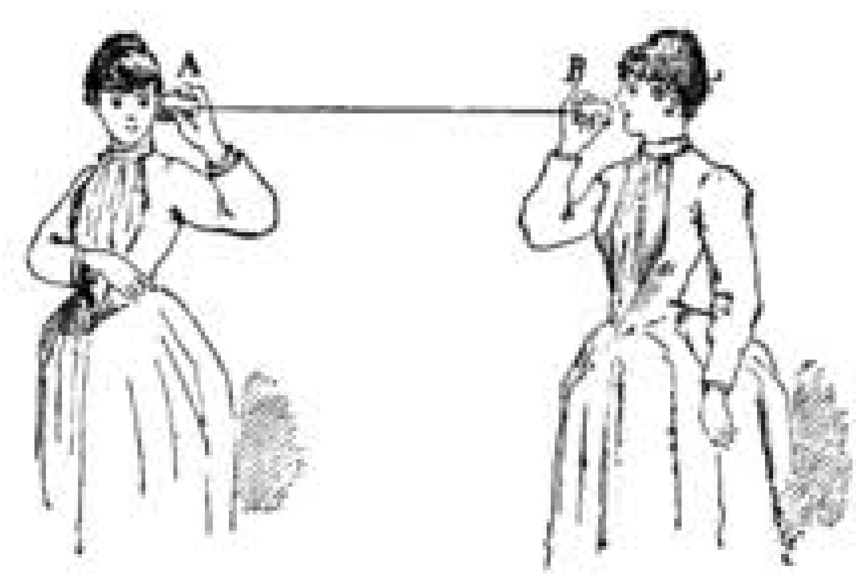
12: Telecom

"If I Called the Wrong Number, Why Did You Answer The Phone?"



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http://rasmusen.org/g406/reg-rasmusen.htm, Erasmuse@Indiana.edu

12.1: Introduction

Telecommunications comprises a set of products which all involve using electric signals to transmit information. Sometimes the signals are sent through wires (telephones) and sometimes through the air (radio).

Three features that make telecommunications particularly prone to market failure are economies of scale, network externalities, and the unusual property rights of electric signals. Technology is in a particularly turbid state of flux these days, so regulation is in flux too We will focus on three components of telecommunication policy: spectrum allocation, the organization of the telephone industry, and "net neutrality." We won't cover such things as the regulation of cable TV or aspects of Internet service provision aside from net neutrality. Interesting as they are, that would take another chapter's worth of pages.

12.2: Allocating the Spectrum for Broadcast Telecommunications

Telecommunications works by translating sounds and sights into radio waves or electrical impulses. These signals are easy to send long distances. At the receiving end, the signals are retranslated into the same sights and sounds as they were originally. Broadcasting uses radio waves that can travel through space, air, and even solid objects, depending on the type of wave. Each type of wave has a frequency— how close the waves are together— and a wavelength— how long they are. Frequency and wavelength are inversely related.

The receiving equipment— the TV, radio, or wireless telephone— can extract just the right wavelength out of a tangle of simultaneous signals, but if two transmissions are made at the same wavelength, they will interrupt and confuse each other. For this reason it is important to assign property rights to make sure that no two senders are using the same wavelength. In fact, in military operations, "jamming" is the idea of broadcasting on wavelengths you think the enemy is using, so he can't tell his real signal from your meaningless signals.

When two transmitters use the same wavelength, they inflict a negative externality on each other. If the transmitters are close to each other geographically, the externality is so bad that both of their transmissions are useless. Unless they make a deal with each other (which the Coase Theorem would suggest!) they would have to engage in a **war of attrition** to see who is willing to wait long enough for the other one to drop out. "Attrition" refers to the reduction in resources due to a conflict, and in this context it would typically refer to the inability or unwillingness of one company to keep incurring the cost of transmitting without getting any benefit. Clearly, wars of attrition are wasteful and do not maximize surplus. The market failure here, as is typical with externalities, can be viewed either as an externality or as a missing property right. Thus, a solution is for the government to give one company the sole right to transmit on a given wavelength. You can think of that either as a penalty on other companies for inflicting an externality if they violate on that same wavelength, or as the wavelength being the "property" of the assigned company, which gets the usual legal right to stop trespassing on its property. Transmissions peter out with distance, so governments assign licenses for particular wavelengths, particular locations, and particular strengths of signal. Table 12.1 shows the radio spectrum and its uses.

Table 12.1
The Radio Spectrum

Frequency	Abb.	Wavelength	Example
Super low	SLF	1,000–10,000 km	Submarines Wall electricity
Ultra low	ULF	100–1,000 km	mines
Very low	VLF	10 –100 km	avalanche beacons,
Low	LF	1–10 km	AM longwave
Medium	MF	100–1,000 m	AM medium-wave
High	HF	10–100 m	Shortwave, citizens' band, ham radio
Very high	VHF	1–10 m	FM, TV ham radio
Ultra high	UHF	100–1,000 mm	TV, microwave ovens mobile phones, wireless LAN, Bluetooth, GPS,
Super high	SHF	10–100 mm	wireless LAN, radar
Extremely high	EHF	1–10 mm	Radio astronomy, microwave radio relay

Notes. As the wavelength of a transmission get shorter, the frequency gets higher, so you can think of *Source:* Wikipedia, "Radio Spectrum," http://en.wikipedia.org/wiki/Radio_spectrum.

Some uses only require very low-intensity signals, signals which have such a short range that there is little likelihood of two users interfering with each other's use. Garage-door openers, for example, don't work from a distance of a block away. In fact, a householder would not like having a garage-door opener in his car which was so powerful that he might accidentally open the door while he was ninety miles away. Thus, assigning a property right would incur too much transaction costs. It is not the right regulation. What is better is to just limit the distance a signal can be transmitted on these wavelengths.

