



The Internet: Basics of Information Transmission

Unit 3. Information and the Internet

Revision Date: Jan 04, 2020

Duration: 1 50-minute session

Lesson Summary

Summary

In this lesson, students will analyze what the Internet is and its basic functionality. Students will learn how the Internet works and how the implementation of the Internet has affected our society. They will discuss the idea of the Internet as a delivery service to get bits from one place to another.

For homework students, should have read and made brief notes on the following sections from the "Blown to Bits" book (Online book link: http://www.bitsbook.com/wp-content/uploads/2008/12/B2B_3.pdf (http://www.bitsbook.com/wp-content/uploads/2008/12/B2B_3.pdf)):

- "The Internet as a Communication System"
- "Packet Switching"
- "Core and Edge"
- "Data Format as Public Property"

These sections are on pages 91-92 & 301-303 in the pdf version.

Learning Objectives

CSP Objectives

- *EU DAT-1 - The way a computer represents data internally is different from the way the data is interpreted and displayed for the user. Programs are used to translate data into a representation more easily understood by people.*
 - LO DAT-1.A - Explain how data can be represented using bits.

- LO DAT-1.C - For binary numbers: a. Calculate the binary (base 2) equivalent of a positive integer (base 10) and vice versa. b. Compare and order binary numbers.
- *EU CSN-1 - Computer systems and networks facilitate how data are transferred.*
 - LO CSN-1.A - Explain how computing devices work together in a network.
 - LO CSN-1.B - Explain how the Internet works.
 - LO CSN-1.D - Describe the differences between the Internet and the World Wide Web.
 - LO CSN-1.E - For fault-tolerant systems, like the Internet: a. Describe the benefits of fault tolerance. b. Explain how a given system is fault-tolerant. c. Identify vulnerabilities to failure in a system.
- *EU IOC-1 - While computing innovations are typically designed to achieve a specific purpose, they may have unintended consequences.*
 - LO IOC-1.A - Explain how an effect of a computing innovation can be both beneficial and harmful.

Math Common Core Practice:

- MP3: Construct viable arguments and critique the reasoning of others.
- MP5: Use appropriate tools strategically.
- MP7: Look for and make use of structure.

Common Core ELA:

- RST 12.2 - Determine central ideas and conclusions in the text
- RST 12.4 - Determine the meaning of symbols, key terms, and other domain-specific words and phrases
- RST 12.6 - Analyze the author's purpose in providing an explanation, describing a procedure
- RST 12.7 - Integrate and evaluate multiple sources of information presented in diverse formats and media
- RST 12.8 - Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text
- RST 12.9 - Synthesize information from a range of sources
- RST 12.10 - Read and comprehend science/technical texts
- WHST 12.6 - Use technology, including the Internet, to produce, publish, and update writing products
- WHST 12.7 - Conduct short as well as more sustained research projects to answer a question
- WHST 12.8 - Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source
- WHST 12.9 - Draw evidence from informational texts to support analysis, reflection, and research

NGSS Practices:

- 1. Asking questions (for science) and defining problems (for engineering)

NGSS Content:

- HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

Key Concepts

The Internet and the systems built on it have a profound impact on society.

The Internet has many layers and was designed to be fault tolerant with redundant features.

Outcomes

- Students will explain the characteristics of the Internet and how the systems built on it influence their use.
- Students will explain the difference between bandwidth and latency.
- Students will analyze relationships of data transfer over the systems within the Internet.
- Students will synthesize how data transfer and Internet systems are affected by the environment and needs of its users.
- Students will describe how communication paths on the internet are hierarchical and redundant. IP is hierarchical. Routing is fault-tolerant and redundant.

Essential Questions

- What is the Internet, how is it built, and how does it function?
- What aspects of the Internet's design and development have helped it scale and flourish?
- How do economic, social, and cultural contexts influence innovation and the use of computing?

