversaw the public broadcaster.

At the BBC, officials believed broadcasting had a cultural, moral, and educational role to improve British subjects. Before 1996, officials at the BBC debated about what types of programming should be aired and decided which programs to commission. Programs were produced in house at the BBC and producers competed amongst each other for commissions. After 1996, broadcasting and production separated and the broadcasting arm could commission program ideas from independent producers. Unlike telegraph and telephone systems, broadcasters played an active role in selecting and creating the content flowing over the airwaves. The vast majority of countries operated broadcasting as a state monopoly until late in the twentieth century.

The content provided by public broadcasters did not satisfy all listeners. To fulfill unmet listener tastes, unlicensed broadcasters cropped up to provide different content to listeners. These so-called "pirate" radio stations were difficult for authorities to control. To work around the UK's state monopoly on broadcasting, "pirate" radio stations, operated from ships or barges off-shore and outside of territorial waters. These stations provided an alternative to the BBC during the 1960s and 1970s. Primarily, pirate stations in Britain broadcast popular rock music using the American, disc-jockey format that the state broadcaster did not provide. Additionally, the high-power station Radio Luxembourg broadcast popular music into the United Kingdom, interfering with the BBC's broadcast monopoly.

The BBC had a radio monopoly in the United Kingdom until the 1970s when the government permitted independent local radio stations. The first of these, the London Broadcasting Company (LBC) began broadcasting in 1973. The advertising-supported, independent local stations were meant to supply the programming that youth audiences sought. In the mid-1980s, the independent local stations became akin to commercial radio stations, prioritizing profits over local public service. A decade later, independent radio stations in Britain had become consolidated and owned by a few companies that abandoned the production of local content and provided narrow genre formats to listeners (Stoller, 2010).

Television Broadcasting

Terrestrial television broadcasting began in Britain as a public experimental service in the late 1930s, only to be interrupted by lack of interest as well as the outbreak of World War II. Television broadcasting began again in the post-war period starting with one transmitter in London. In 1952, the BBC built a network of transmitters capable of reaching nearly 80 percent of the population. At this time, there was only a single television channel.

The Broadcasting Act of 1954 permitted the establishment of commercial television. In 1955, "Independent Television" or ITV launched, a network of independent, regional broadcasters providing television services to compete with the BBC's offerings. In addition, the Act created the Independent Television Authority (ITA) to regulate the commercial broadcasters. The ITA owned and operated the television transmitters and provided regional franchises to companies that created the content. Like the

BBC, the independent broadcasters had to entertain, educate, and inform audiences. The government, responding to the competitive pressures on the BBC brought on by ITV, provided the BBC with a second television channel, BBC-2, in 1964. This channel was to provide programming with popular appeal (Crisell, 2005). A fourth television channel dedicated to special interest content, Channel 4, began in 1982.

Cable and Satellite Television

In the UK, cable and satellite television providers joined the television landscape during the 1990s. This was a period of neo-liberalism, a doctrine that favored market forces as regulation and valued increased consumer choice. The 1990 Broadcasting Act, based on this ideology, did not outline regulations for cable and satellite television. Instead, the government left the regulation of these broadcasters to the market place. In the UK, cable systems were slow to develop as investors did not fund them. By 1988, cable systems were only available to 300,000 homes across the UK and only a fraction of these homes subscribed.

In 1977, the World Radio Administrative Conference allotted the UK five digital television channels. Originally, the BBC planned to use the channels but was unable to secure adequate funding for the venture. Therefore, the BBC withdrew. In 1986, the Independent Broadcasting Authority (IBA) asked for a commercial venture that wanted to use the digital channels, would follow public service mandates, and be on the air before 1990. The IBA awarded the contract to British Satellite Broadcasting (BSB), a consortia. The transmission technology BSB was required to use delayed the launch of the service. In 1989, before the technology issue was sorted, the Australian media owner Rupert Murdoch launched Sky satellite television. Sky used the Luxembourg Astra satellite and ignored rules about the required transmission technology, using a less-expensive and immediately available device. The UK government did not stop Murdoch's venture. By providing service before the IBA-selected BSB, Sky had the first to market advantage and amassed subscribers, eventually merging with BSB to become BSkyB. This provider quickly became dominant in the analog satellite market (Smith, 1999).