TABLE 12.2
UNLICENSED SPECTRUM BANDS IN THE UNITED KINGDOM

Band	Application
9 kHz to 30 MHz	Short Range Inductive
27 MHz	Telemetry, Telecommand and Model Control
40 MHz	Telemetry, Telecommand and Model Control
49 MHz	General Purpose Low Power Devices
173 MHz	Alarms, Telemetry, Telecommand and Medical
405 MHz	Ultra Low Power Medical Implants Devices
418 MHz	General Purpose Telemetry and Telecommand
458 MHz	Alarms, Telemetry, Telecommand and Medical
864 MHz	Cordless Audio
868 MHz	Alarms, Telemetry and Telecommand
2400 MHz	General Purpose Short Range Applications, CCTV, RFID. WLANs including Bluetooth
5.8 GHz	HyperLANs, General Purpose Short Range including Road Traffic and Transport Telematics
10.5 GHz	Movement Detection
24 GHz	Movement Detection
63 GHz	2nd Phase Road Traffic and Transport Telematics
76 GHz	Vehicle Radar Systems

Notes. As wavelengths get shorter, frequencies get higher, so they're really two ways of assigning the same property right. "MHz" means "megahertz", a unit of frequency, and "GHz" means "gigahertz". *Source: The ICT Regulation Toolkit* http://ictregulationtoolkit.org/en/ (September 16, 2010). "Module 5: Radio Spectrum Management," p. 16.

Table 12.2 shows examples of various uses that don't have property rights assigned in the United Kingdom. "Telemetry" is the collection of data at a distance, e.g., spy cameras. "Telecommand" is the control of machines at a distance, e.g., a TV remote. "Telematics" is the combination of telemetry and telecommand, e.g. truck fleet management.

In the early 20th century, no one realized how valuable property rights in the spectrum would be, and the government did not try to sell them. The early owners of licenses were nonetheless allowed to sell them to others, and it soon became apparent how valuable a radio license could be. Starting in 1912 the Commerce Department regulated radio, but in 1927 this was replaced by a commission which later was given its present name, the **Federal Communications Commission (the FCC)**. As other telecom services besides radio were developed, the FCC began to regulate them too (television, cellphone signals, etc.) The FCC is an independent commission, run by five commissioners appointed by the President for five-year terms with only three commissioners allowed to be of any one political party.

For a long time, the FCC assigned licenses without requiring any payment from whoever got the license. Economists argued that the government should treat the radio spectrum like fee simple property in land, selling it to companies and allowing them to resell it afterwards, but the FCC paid little attention so long as radio and television wavelengths were the focus of attention.[1] Both political influence and considerations of fairness opposed the idea of making companies pay for rights they were currently enjoying for free. In the 1990's, however, new technologies such as cellphones were developed, and it became clear that the companies selling those services would need property rights. Rather than giving away the rights, the United States and other governments started selling the parts of the spectrum reassigned to be used by new technologies. In 2000–2001, for example, a sequence of auctions took place in Europe, beginning with the United Kingdom, where operators bid significant amounts— $35 billion for five 3G licences, for example.

There are many ways to set up an auction. Consider the following three possibilities for auctioning off cellphone service.[2]

1. The regulator auctions a single licence for national second-generation mobile telephone service using a **sealed-bid auction**. The successful applicant must provide coverage to 50% of the land area and 80% of the population. Sealed bids must be submitted by a specified date, by firms which have pre-qualified, showing that they can actually provide the coverage. The winner is the firm which bids the most.

2. The regulator auctions three licences for national 3G mobile service. Pre-qualified applicants bid against each other in an **open auction**, meaning that bidders always see which is the highest bid, though not, in this case, every amount bid. They submit new bids at pre-specified intervals. The auction ends when the highest bids for each licence are the same, in terms of bidder and sum bid, as in the previous round.

[1]Thomas W. Hazlett, "Assigning Property Rights To Radio Spectrum Users: Why Did FCC License Auctions Take 67 Years?" *Journal of Law and Economics*, 41: 529–575 (October 1998). See also Ronald H. Coase, "The Federal Communications Commission," *Journal of Law and Economics*, 2: 1-40 (October 1959).

[2]Based on *The ICT Regulation Toolkit* "Module 2: Competition and Price Regulation," http://ictregulationtoolkit.org/en/ (September 16, 2010). Module 5: Radio Spectrum Management, "Module 5: Radio Spectrum Management."

The auction has an **activity rule**: if four rounds pass without a bidder being the high bidder on at least one licenses, it must drop out of the auction.

3. The regulator auctions four identical licenses using an **ascending clock auction**. In this kind of auction, the regulator increases the price over time (prices ascend with the clock) and bidders choose whether to accept or reject the announced prices. The auction is over when the number of bidders still accepting the price has fallen to four, the numbers of licenses. The winning bidders all pay the ending price.

Which of the three is best? Governments have tried hard to figure out which set of rules would raise the most revenue, a rough indicator of which set of rules maximizes surplus since being willing to pay more corresponds with having more valuable uses for the licenses. The auctions used in the U.S. by the FCC are closest to Auction 2, with its multiple rounds and activity rule. Auction 79, held in 2009 for FM Broadcasting, is a typical example.[3] It was a simultaneous multi-round auction which lasted 50 rounds over 10 days. 85 permits were sold to 72 qualified bidders, with the gross bids totalling 6.2 million dollars— tiny compared to the U.K. 3G auction, but not all auctions are for important new technologies.

Details of the auction rules have evolved over time as the FCC and another countries' regulations developed experience with auctions. One big concern is antitrust violations, since whenever an auction is held, the bidders can save enormous amounts of money if they collude. In the FCC's Auction 11, a PCS ("personal communication service") auction, participants used the amounts they bid to signal to competitors. This was for licenses worth millions of dollars, and a 7-digit bid was used to signal that the bidder was warning off other bidders from bidding on that particular license. Peter Crampton tells the story:

> Mercury PCS ended its bids with market numbers to signal its rival, High Plains Wireless, that it wanted it to move off of Lubbock, Texas or that it would be punished on Amarillo, Texas. Each market has a three digit market number (for example, 264 for Lubbock and 013 for Amarillo). After trading bids on block F of Lubbock for several

[3]FCC, "Auction 79: FM Broadcast," http://wireless.fcc.gov/auctions/79/. The website has the detailed auction rules and shows what high bids were during each of the rounds.

