# Definitions to Know

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td><strong>ARPU</strong></td>
<td>Average Revenue Per User: represents the average monthly bill that a customer will pay to their service provider. Generally blended between postpaid and prepaid.</td>
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<tr>
<td><strong>Bandwidth</strong></td>
<td>Frequency width, or range of frequencies, of a communications channel that can carry a signal without distortion on a transmission medium. Measured in hertz (Hz).</td>
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<td><strong>Calling Party Pays</strong></td>
<td>Refers to the arrangement in which the mobile subscriber does not pay for incoming calls. Instead, the calling party pays for those calls.</td>
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<td><strong>DSL</strong></td>
<td>Digital subscriber line: a family of technologies that provide digital data transmission over the wires of a local telephone network.</td>
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<td><strong>Dual-Band Network</strong></td>
<td>Cellular radio system that operates in two different frequency bands, in which network elements conform to identical network architectures and radio interfaces.</td>
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<td><strong>GSM (Global System for Mobile Communications)</strong></td>
<td>Digital cellular phone system standard that originated in Europe and extends to 860 networks in 220 countries. GSM uses a time division multiple access (TDMA) radio propagation scheme. Multi-frequency handsets are available that support international roaming among these standards. See Dual-Band Network.</td>
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<td><strong>Hot Spot</strong></td>
<td>Area that is covered by a wireless local area network (WLAN) service. This service is available for the public to use for a nominal charge, for free, or as a premium service.</td>
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<td><strong>ISDN (Integrated Services Digital Network)</strong></td>
<td>A network architecture that uses digital technology to support integrated voice, data, and image service through standard interfaces over copper twisted-pair telephone lines. Its major purpose is to integrate access to established network services while providing new digital services.</td>
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<td>LTE (Long Term Evolution)</td>
<td>A Third Generation Partnership Project (3GPP) venture to define the requirements and basic framework for the wideband code division multiple access (WCDMA) mobile radio access network (RAN) beyond third-generation (3G) technology.</td>
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<tr>
<td>MNP</td>
<td>Mobile Number Portability: enables mobile telephone users to retain their mobile telephone numbers when changing from one mobile network operator to another.</td>
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<td>Mobile Broadband</td>
<td>Describes various types of wireless high-speed internet access through a portable modem, telephone or other device.</td>
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<td>Mobile Termination Rates</td>
<td>The charges which one telecommunications operator charges to another for terminating calls on its network.</td>
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<td>NFC (Near Field Communication)</td>
<td>Emerging short-range networking techniques designed to provide a means of conducting secure transactions for consumers applications over a range of 10 centimeters (about 4 inches)</td>
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<tr>
<td>Post-Paid</td>
<td>Typically contract based customers, majority of US cellular users.</td>
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<td>Prepaid Connection</td>
<td>Requires no contract and the user pays for it in advance.</td>
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<tr>
<td>Roaming</td>
<td>Ability of a mobile user to access cellular services while away from the home network.</td>
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<tr>
<td>SIM (Subscriber Identity Module)</td>
<td>Part of a removable smart card for mobile cellular telephony devices such as mobile phones and computers</td>
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<tr>
<td>Spectrum</td>
<td>Loosely described as the radio airwaves that wireless devices use to communicate, measured in units called hertz.</td>
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<tr>
<td>Unbundling</td>
<td>Refers to the regulatory process of allowing multiple telecommunications operators to use connections from the telephone exchange to the customer’s premises.</td>
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Introduction to Wireless Telecommunications

Overview

- In the last half decade wireless mobile communications has become essential to everyday life and business. This has led to the rapid growth of the telecommunications markets, as more infrastructure and capital is required to meet the demands of the global economy.
- Firms have been able to grow their business through growing subscribers and increasing ARPU.
- The large majority of subscriber growth in recent years has come from Asia and India. There are now over one billion cellphone users in China alone, while India is expected to pass this mark this year.
- In developed markets however most of the growth has been seen through growing ARPU as subscriber numbers have began to flatten.
- Despite maturity beginning to set in the industry as a whole is expected to see large growth over the next five years, reaching $1.7T.
- What will drive most of this growth in ARPU is the growing demand for data and the rolling out of 4G networks.
- The telecommunications industry faces high regulations, which greatly varies across countries and has significant implication on markets.
- Due to the nature of the business there tends to be 3-5 carriers in each market, as after that competition gets too high and the costs of running the network quickly outweigh the benefits.
- Many wireless telecommunications companies are diversified with revenues also coming from wire line, media assets and broadcasting.

Establishments

Global Revenue and Subscribers

![Graph showing the number of establishments over years](image1)

![Graph showing global revenue and subscribers over years](image2)
**Overview of Wireless Networking**

- Spectrum is the most important element in wireless networking, roughly defined as the electromagnetic waves that wireless devices use to communicate.
- Spectrum is divided into units called hertz and represent a range of frequency, of which cellphones utilize radio waves which fall into the 450 MHz to 3 GHz.
- Significant coordination must be done by the regulator to insure that spectrum is used efficiently and properly. As users of spectrum include military, broadcasters, public safety and other applications, coordination is necessary across parties to prevent interference.
- Signals are propagated through advanced antenna technologies dubbed MIMO (multiple input multiple output). These antenna networks employ antennas on both the terminal and at the base of the station. A challenge of MIMO is that the small size of cellphones do not allow for adequate special separation between antennas.
- Three ways to increase efficiency in networks include: deploying new spectrum, developing new technologies and cell splitting.