BSkyB's dominance in the analog satellite market led the Independent Television Commission to utilize economic regulations to ensure that the company's dominance in one market did not mean it would use its power to become dominant in digital television. BSkyB's customers had set top boxes, or decoders, that would give them conditional access to the television signals they paid to receive. As the dominant company, BSkyB had advantages in the pay television market because its customers already had its set top boxes and would not likely change the company they subscribed to or purchase a second set top box. To constrain these first mover advantages, European Union regulations on cable and satellite system owners, the Advanced Television Services Directive of 1995, calls for access to digital encryption services to be proved on fair, reasonable, and non-discriminatory terms to third party broadcasters and requires member countries to ensure this occurs. Two years later, the UK government acted to implement the EU directive. At central issue was which body would regulate oversee interconnection of competitors to conditional access systems, Oftel, the telecommunications regulator or ITC, the broadcast regulator. The government eventually chose to regulate conditional access systems as telecommunications, and put them under the purview of Oftel.

ACCESS TO BROADBAND INFRASTRUCTURE

In the past, governments operated and regulated telecommunications and broadcasting systems separately. As outlined above, historically telephone companies operated as common carriers and broadcasters were permitted editorial control over the messages transmitted. These separate systems, however, converged. Traditional communications systems and media were analog; whereas currently text, audio, and visual materials are created, stored, and transmitted in digital formats. Viewing digitization as a means to more efficiently provide services to consumers, telephone and cable providers digitized their services. The internet also allows people to create, transmit, and store text, audio and visual materials digitally. Digital technology has led to the convergence of the formerly separate systems of telecommunications, television, cable, and computing technologies. Technological convergence was assisted by philosophical changes by governments around the world, which transitioned from favoring traditional state monopoly carriers to systems regulated by competition. The era of liberalization which began in the 1970s favored competition and governments and regulators began to desire previously separate systems, such as the telephone and cable systems, to compete with each other in the provision of telephone and television services. The current communications environment includes incumbents with legacy networks, new competitors, and plans to upgrade infrastructure to next generation networks. While communications systems historically provided vertically distinct, single services through one infrastructure, the internet protocol can provide voice, data, and video over any physical network infrastructure. This change leads to horizontal, multi-service, and converged markets for telecommunications.

Questions around broadband and next-generation networks center on what is commonly called network neutrality. While there are multiple definitions of the term, in general, the concern is that broadband providers might discriminate in favor of some applications, such as those they own or have a financial interest in, or they may slow traffic to sites that do not pay for higher service tiers without regulation to rein in such anti-competitive behavior (Wallsten & Hausladen, 2009). The basic concern of network neutrality is the providers will favor or discriminate against particular network content. To cope with the rapidly changing communications environment, governments have used three different forms of regulation: structural separation, access regulation, and unregulated competition (Kirsch & von Hirschhausen, 2008).

Network Neutrality and Competition in the United Kingdom

The United Kingdom is using structural separation to regulate advanced telecommunications. In 2005, Ofcom released the Telecommunications Strategic Review outlining new regulatory directions for the telecommunications sector in the UK. Information services in the UK rely on BT's copper wire legacy network. The review found bottlenecks to competition within this fixed telecommunications system, specifically the supply of wholesale access and backhaul network services, and called for strategies to promote competition between competing infrastructures. Ofcom, however, realized that competitors had to rely on BT for network access where competition was unsustainable. To overcome this problem, Ofcom adopted an equality of access approach meaning that BT had to make access to the network available to competitors on the same terms access was available to BT itself (Ofcom, 2005). To implement equality of access, Ofcom selected structural separation as the regulatory choice for ensuring non-discrimination. In response, BT created Openreach, a separate access services division, to manage the UK's telecommunications infrastructure. Openreach treats BT's retail and wholesale businesses the same as other operators desiring access to the infrastructure.