> rounds, with the price rising by 10% in each round, Mercury bumped High Plains in round 121 from Amarillo, a market on which High Plains had been the standing high bidder since round 68. This was Mercury's first bid on Amarillo during the auction. The bid served as a punishment to High Plains for bidding against Mercury on Lubbock, a punishment made clear since it contained as its last three digits "264," the market number for Lubbock. Mercury's bid on Amarillo said to High Plains, "I am bumping you from Amarillo, a market you have held since round 68, a market that I have shown no interest in whatsoever. To win Amarillo back you will have to bid higher by at least two bid increments more than your previous bid. I want you to back off of Lubbock, leaving it to me." To clarify that the Amarillo bid was a retaliation for High Plains bid on Lubbock, Mercury tagged its rebid in Lubbock with "013," Amarillo's market number.[4]

As a result, the FCC required bids in future auctions to be in specified increments, so a bidder would have to bid $1,000,000 instead of $1,000,264. This was an application of the idea of telecom to the auction itself. Remember that this chapter started by saying that the idea in telecom was to convert something complicated into a signal that could be converted back to the original information by the receiver. Here, the bidders wanted to convert the illegal idea that they considered this "their" frequency to a number, and would use something like the digits "264". What the FCC did was to say that bids couldn't use as many digits, which made encoding the message much more difficult. The FCC was purposely restricting the ability of the companies to communicate.

Telecom auctions have stimulated quite a bit of investigation into auctions generally. Such large amounts are at stake compared to, say, antique auctions, that it has been worthwhile for the governments and the bidders alike to hire economists as consultants for their auction design and strategies. Much has been learned.

1. Open bidding is better than a single sealed bid. By having more than one round of bidding, an open auction allows bidders to see what other bidders are interested in a license, so that if one bidder has information

[4] Peter Cramton and Jesse A. Schwartz, "Collusive Bidding: Lessons from the FCC Spectrum Auctions," *Journal of Regulatory Economics*, 17, 229–252, May 2000, http://www.cramton.umd.edu/papers2000-2004/00jre-collusive-bidding-lessons.pdf.

indicating that a license is particularly valuable, other bidders can figure that out and respond by bidding higher themselves. Also, a bidder can decide to switch from one license to another if the price of his first choice is unexpectedly high.

2. Allowing bidders to bid for packages— their choice of a bundle of local licences— is desirable in principle but difficult in practice. Teh advantage is that a bidder might wish to bid a lot for the bundle—for Illinois, Indiana, and Ohio— but much less for the components— winning just Illinois and Ohio without Indiana. Package bidding is difficult to administer, however.

3. Collusion in a major problem, The use of the ending digits in Auction 11 is just one example. The FCC has stopped reporting all the bids in each round, instead just reporting the highest bids, so that losing bids cannot be used for signalling. Collusion is a standard anti-trust problem, of course, but it is especially tempting in auctions for multiple objects, since the gains to the colluders are so clear and they can share the gains by letting each of them win some of the objects.

SIDEBAR 12.1
THE RICHEST PRESIDENT

"The cornerstone of Johnson holdings is KTBC, an Austin radio-TV operation that was bought in 1943 with a $17,500 certified check from Lady Bird Johnson. At that time, KTBC was an unsuccessful 250-watt radio station that had been in trouble with the Federal Communications Commission over regulatory violations. . . .

A syndicate of Texas businessmen had been trying to buy KTBC long before the Johnsons entered the scene, but the FCC refused to approve the sale. In December 1942, a member of the syndicate, Austin Businessman E. G. Kingsbery, met with Lyndon Johnson, then a 34-year-old Congressman. As Kingsbery remembered that meeting, Lyndon first reminded him that Kingsbery's son had obtained an appointment to the Naval Academy through Johnson's office. Said Lyndon: "Now, E.G., I'm not a lawyer or a newspaperman. I have no means of making a living. At one time I had a second-class teaching license, but it has long since expired. I understand you've bought the radio station. I'd like to go in with you or have the station myself." . . .

By 1952, when Lyndon Johnson was a U.S. Senator, television arrived, and the FCC gave KTBC the only very high frequency (VHF) channel in Austin. The station quickly picked up highly profitable contracts to carry programs from all three major networks—CBS, NBC and ABC. Unlike most single-channel cities, there is no "overlap" from stations in nearby cities—which means that the Johnsons own a television advertising monopoly in the whole Austin area. . . . In 1954, when Lyndon was Senate minority leader, the Johnsons bought KANG, a foundering UHF (ultrahigh frequency) television station in Waco. The FCC had just given a VHF license to a proposed Waco TV outlet, KWTX. CBS, which had been negotiating with KWTX, quickly decided to award its contract to KANG instead. Shortly thereafter, so did ABC. Then, with FCC approval, the Johnsons increased the transmitting power of their Austin station and made a costly swath across KWTX's viewing and advertising market. KWTX pushed an unsuccessful federal antitrust action against the Johnsons, finally gave up and agreed to sell them 29.05% of its stock in a trade for KANG— including the major network franchises that KANG had sewed up."[a]

[a] *Life*, Friday, Aug. 21, 1964, "The Presidency: The Multimillionaire," http://www.time.com/time/printout/0,8816,876014,00.html. *Life* estimated the family fortune at $14 million in 1964. See also: Robert A. Caro, "Annals of Politics, The Johnson Years: Buying and Selling," *The New Yorker*, December 18, 1989, p. 43.

12.3: Telephone Service

Regulation of broadcast radio and TV is relatively simple, requiring only the allocation of spectrum rights. Telephone service raises additional problems: economies of scale and network externalities.

Like electricity, water, and natural gas, telephone companies have long been regulated as natural monopolies. Originally, each telephone had to be connected to other telephones by wires, a product now called **landline** service. Each house or business with a landline telephone requires wires and must be connected to each other by switches. Such a large sunk cost meant that economies of scale prevent effective competition and it would be inefficient for more than one company to operate in a given area. Moreover, originally the vast majority of phone calls were local calls, within one city or county. As a result, governments either socialized telephone service or used rate-of-return regulation.

Although local landline telephone service is indeed a natural monopoly, technological innovation has made that monopoly increasingly harmless. With increasing national wealth and decreasing costs of providing it, long-distance service has become more important, with room for numerous providers. Wireless cellphones were developed, and they competed directly with landline service. The Internet provided yet another competitor, with email and voice service sent through the Internet instead of through landline telephone switches or cell towers.