Teacher Resources

Student computer usage for this lesson is: **required**

Blown to Bits (Abelson, Ledeen, Lewis): <http://www.bitsbook.com/> (<http://www.bitsbook.com/>)

Optional Student Handout: Internet Change Student Handout

Answer Key for Teacher: Internet Change Answer Key

The following links provide background on the topics covered in this lesson:

- <http://www.policy.hu/inetclass/arpaNet.html> (<http://www.policy.hu/inetclass/arpaNet.html>)
- <https://www.youtube.com/watch?v=JU57iG1mNjl> (<https://www.youtube.com/watch?v=JU57iG1mNjl>)
- <http://googlemapsmania.blogspot.com/2013/12/mapping-internet-of-things.html> (<http://googlemapsmania.blogspot.com/2013/12/mapping-internet-of-things.html>)
- <http://www.google.com/green/storyofsend/desktop/> (<http://www.google.com/green/storyofsend/desktop/>) (defunct as of 10/1/2014)
- <http://www.webperformancetoday.com/2012/04/02/latency-101-what-is-latency-and-why-is-it-such-a-bigdeal/> (<http://www.webperformancetoday.com/2012/04/02/latency-101-what-is-latency-and-why-is-it-such-a-bigdeal/>)
- <http://www.coolnerds.com/Newbies/Bandwidth/Bandwidth.htm> (<http://www.coolnerds.com/Newbies/Bandwidth/Bandwidth.htm>)
- <http://www.cnet.com/internet-speed-test/> (<http://www.cnet.com/internet-speed-test/>)

- <http://www.speedtest.net/> (<http://www.speedtest.net/>)
- <http://www.bandwidthplace.com/> (<http://www.bandwidthplace.com/>)
- <http://www.akamai.com/html/technology/dataviz1.htm>
(<http://www.akamai.com/html/technology/dataviz1.html>)

Lesson Plan

Getting Started (10 min) - Investigate and Discuss: What is the Internet?

Ask: How does the Internet work?

Journal: Define

- The Internet
- A Web browser

Share student responses and develop class definitions.

Compare student responses to the following.

- Internet: A collection of systems working together to deliver data to the user. Data delivery includes email, video streaming, social media traffic, and cloud file storage and retrieval.
- Web Browser: A software application used to retrieve and display information from the world wide web, which is one part of the Internet.

Guided Activity (35 min)

Part 1 - Exploration (10 min)

Say: How did the internet and web browsers come about? The internet wasn't originally intended for everyone. Originally it was a tool for scientists to communicate.

Show how the Internet has grown from the small ARPANET system to what it is today.

1. View ARPANET image: <http://www.policy.hu/inetclass/arpaNet.html>
(<http://www.policy.hu/inetclass/arpaNet.html>) (from 1971)
2. Watch the discussion from the Today Show on "What is the Internet?" (2:12 min):<https://www.youtube.com/watch?v=95-yZ-31j9A> (<https://www.youtube.com/watch?v=95-yZ-31j9A>)
3. View the image of today's Internet: <http://googlemapsmania.blogspot.com/2013/12/mapping-internet-of-things.html>
(<http://googlemapsmania.blogspot.com/2013/12/mapping-internet-of-things.html>) Note: zoom in to see the details. Investigate your local area including your own school, and explore. Have students find 4 different things with 4 different colors.

Part 2 - Discussion (10 min)

Show the video *Who Invented the Internet and Why* (<https://youtu.be/21eFwbb48sE>) through 4:49.

Ask: How is all this interesting and valuable information represented?

Answer: binary.

Lead students to develop the concept that lower-level abstractions can be combined to make higher-level abstractions such as texting (SMS), email, images, sound or video. (ie: one byte can represent one note, put notes together to make a soundtrack. 6 bytes make 1 color pixel. Put pixels together to make a picture. Put sound and pictures together to make a video)

Ask: who and what was theWorld Wide Web was originally intended for?