In the United Kingdom, net neutrality became an issue in 2007 when the BBC released the iPlayer, a service that allows people to watch BBC programming online for seven days after its original broadcast date. Internet service providers (ISPs) in the UK worried that the potential popularity of the iPlayer would overwhelm networks and decrease the quality of service that all ISP users received. As such internet service providers complained that the BBC was offloading its distribution costs onto the ISPs and they demanded that the BBC pay for costs imposed on the network due to the bandwidth requirements of the service. They threatened to throttle, or slow down, traffic from the iPlayer to customers' devices if the BBC did not help to offset the costs for network upgrades. In response, the BBC installed additional servers around the UK to help manage the traffic. Despite the row over the BBC's iPlayer, the UK government rejected creating network neutrality legislation in its 2009 report "Digital Britain" and noted that they would not prohibit network traffic management except in cases where it is used in an anti-competitive manner.

Network Neutrality in the United States

In the United States, the national regulatory body, the Federal Communications Commission (FCC) regulates telecommunications services as common carriers whereas information services that provide and manage information, such as cable, DSL, and broadband, are not common carriers and remain unregulated. This distinction has played a central role in the network neutrality debate in the United States as information services wish to exercise editorial control, as in the older model of broadcasting regulation, rather than provide non-discriminatory access. The Internet Protocol (IP) was designed to use the end to end principle. It can operate on a variety of physical communications infrastructures and can serve different applications. As a result of these technical characteristics, some people view the internet as non-discriminatory. This perspective comes into direct conflict with the desire of information services to be able to block and prioritize web traffic; charge bandwidth-intensive content providers for better service (enabling information services to pay for upgrades to handle the requests for service); and charge different content providers different prices for service (Hart, 2011). Each of these tactics is discriminatory in that they create different quality grades for internet service, use price discrimination, and block or slow access to particular websites.

Although the FCC does not impose common carrier obligations on information services, it created open internet rules in 2010. Cable, DSL, and broadband providers fought against the rules whereas information providers favored them. The FCC's ability to impose open access rules on information services was questioned in court. In January of 2014, the U.S. federal appeals court for the District of Columbia struck down the FCC's open internet rules because the Commission is not allowed to impose what amounted to common carrier rules on information services. If the U.S. government wants to implement network neutrality rules, it will need to pass new legislation to reclassify information services as common carriers thus requiring them to provide access to all services without discrimination.

Access Regulation in the Republic of Korea

The third form of regulation used by national regulators to promote net neutrality is access regulation. South Korea uses this approach. South Korea is a worldwide leader of broadband provision. The government has played a central role in the expansion of advanced telecommunications and its involvement in broadband has led to near universal service. Between 1995 and 2000, the government funded the South Korean Information Infrastructure Project (KII) that constructed a national high-speed transmission network. South Korea has infrastructure competition, with cable, fiber, and DSL providing

broadband services. The incumbent, KT (formerly Korea Telecomm) that the government privatized in 2002 has significant market power and it captures half of the broadband market. Competitors SK Broadband (formerly Hanaro Telecom) and LG U+ also provide broadband services. Cable providers also offer competition although originally the Korean government did not allow cable providers to provide broadband. Rather, internet providers leased space on the cable networks. Korean regulators require networks to provide open access for competitors to bottleneck facilities.

Open Access and the Alberta, Canada, SuperNet

One notable regional project which reverses the trend of the privatization of infrastructure is the Government of Alberta, Canada's Alberta SuperNet. The SuperNet is a fiber optic infrastructure built as a public-private partnership between the Government of Alberta, the telecommunications company Bell, and a network manager, Axia. Bell owns and operates the fiber within the province's major cities while the government owns the extended network, the parts of the network outside of the cities. The extended network is managed by a private company, Axia, which provides open access to the broadband infrastructure. Connectivity to the SuperNet is available at uniform rates to any service; a guaranteed megabit per second for \$50 Canadian per month. As the manager, Axia is prohibited from offering retail services on the network. As such, Axia does not have an interest in keeping any service off of the network; instead, it reaps more revenue the more services are on the network. The provincial government's original intent was to encourage competitive access to service providers within the extended region. Such competition has been slow to emerge due to the economic realities of providing services to regions with low population densities.

Access to broadband infrastructure is an issue of great import to telecommunications regulation. Choices made at the political and regulatory level influence providers' ability to transmit information as well as citizens' ability to access it.

SEE ALSO: Access to content; digital divide(s); ICT4D and global connectivity; ICT4D and local access; internet governance; network neutrality; technology and the law.

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