Regulation originally favoured government ownership of telephoen service in most of the world, and the company ATT in the United States.[5] The late 1980's, however, saw the beginning of dramatic sales of state-owned operators, starting with British Telecom and Cable and Wireless in the United Kingdom. Privatization had a number of motivations.

1. The superior performance of private companies in cost and quality.

2. The need for revenue, especially during financial crises. This was the main reason behind privatizations in several developing countries such as Argentina.

3. The need to raise capital to expand infrastructure, such as in Singapore,

[5]Geoff Edwards and Leonard Waverman, "The Effects of Public Ownership and Regulatory Independence on Regulatory Outcomes," (2006) *Journal of Regulatory Economics*, 29: 23-67.

4. Improving technology and management expertise, a motivation in some African countries.

5. Opening the market to competition to give more incentive to reduce costs, such as in Brazil.

We have already discussed the aspects of government failure that make government companies less effective than private companies. Rational ignorance and the great variety of tasks that government perform means that government leaders have less incentive than private executives to keep costs low and quality high and to innovate. To this first problem, the list above adds a number of other considerations such as the funds the government can raise through privatization. With natural monopoly dwindling as a concern, there was little reason to operate this area of the economy as a government operation, or even to worry about how to regulate it using rate-of-return regulation.

The Interconnection Problem

Although technological natural monopoly is not the problem it was with the landline telephones of the 1960's, network externalities remain a major concern. If there is just one company providing phone service, it internalizes the costs and benefits of adding customers. If there is more than one company, network externalities become a problem. The externality is that if there is no regulation, and Acme Inc. steals customer Smith from Brydox Corporation, Acme's service becomes more valuable to all its other customers (because now its customers can call and be called by Smith), and Brydox's service becomes less valuable. Think of a new company that just has one customer. If he has no one else to call, his telephone is useless! With two customers, they can communicate with each other, and as more customers join, the network becomes more and more useful. This creates an economy of scale, but one on the demand side rather than the supply-side technological economies of scale we have talked about before. The result is that if networks do not connect, we would expect only the biggest company to survive in a competitive market.

Whether one thinks of this as a problem of market power or of externalities, the result is that government regulation can help by requiring telephone companies to link to each other's networks. That is easier said than done, however. We also do not want Acme to free ride on Brydox's investment, using a required link to Brydox's network to allow Acme's customers to make phone calls without Acme actually having to provide any more infrastructure than a link to Brydox. If we simply require linkage without payment, this kind of free riding will mean that every company will try to keep its investment low and free ride on the others. Thus, the regulator needs to make sure each side of the network connection pays the right amount to induce efficient usage, investment, and innovation.

All two-way communication faces an interconnection problem when a customer of Company A wants to use a device to communicate with a customer of Company B. In between is a complex tree of loops and switches, owned partly by A, partly by B, and perhaps partly by some third Company, C. The problem is how to decide what price Company B charges Company A for access to B's customer. The two firms could agree on a price by bargaining with each other. But if Company A has five times as many customers as Company B, connection to A's customers is more valuable. Company A will be able to charge more to B for access to A's customers than B can charge to A for access to B's customers. That means B's costs will be higher, and it will have to charge a higher price than A to break even, and so in a competitive market B will lose customers to A, further exacerbating its problem of small network size.

The result is that there is a good case for government regulation of not just the consumer prices of a telephone company that is a local natural monopoly because of the fixed cost of laying wires to houses, but also of the interconnection prices. Wired telephones are called **land-line telephones**. As competition to them from wireless telephones has increased, it has become less and less important to regulate landline prices. Interconnection, however, is just as important as ever because wireless networks vary in size.

Requiring Companies to Share Their Equipment

What is more controversial than regulating interconnection fees is the regulation of prices at which a landline telephone company must sell access to its local equipment. The Telecommunications Act of 1996 required incumbent local landline telephone companies to allow other companies to use their local equipment. This is known as **unbundling**, the offering by the incumbent of specific elements of its hardware to other companies. Under **full unbundling**, the incumbent must offer full access to each customer's **local loop**— the lines that go to his building. Under **shared access** the incumbent must provide access to the non-voice frequencies of the local loop (for data) and to equipment that can interconnect to it. This is a form of regulation of natural monopoly that we didn't talk about earlier in connection with electricity. The idea is that although there should be only one set of physical connections per customer, that doesn't mean we can't have competition: we can just have the one owner be required to rent use of those connections. The problem, of course, is deciding what rent should be paid. In the years immediately after 1996, the Federal Communications Commission required incumbent local exchange carriers to unbundle extensively. It has since narrowed its approach to require unbundling of a more limited set of network elements, so that switching equipment, for example, is no longer included.

Once access is required, the question is what price the incumbent is required to charge. That question of price regulation is very much like the question utility regulators face, because the objective is to make a monopoly with economies of scale charge a price close to marginal cost, but not so little that it loses money on its investment because it gets no compensation for its fixed cost. Thus, let us turn next to costs.

12.4: Costs.

Costs can be broken into fixed costs and variable costs for providing a given service, in the same way we break up the cost of producing physical goods.

Fixed costs do not increase as the volume of a service provided increases. For a firm that provides several services that share a fixed cost— the problem that leads to Ramsey pricing in natural monopoly regulation— we can split fixed costs into three categories.

- **Service-specific costs** are costs the firm must incur to provide the one service. A firm supplying any level of the service would incur service-specific fixed costs, but it would avoid these costs altogether by ceasing production of the service entirely.

- **Shared costs** are fixed costs the firm must incur to provide a group of services. Shared fixed costs do not vary with the level of any individual service in the group, nor do they fall if any one of the services in the group is discontinued. The firm can avoid shared fixed costs only if it stops producing all the services in the group.

- **Common costs** are fixed costs are shared by all services produced by the firm, for example, the cost of the president's desk.