**Spectrum Breakdown**

**High vs. Low Frequency**

**High frequency** signals have a short wavelength and high quantum energy. This is better for high capacity. However, high frequency signals cannot easily travel through long distances or through walls which will cause signal to drop in parking garages and high-rise buildings or “dead spots”.

**Low frequency** signals have a long wavelength and low quantum energy. Low frequency bands tend to travel about twice as far as higher signal and are less susceptible to signal drops.

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**Architecture of a Simple Cellular Network**

Source: JDS Uniphase, Mobile Networks Tutorial
## Mobile Phone Supply Chain

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<th>Service</th>
<th>Hardware</th>
<th>Software</th>
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<tr>
<td>Government</td>
<td>Physical Resource</td>
<td>Software Developer</td>
</tr>
<tr>
<td>Telecom Service Provider</td>
<td>Electronic Manufacturing Services</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hardware Provider</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Telecom Service Provider</td>
<td></td>
</tr>
<tr>
<td>Consumer</td>
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Wireless Business Model

Post-paid vs. Prepaid

Wireless has two basic revenue models:
- Post-paid or contract model
  - Includes contract for a year or more with an early termination penalty for a subsidized handset.
  - Termination penalty protects carrier’s subsidy investment and creates a degree of control over customer relationship.
- Prepaid or “Pay-As-You-Go” model
  - No contract obligation for the customer as well as no handset subsidy.
  - Potential for lower prices and/or higher margins
  - Used by discount brands featuring low-cost distribution

CPP (Calling-Party Pays)

Caller pays to place a call to a mobile phone, not dependent on if the caller is using a fixed or mobile phone. The norm in most countries.
- CPP tends to:
  - Make margins lower and more dependent on market share
  - Increase effective volume pricing
  - Low usage
  - Encourage customers to use multiple SIM cards
- CPP creates a monopoly for the terminating networks
  - Customers minimize charges by having multiple SIM cards (one for cheaper originating calls and one for cheaper terminating calls)
  - Carriers combat this arbitrage opportunity by bundling

Data vs. Voice

- Telecom companies typically charge different amounts for data and voice use, with data costing more
- This model of charging different rates also allows for bundling packages of both data and voice
- Data costs more because it uses more of the network’s resources and requires a higher bandwidth
- Voice is charged by the minute, while data is charged generally by the gigabyte or megabyte
- In recent years there has been an explosion in the amount of mobile data used, allowing for higher ARPU

Telecommunications Services Product Adoption Curve
The wireless market in Canada has seen strong growth as coverage has expanded, smartphones and tablets have been adopted and the demand for high margin data has exploded. These factors have led to revenue reaching $21 B at an annualized growth rate of 4.9%

Businesses are large users of wireless telecommunications in Canada, accounting for 42.3% of revenue. The next largest group is consumers aged 25 to 54 and consumers aged 55+ making up 26.9% and 12.4% respectively

The Canadian wireless market is dominated by three large companies: Bell Canada Enterprises (BCE), Rogers Communications (RCI) and TELUS (T). These players known as the Big Three have been able to capture over 90%+ of Canadian wireless revenue and users

The Canadian market is characterized by tough barriers to entry, mainly due to the extremely large geographic size of the country

These barriers to entry make it extremely hard for new players such as Wind and Public Mobile to be successful

The Canadian Radio-television Telecommunications Commission (CRTC) is the main regulatory body for the wireless industry and is in charge of setting many rules within Canadian communications. Recently the CRTC has been pushing for a fourth powerful wireless player

The main Canadian wireless players also have large market share in wire line market, as well as the Canadian media space

### BCE

- BCE is one of Canada’s oldest companies, founded in 1880.
- BCE is Canada’s largest telecommunications company by market cap and holds full ownership of its related operating company, Bell Canada
- However Bell has lowest number of wireless subscribers, due to diversification across subsectors

### Rogers

- Rogers Communications was originally established as The Rogers Vacuum Tube company in 1925
- The present enterprise was founded by Ted Rogers in 1961
- Rogers was historically a first to market leader in the Canadian wireless space, leading it to capture the most cell phone users

### TELUS

- TELUS was originally created in 1990 by the government of Alberta as a holding for crown operations. In 1995, it acquired Ed Tel from the City of Edmonton.
- This establishment has led TELUS to have a strong presence in Western Canada
- In recent years TELUS has seen the fastest growth among incumbents
Canadian Wireless Details

Wireless Revenue & ARPU

Revenue Breakdown

Canadian Telecoms Subscriber Growth
Foreign Players

Americas

- AT&T
- Verizon
- América Móvil

Europe, Middle East & Africa

- Airtel
- Vodafone
- STC

Asia Pacific

- China Mobile
- China Unicom
- Softbank