Answer: only for rapid and easy exchange of information within the scientific community.

Point out how, like many innovations, it grew beyond the original vision, but because of the limited view of its use in the beginning, there were serious holes in the security design of the system. Other design features, like scalability, have served the system well over many years.

Ask: How is information retrieved on the Internet?

Answer: Web browsers make requests for image, sound, web page and other files using the http or https protocols.

Requested files are broken into smaller pieces and the transmission of these pieces is done following the TCP/IP protocol.

Discuss the following sections from pages 301-303 in the "Blown to Bits" book. (Online book link: http://www.bitsbook.com/wp-content/uploads/2008/12/B2B_3.pdf (http://www.bitsbook.com/wp-content/uploads/2008/12/B2B_3.pdf)):

- "The Internet as a Communication System"
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Part 3 - Internet Simulation (15 min)

1. Ask: What happens if one of the computers along the pathway loses power or is overloaded with data traffic? Point out that in case of problems there are many different paths (redundancy) that a message can be routed along and that everything on the internet has its own address (IP address) to be covered in upcoming lessons.
2. Explain that packet transmission rate is measured by "bandwidth" and the time it takes for packets to be delivered is called "latency."
 1. Pass a message along one row a single word at a time, and then send it back across the room using multiple rows (paths) at once to demonstrate bandwidth. Measured in bits per second = how many bits arrive.
 2. To show latency, have each student pass each packet under their chair before passing it on creating greater latency (delay) to get information from one side of the room to the other. Explain that latency could be caused by a single slow link in the connection or overall slowness.
3. Students read the following articles (both are relatively short) and answer questions after.
4. Latency: <http://www.webperformancetoday.com/2012/04/02/latency-101-what-is-latency-and-why-is-it-such-a-big-deal/>
(<http://www.webperformancetoday.com/2012/04/02/latency-101-what-is-latency-and-why-is-it-such-a-big-deal/>)
 - Latency is the delay. How long you have to wait to send or receive.
5. Bandwidth: <http://www.coolnerds.com/Newbies/Bandwidth/Bandwidth.htm>
(<http://www.coolnerds.com/Newbies/Bandwidth/Bandwidth.htm>)

- Bandwidth is like the width of a highway, the more lanes you have the more cars can drive on the road at once

Wrap-up (5 min)

In this activity, students will each share one thing they have learned from this lesson. This can be done in several ways depending on time constraints or disabilities. All students should participate in some way before leaving the classroom.

- Have all students stand. In order to sit back down, students must share one thing they have learned to the class. (This may happen organically, or in a prescribed order.)
- If there is a disabled student for whom the standup/sit activity would not be an option, develop an alternative way to indicate who in the class has answered (such as having them raise their hands).
- If there is a student who has difficulty speaking in front of the class or there isn't sufficient time, hand out index cards on which each student must write what they have learned, to be handed in as an exit ticket to leave the class.

Options for Differentiated Instruction

- Students can share comparisons of assignments in small groups.
- Students can further explore net usage (using <http://www.akamai.com/html/technology/dataviz1.html> (<http://www.akamai.com/html/technology/dataviz1.html>)) specifically targeting mobile usage and/or broadband usage by geographical regions. Analyze the differences between these geographical regions of packet usage.

Evidence of Learning

Formative Assessment

Using a real-time network tool that measures the number of views per minute, students generate a question that can be answered using this tool. They will then collect the data and write a report that answers this question. The report should use current real-time screenshots for data and examples. (Note: Students can possibly start this assignment in class, but will likely need to complete as homework.)

Summative Assessment

Possible question(s) to use for a future test:

- What is the relationship between bandwidth and latency?

- When using Internet tools to display data, what are some important factors that need to be considered to better understand the information being displayed?



(<http://www.umbc.edu/>)



(<http://www.umd.edu/>)



(<http://www.nsf.gov/>)

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