Sunk cost is an economic cost concept that is a little different from fixed cost. It will not be important for the present discussion, but it is worth talking about in order to understand fixed costs better. A sunk cost is a cost incurred in the past, one that cannot be recovered. Sunk costs are historic costs that are irreversibly spent and independent of the future quantity of the service that is supplied. An example is the cost of a marketing campaign for a new telephone service. The cost of switching equipment, on the other hand, might not be a sunk cost, because maybe the company can resell the equipment and get back what it spent. Both of those, note, are fixed costs, because they are incurred before output is chosen and even if very little use is made of the phone service, that little use requires a marketing campaign and switches. Once incurred a sunk cost cannot be recovered even if the service is discontinued. The concept of sunk cost is crucial for a business making operating decisions, but for our question of access connections it is not, since the objective is to give the proper incentives for investment by new firms and interconnection by the old ones.

Variable costs unlike fixed costs, vary with the volume of the service provided. **Marginal cost** is the cost of producing one additional unit of output. **Incremental cost** is a term that is sometimes used for the additional cost of producing a given increment of output, where that increment might not be just one unit. It asks how much the firm's total costs increase if the quantity of a particular service increases by the increment, where naturally it will be bigger for a bigger increment (or at least no smaller). We might speak of the incremental cost of increasing the number of cellphones by 100 and compare that with the incremental cost of increasing the number by 1000. Marginal cost is a limiting case of incremental cost where the increment is one unit, or, if the good or service is divisible, it is the rate of change of costs as quantity increases.

We now come to two concepts special to access charges, SAC and TELRIC.

In telecom regulation, the **Stand-alone cost (SAC)** is the total cost that a stand-alone firm (a firm producing no other services) would incur to produce a particular service. The stand-alone cost for serving a single phone customer would be huge, because it would include the common and shared fixed costs that go to serving all the other customers too.

The concept of **Total Element Long Run Incremental Cost (TELRIC)** is a special case of incremental cost where the relevant increment is the total volume of the the service in question (the "element"), and the economic horizon is the long run. Thus, TELRIC includes all the costs that though fixed in the short run are variable in the long run.[6] In economics, the long run is by definition the time horizon in which all costs are variable, so TELRIC is a form of total average cost. TELRIC is the additional cost a firm incurs when it adds a new service to its existing lineup. Thus, TELRIC does not include the common costs or the shared fixed costs.

For a single-service firm, TELRIC and SAC are equal. For a multiple service firm, SAC will be greater than TELRIC, because SAC includes shared fixed costs and common fixed costs.

It is important to note that TELRIC is a long-run cost, not short-run. In the long run, all costs are variable. **Short-run costs** are the costs of providing a given service, assuming that the current stock of capital is fixed. Over the long run, firms can vary their stock of capital, for example by investing in new plant. A service's **long-run cost** therefore includes the cost of the capital required.

12.5: Forward-Looking Costs and the Verizon Decision

In Australia, the United Kingdom, the European Union generally, and the United States, regulators set interconnection prices based on TELRIC. In the United, State, the Telecommunications Act of 1996 required incumbent local phone companies to sell interconnection to other companies at a price based on cost but unrelated to the price state regulators calculated using rate-of-return regulation. The FCC's decision to use TELRIC in the particular way it did was challenged in the Supreme Court in *Verizon Communications v. FCC*, 535 U.S. 467 (2002). Verizon and the other incumbents thought TELRIC generated too low an interconnection price. Their big complaint was that FCC used a TELRIC based on current value of the wiring in the local loops, not the amount the wiring cost. Current value had fallen below wiring cost, because new technology meant that the cost of putting in new wiring was falling over time. The incumbents said that for the FCC to use TELRIC meant the government was illegally forcing them to sell their product at below cost.

The Supreme Court upheld the use of TELRIC in the FCC regulations. I will quote the decision extensively, since it lays out the issues very well. The decision starts with the basic controversy:

[6] The name used in Europe is "total-service long-run incremental cost" (TSLRIC). I would guess that the American name is due to the superior pronounceability of "telrick" over "tisselrick." Americans are good at coming up with acronyms.

> To derive a "nondiscriminatory," "just and reasonable rate for network elements," the Act requires the FCC to decide how to value "the cost . . . of providing the "network element [which] may include a reasonable profit," although the FCC is (as already seen) forbidden to allow any "reference to a rate-of-return or other rate-based proceeding." Within the discretion left to it after eliminating any dependence on a "rate-of-return or other rate-based proceeding," the Commission chose a way of treating "cost" as "forward-looking economic cost," something distinct from the kind of historically based cost generally relied upon in valuing a rate base after *Hope Natural Gas*. In Rule 505, the FCC defined the "forward-looking economic cost of an element [as] the sum of (1) the total element long-run incremental cost of the element [TELRIC]; [and] (2) a reasonable allocation of forward-looking common costs," common costs being "costs incurred in providing a group of elements that "cannot be attributed directly to individual elements." Most important of all, the FCC decided that the TELRIC "should be measured based on the use of the most efficient telecommunications technology currently available and the lowest cost network configuration, given the existing location of the incumbent's wire centers."

The Court provides a helpful example of TELRIC:

> "The TELRIC of an element has three components, the operating expenses, the depreciation cost, and the appropriate risk-adjusted cost of capital." A concrete example may help. Assume that it would cost $1 a year to operate a most-efficient loop element; that it would take $10 for interest payments on the capital a carrier would have to invest to build the lowest cost loop centered upon an incumbent carrier's existing wire centers (say $100, at 10 percent per annum); and that $9 would be reasonable for depreciation on that loop (an 11-year useful life); then the annual TELRIC for the loop element would be $20.[7]

The court's decision turned on the meaning of "cost". Courts start by looking at the everyday meaning of words and then go on to the technical meaning, and that is what the Supreme Court did here.

> The incumbent carriers' first attack charges the FCC with ignoring the plain meaning of the word "cost" as it occurs in the provision

[7] *Verizon Communications v. FCC*,) 535 U.S. 467 (2002). The original opinion says $20.16 rather than $20; I don't know how the 16 cents crept in.

> of §252(d)(1) that "the just and reasonable rate for network elements . . . shall be "based on the cost (determined without reference to a rate-of-return or other rate-based proceeding) of providing the . . . network element." The incumbents do not argue that in theory the statute precludes any forward-looking methodology, but they do claim that the cost of providing a competitor with a network element in the future must be calculated using the incumbent's past investment in the element and the means of providing it. They contend that "cost" in the statute refers to "historical" cost, which they define as "what was in fact paid" for a capital asset, as distinct from "value," or "the price that would be paid on the open market." . . . The argument boils down to the proposition that "the cost of providing the network element" can only mean, in plain language and in this particular technical context, the past cost to an incumbent of furnishing the specific network element actually, physically, to be provided.
>
> The incumbents have picked an uphill battle. At the most basic level of common usage, "cost" has no such clear implication. A merchant who is asked about "the cost of providing the goods" he sells may reasonably quote their current wholesale market price, not the cost of the particular items he happens to have on his shelves, which may have been bought at higher or lower prices.
>
> When the reference shifts from common speech into the technical realm, the incumbents still have to attack uphill. To begin with, even when we have dealt with historical costs as a ratesetting basis, the cases have never assumed a sense of "cost" as generous as the incumbents seem to claim. "Cost" as used in calculating the rate base under the traditional cost-of-service method did not stand for all past capital expenditures, but at most for those that were prudent, while prudent investment itself could be denied recovery when unexpected events rendered investment useless. And even when investment was wholly includable in the rate base, ratemakers often rejected the utilities' "embedded costs," their own book-value estimates, which typically were geared to maximize the rate base with high statements of past expenditures and working capital, combined with unduly low rates of depreciation."

You mght wonder why the phone companies argue that cost "can only mean, in plain language and in this particular technical context," the past cost. Why don't they just argue that Congress *most likely* meant historical cost? The reason is the Chevron Doctrine. If the meaning of cost in the statute is ambiguous, then the Chevron Doctrine says that the regulatory agency— the FCC here— can choose any of the reasonable meanings. That is why this case was so difficult for the incumbent phone company to win.

The *Verizon* opinion talks not just about the meaning of the words, however, but about the economics of the telecom market:

> The incumbents say that in purporting to set incumbents' wholesale prices at the level that would exist in a perfectly competitive market (in order to make retail prices similarly competitive), TELRIC sets rates so low that entrants will always lease and never build network elements. And even if an entrant would otherwise consider building a network element more efficient than the best one then on the market (the one assumed in setting the TELRIC rate), it would likewise be deterred by the prospect that its lower cost in building and operating this new element would be immediately available to its competitors; under TELRIC, the incumbents assert, the lease rate for an incumbent's existing element would instantly drop to match the marginal cost of the entrant's new element once built. According to the incumbents, the result will be, not competition, but a sort of parasitic free-riding, leaving TELRIC incapable of stimulating the facilities-based competition intended by Congress. . . .
>
> TELRIC rates in practice will differ from the products of a perfectly competitive market owing to built-in lags in price adjustments. In a perfectly competitive market, retail prices drop instantly to the marginal cost of the most efficient company. See Mankiw 283–288, 312– 313. As the incumbents point out, this would deter market entry because a potential entrant would know that even if it could provide a retail service at a lower marginal cost, it would instantly lose that competitive edge once it entered the market and competitors adjusted to match its price. Wholesale TELRIC rates, however, are set by state commissions, usually by arbitrated agreements with 3- or 4-year terms . . .[8]

The FCC was trying to make sure that entrants could enter and connect using just a small amount of new technology investment without having to build all the equipment required if connection were blocked, which would cause them to pay the stand-alone cost. At the same time, this results in

[8] I omitted most of the citations in this quotation. I thought economics students would like to see the Mankiw cite, though, since many of you have used his textbook.

less incentive for the entrant to build the purchased technology itself. If the connection price is too low, the entrant can buy access so cheaply it will do that instead of investing in new technology that is more efficient but also more expensive because of the artificially low price. Setting the access price using TELRIC based on historical cost would give more incentive for entrants to build their own technology, but that might lead to inefficiency because it would duplicate the existing equipment.

The court notes that even the forward-looking TELRIC wouldn't be entirely forward-looking, because it would only be adjusted every 3 or 4 years, and costs could fall in the meantime, so that the entrant might prefer to buy new equipment instead of access to the incumbent's. Perhaps a better response, however, would be to acknowledge that forward-looking TELRIC discourages investment but note that since stand-alone-cost is so high, entrants are unlikely to invest much in new technology anyway, and the main goal is to encourage whatever new technology can be used for the entrants to connect to the old network of the incumbent at various points.

Let's go back to the original problem we were talking about. It was how to regulate a telecom natural monopoly so that other telecom companies could connect to it, and, in this case, how to let them rent the natural monopoly's equipment and actually compete with it. We wanted to avoid free riding by the entrants so that the entrants would invest enough and not outcompete the monopoly by taking advantage of the low "rent" they paid it for the equipment. Getting the rental fee right does this, and simultaneously gives the right signal to the natural monopoly of how much to invest and how much to innovate when it makes its choices to maximize the profits it earns from selling services itself and from renting out equipment.

12.6: Net Neutrality

We've talked about a very old problem in telecom regulation— licensing the radio spectrum— and one that has been present for several decades— how to deal network externalities and technological economies of scale in requiring telephone companies to let competititors connect to them. Our third telecom topic will be an issue that surfaced about ten years ago and which is still more about future company behavior than with past problems. This is net neutrality, a debate over regulation of the Internet. **Net neutrality** is the idea that an **Internet service provider (ISP)** should not be allowed to charge different prices for different kinds of Internet traffic, or to slow down certain traffic, or to ban it entirely. There are different versions of net neutrality. The most extreme net neutrality would say that the ISP could not even block child pornography, or drug dealing sites, or mass messages sent by hackers to deliberately jam up the system. Less dramatic is the fact that ISP's need to organize how signals flow through the system in order to provide reliable service. Those things are not what the debate is about. Rather, it is about whether the ISP's should be able to vary its charges and service quality depending on the type of content (movies vs. emails, for example) or the content provider e.g., (Netflix vs. Amazon Prime).

Under an extreme version of net neutrality, the ISP company you pay for your home Internet connection would not be allowed to charge you more per megabyte downloaded of movies than per megabyte downloaded of text. Nor would it be allowed to give text transmissions priority over movie transmissions— it would have to treat all kinds of content equally. Whether regulating the ISP's to require net neutrality is good or bad is a matter of fierce debate, with large companies on both sides of the question. Few people go so far as to argue for extreme net neutrality, though, and what is under the most discussion is whether an ISP should be allowed to block some kinds of legal sites entirely and whether it should be allowed to charge **content providers**— the people and companies that put up websites— for access to its customers. In 2009, the FCC issued a notice of proposed rules on the subject, but in 2010 it suffered a defeat in a 2008 order it had given to the ISP company Comcast that restricted Comcast from interfering with P2P (peer-to-peer) traffic which Comcast had limited so as to keep its service faster for other users.[9] The FCC was not proposing to stop companies from pricing by usage, but it did want to stop the ISP's from charging content providers different amounts based on the identity of the provider rather than just the bandwidth used. In 2015 the FCC issued a strongly net-neutral rule, declaring ISP's to be "common carriers" who could not charge different customers different prices for carrying their traffic, but the Trump Administration may go through notice-and-comment again and change the rule.

The idea of the **common carrier** is a very old one in English law. A common carrier is a business that provides transportation on a regularly scheduled route at standard rates. A city bus line is a common carrier, because it follows the same route every day and charges according to a posted rate schedule. A rental limousine is not a common carrier. The customer

[9] *Comcast v. FCC, D.C. Circuit* (April 6, 2010) http://net.educause.edu/ir/library/pdf/EPO1009.pdf.

hires the transportation for a route he specifies at a time he specifies and he negotiates the price individually with the company. A company like Uber falls somewhere in between, and state laws differ on whether it is a common carrier. The definition is important because a common carrier is more regulated. It cannot raise its price to a particular customer just because it thinks that customer will pay more. This would cause problems in public transportation, because customers need to be able to rely on getting the transportation they expect at the price they expect. To reduce the transaction costs of having to lock in prices and service details with individualized contracts between transport company and consumer, the law prevents the company from haggling over prices or excluding passengers for arbitrary reasons. This is very much like the problems we discussed with product quality. If a company wasn't regulated as a common carrier, it would be tempted to take advantage of its customers, and in the long run the customers, knowing that, would give up on the service and use something else. Thus, regulation is efficient. On the other hand, something like a limousine service is providing a somewhat different product to each buyer and it is not hard to pre-negotiate the price. By deciding that the ISP is a common carrier, the FCC is saying that it cannot charge different content providers different prices or provide them with different levels of service based on the content provider's identity.

Note too that despite its high profile, net neutrality is really about regulation for the future rather than about changing the way ISP's operate now. ISP's have not been charging Netflix more than Amazon Prime in the past. The big question is whether they will be allowed to in the future, when they might find it more to their advantage.

Let's back up a bit, though, and go through various issues of Internet pricing to see how we can apply surplus maximization.

Issue 1. *Should an ISP be allowed to charge consumers more if they use the Internet more?*

One way to price the Internet for consumers, the most common way, is with a fixed fee for access, regardless of how many bits of information the consumer downloads. Another way is to charge different consumers different amounts based on usage. This second way is discriminatory in the sense of charging different people different prices. Should companies be allowed to do this?

In one sense, the answer seems obvious. Usage-based pricing is what companies employ for almost every product we buy. One does not buy a monthly access permit from a restaurant that allows you to eat as many meals as one wants. That would be inefficient, because each meal has a positive marginal cost, and the customer would continue eating meals there even after his marginal benefit from a meal was less than the marginal cost. But does Internet usage have a marginal cost to the company?

Usage does have a marginal cost—congestion. With more traffic on the ISP's system, the ISP cannot transfer all customer's information simultaneously. Someone comes first, and someone comes second. Ordinarily this may not be noticeable. If you try a speed tester such as the one at http://www.2wire.com/bandwidth/initialmeter.php, you can see how much the speed of your connection changes over the day, but most of the time it is hard to tell without such a tester. At peak usage times, however, user can more easily see how the the system slows down. The marginal cost of extra downloads is this congestion externality.

Thus, usage pricing certainly has the potential to raise total surplus, by preventing usage that has high congestion costs to other users but low marginal benefit to the downloader. It is not used by most ISP's (though smartphones are more likely to have usage limits), perhaps because of the inconvenience to customers to being billed by usage, but there is no need for government regulation to stop IPS's if they begin deciding it is useful.

Issue 2. *Should the ISP be allowed to give some consumers preferential fast transmission at a higher price?*

For Issue 1 we talked about how congestion slows down the Internet and how not all traffic can be sent through at once. One option for the ISP is to slow down all customers equally. Another would be to give some customers preference in exchange for a higher price, routing their traffic first. This means, of course, that the customers put at the end of the line will suffer slower speeds.

Such pricing will raise total surplus. The reason is that ISP will not use it unless the customers getting faster speed have gained more than the customers getting slower speed have lost. Compared to when all consumers were treated equally, the ISP must charge a lower price to the slowed-down consumers.

Another way to see this is to think of two consumers downloading movies and think about about the amount each would pay to have his movie downloaded first. If Consumer A would pay \$.12 to have his movie downloaded first, but Consumer B would pay \$.22, then surplus maximization clearly requires that Consumer B get preference. If we start with a system in which they take turns having first priority— the equivalent of equal treatment by the ISP— then both of them would prefer a system in which every time it was Consumer A's turn to go first, Consumer B paid him $.05 to get preference. The ISP does that by raising the access charge to B and lowering it for A.

Issue 2.5. *Should the ISP be allowed to give some types of content faster speeds?*

This can be useful because some types of users value speed more than others do. Someone who watches a live sporting event, for example, might value uninterrupted video more than someone watching You-tube, though both, of course, would like the best quality service possible if they didn't have to pay for it. Allowing different prices for different content would help by providing the Invisible Hand's usual signal of who really values quality the most.

Issue 3. *Should the ISP be allowed to charge individual content providers higher prices?*

Issue 3 is the most contentious. Figuring out what happens if we impose net neutrality depends crucially on whether the ISP and the content provider have market power, as we will see in the following example.

Supppose that one or two ISP's (Comcast and Verizon) supply broadband Internet service, and one or two content providers (Netflix and Amazon) supply movies. If only one firm sells something, it acts as a monopoly, and if two do, they compete the price down to average cost, an extreme assumption we'll make to simplify the analysis. Let the cost of supplying a consumer with broadband be 30 and the value to him be 40. Let the cost to supply a consumer with movies be 10 and the value to him be 15. (In reality, the marginal costs are near zero, but we'll sidestep that issue.) We will look at the four combinations of different degrees of competition in the ISP and movies markets.

(a) The broadband and movie markets are both competitive.

In this case, prices in both markets will be competed down to marginal cost: 30 for broadband and 10 for movies. Net neutrality regulation is irrelevant, because if Comcast tries to charge Netflix and Amazon for access, they can refuse, and all the consumers will prefer Verizon, through which they can get movies and consumer surplus of (40+ 15) - (30+10)= 15. Any consumer that chose Comcast would only get a surplus of 40-30 =10 if Comcast lost Netflix and Amazon by trying the charge them. Thus, net neutrality is not an issue if all markets are competitive.

The price of broadband will be 30.
The price of movies will be 10.
Comcast and Verizon. Profit will be 0.
Netflix and Amazon. Profit will be 0.
Consumers. Consumer surplus = 15.

(b) The broadband market is competitive, but the movie market is a monopoly.

Case (b) is also simple. Comcast and Verizon will compete the price of broadband down to the marginal cost of 30, and consumers will get consumer surplus of 10 from that market. Netflix, now a monopolist, will charge a price of 15 to consumers for movies, earning profit of 5 and leaving the consumers with no surplus. Again, net neutrality regulation would make no difference, because the ISP's have no market power and if one of them tries to make Netflix pay for access, Netflix can simply use the other ISP.

The price of broadband will be 30.
The price of movies will be
Comcast and Verizon. Profit will be 0.
Netflix. Profit will be 5.
Consumers. Consumer surplus = 10.

(c) The broadband market is a monopoly, but the movie market is competitive.

In case (c), competition in the movie market will ensure that the price of movies is driven down to the marginal cost of 10. What is interesting here, however, is that Comcast, now a monopoly, can charge not just the entire consumer value of 40 for broadband service, but also 5 more— to take away the consumer surplus they would earn from movies. Because the consumers cannot get the movies unless they buy Comcast's broadband service, Comcast can extract monopoly profits from the movie industry.
The price of broadband will be 45.

The price of movies will be
Comcast. Profit will be 15.
Netflix and Amazon. Profit will be 0.
Consumers. Consumer surplus = 0.

In case (c) net neutrality regulation would not help. The real problem is monopoly in the broadband market, and Comcast doesn't need to charge the movie companies for access to be able to earn high profits.

(d) Both the broadband and movie markets are monopolized.
When both markets are monopolized, net neutrality regulation does make a difference. Thus, let's start with the case where regulation prohibits the monopoly Comcast from charging the monopoly Netflix for access. In that case, each firm will charge its monopoly price— 40 for broadband and 15 for movies— earning monopoly profits and driving consumer surplus to zero.

The price of broadband will be 40.
The price of movies will be 15.
Comcast. Profit will be 10.
Netflix. Profit will be 5.
Consumers. Consumer surplus = 0.

Next, consider what happens if the net neutrality regulation is lifted, so that Comcast can charge Netflix for access to its customers. Now Comcast can charge Netflix for access to its customers. If Netflix refuses to pay, Netflix will lose its 5 in profit, and Comcast loses nothing, since its customers were not earning any consumer surplus from movies anyway. Netflix and Comcast will engage in bargaining over an access price to split the monopoly profit from movies. A reasonable assumption is that they will split that surplus of 5 equally, in which case the result is this:

The price of broadband will be 40.
The price of movies will be 15.
Access charge equals 2.5
Comcast. Profit will be 12.5.
Netflix. Profit will be 2.5.
Consumers. Consumer surplus = 0.

What these four cases have shown is that net neutrality regulation is chiefly important when there is market power both in the ISP market and the content provider market. It is important, however, not so much to protect consumers as to regulate how profits are divided up between content providers and ISP's.

This analysis does leave out one important point. It may seem unimportant how the ISP and the content provider divide up the monopoly profit, since the consumer loses either way. Where that can make a difference, however, is in the incentive to produce new content. If content providers do not earn as high profits, there is less incentive to innovate and introduce a new kind of content that might become a profitable monopoly. Thus, the chief threat from access charges is that by moving profits from the content providers to the ISP's it might reduce the amount of new content. ISP's counter by saying that they, too, will innovate more if they have more of the profits. The question then comes down to where we think monetary incentives are more important, for content or for the internet service itself.

Another interesting feature of net neutrality is that the idea extends logically to many of the companies that the ISPs serve as "content providers". Is Google a content provider? Yes, in the sense that it provides a web application, its search engine. But we could also think of Google as just the "internet search provider", the ISP, and the sites it searches provide the content. Since Google has considerable market power, application of net neutrality would prevent it from charging for special priority, something which is its current practice, not merely a theoretical danger as it was with the Internet Service Providers. If Google were classified as a common carrier, it also would not be able to refuse to search for sites it dislikes. Thus, it would not be able to steer traffic away from conservative web pages, as it does now.[10] Since the use of either market power or regulation to advance political positions is fraught with the risk of creating government failure, this last is an especially difficult issue.

Concluding Remarks

Telecom regulation is daunting. It relies heavily on the details of technology, and a technology which is constantly changing. The same kinds of market failure that we look at generally apply here too, and the main challenge is just figuring out the cost structure of the companies involved.

[10] See, for example, "Google's search bias against conservative news sites has been quantified," Leo Goldstein, Watts Up with That? blog, September 8, 2017.

As with electricity regulation, defining and measuring costs is perhaps the trickiest problem.

Review Questions

1. What is the alternative to auctioning off airwaves?
2. What is the interconnection problem in telephone systems?
3. What is TELRIC and what was the controversy in the Verizon case about?
4. What government regulation is involved in net neutrality?
5. What are the arguments for and against net neutrality?

Readings

1. "Regulatory Warfare Ensnares the Wireless World," *The San Francisco Examiner.*
2. " 'Neutrality' for Thee, but Not for Google, Facebook and Amazon," *Wall Street Journal.*
3. "Lawmaker to Try Again to Find Common Ground on Internet Rules," *Wall Street Journal.*
4. "Unlocking the Airwaves," *Wall Street Journal.*
5. "Microsoft Eyes Buffer Zone in TV Airwaves for Rural Internet," *Wall Street Journal.*