Internet of Things (IoT)
What is a script kiddie?

- A. A malicious script
- B. A teenage hacker
- C. A person who has a hostile intent, possesses sophisticated skills, and may be interested in financial gain.
- D. A person who follows instructions to carry out a cyber attack, without understanding the meaning of the steps he or she is performing?
Security News Review

Read the news, find out the answer for these questions:

➤ Pick up 3 key words from the news relevant to this class.
➤ When and where did that incident happen?
➤ What was affected? Or what’s the impact?
➤ What did experts say/suggest (if any)?
Officials: DC security cameras hacked 8 days before inauguration by man, woman in London


Computer Virus Wipes Out 7 Years Of Police Evidence

https://www.youtube.com/watch?v=_mhMb6xeoJk
Internet of Things (IoT) describes objects in the physical world connecting to the Internet and allowing for any-to-any connectivity as long as the use is authorized by its owner.
The IoT’s Impact on Humans (daily lives)

- Health monitoring and updating - sensors can monitor human vital statistics and securely send data analytics to a bedside application or mobile application. New human IoT applications will provide near real-time monitoring of human performance.

- Home security and smart home control systems - homeowners can have near real-time access to home security systems, access to home surveillance video camera feeds, and full control over home heating and air-conditioning settings to maximize energy efficiency.

- Near real-time tracking and monitoring of family members via global positioning systems (GPS) - GPS tracking applications and mobile applications provide parents with near real-time location finding of their children using their smartphone as the tracking device.
Online banking, bill paying, and financial transactions - homeowners can now automate bill payments using online banking systems and applications via autopay deductions directly from checking accounts.

Online e-commerce purchases for household goods, food, services - homeowners now have the ability to purchase goods and services online and pick them up at a retail store or have them drop-shipped to their front door.

Automobiles with smart computers and "always-on" Wi-Fi Internet access - remote control ignition starter, automobile diagnostics that can be securely uploaded to the manufacturer prior to a car service appointment for preassessment analysis.
INTERNET OF THINGS
EXPLAINED BY ILLUSTRATOR

He's waking up in 20 minutes!
Breakfast time for my master

Done!

Yummy!

You could have kitchen appliances that "talk" to your alarm clock and know to start prepping for breakfast time right when you wake up.

by QuasrSoft.com
After breakfast, your fridge might tell you the milk has gone bad and that you should throw it out. It may also tell you where to buy milk for the best value, or even tell you if a specific brand you like is or is not in stock before you even leave the house.
The IoT’s Impact on Humans - Toothbrush

Your toothbrush could track how often you’ve used it today and how long you should brush. It could send you a reminder to your smart phone when you last went to the dentist, and then your smart phone could automatically set up an appointment for you.

by QuartoSoft.com
You jump in your car to head to the store, which automatically recognizes you as the driver. It reminds you that you should get an oil change in 500 miles and then starts on its way, automatically driving there for you. It knows on its own to avoid traffic and take an alternative route, which it knows due to sensors in the roads that communicate with all travelling vehicles. It also sends a notification to your house that you're leaving for the store, so it turns off the light you forgot to switch in your kitchen for you.
When you reach the store, there are no cashiers or check outs. You get directed by your smartphone exactly where the milk is. It knows which container is the freshest and tells you to grab it. You walk out of the store, pass through a scanner, and the store automatically debits your bank account for the milk. The bank sends you a receipt to your e-mail.
The IoT’s Impact on Businesses

▶ Retail stores - stores, banks, restaurants, and manufacturers must have a World Wide Web presence direct to their customers.

▶ Virtual workplace - businesses and companies that are in the people or professional services business line do not need to come to a physical office unless it is for important meetings or presentations. Today, the IoT supports all communication types, including full two-way video conferencing and collaboration with colleagues that are located remotely or teleworking from home.

▶ Remote sensors for utility/environmental/infrastructure monitoring - Any business involved in utilities, critical infrastructure, or environmental services can benefit from Internet-connected sensors and meter-reading devices. This access can replace the need for a human to physically visit the location and obtain a meter reading.
The IoT’s Impact on Businesses

- City and public service traffic-monitoring applications - smart cities can monitor and report on real-time traffic conditions and redirect traffic flow during rush-hour conditions with near real-time updates to mobile applications accessible to smart cars. City parking garages can pinpoint available parking spots.

- New "Anything as a Service" IoT applications - Anything as a Service (AaaS) means that whatever you are currently doing can be transformed into a hosted, secure cloud solution where you access your content and information from a website. Calendars, healthcare reminders, dry cleaning, grocery shopping, babysitting, tax preparation services, finding products or services, or finding anything, for that matter, are possible with the Internet.
New Challenges Created by the IoT

- Security - how do you keep the bad guys out if you enable the IoT for your personal and professional life?

- Privacy - how do you protect your family’s identity and privacy data from theft or unauthorized access that can lead to identity theft?

- Interoperability and standards - how well do IoT manufacturers and application developers ensure that devices communicate securely?

- Legal and regulatory compliance - what role do the international, federal, and state levels contribute toward legal, tax, and regulatory requirements regarding IoT-related business transactions that involve payment for goods and services?
Challenge for the IoT - Security

The Internet of ransomware things...

- **HUNGRY? PAY UP AND I'LL UNLOCK MY DOOR!**
- **ON STRIKE UNTIL YOU SEND MONEY TO MY HACKERS.**
- **20 BUCKS IN MY PAYPAL ACCOUNT OR I'LL ONLY BREW DECAF!**
- **I'LL BE BURNING THE TOAST IF YOU DON'T GET ME SOME DOUGH!**
- **THE NEXT TIME YOU LEAVE, IT'LL COST YOU 100 BUCKS TO GET BACK INTO THE HOUSE, UNLESS YOU GIVE ME $75 NOW!**
- **30 BUCKS IN BITCOIN, OR NEXT TIME I SMELL SMOKE, I MIGHT JUST LET YOU SLEEP.**
- **MY ALARM SYSTEM IS GOING TO GO OFF RANDOMLY THROUGHOUT THE NIGHT, UNLESS YOU "DONATE".**
- **I'M TURNING OFF THE HEAT UNTIL YOU WARM UP MY BANK ACCOUNT!**
- **WIRE MY HACKER $100 OR I'LL REVERSE MY MOTOR AND BLOW DIRT ALL OVER THIS PLACE!**
- **YOUR DIRTY DISHES CAN WAIT, I'M BUSY MINING BITCOINS.**
- **EXCUSE US WHILE WE PARTICIPATE IN A DDOS ATTACK.**
- **IF YOU DON'T SEND US CASH, YOUR REPUTATION WILL BE IN THE TRASH.**
- **I'LL START YOUR CAR, BUT ONLY TO TAKE YOU TO YOUR BANK TO MAKE A TRANSFER.**
- **SEND ME $25 OR I'LL TELL EVERYONE ON YOUR SOCIAL NETWORK THAT YOU WERE STUPID ENOUGH TO BUY AN INTERNET-CONNECTED BROOM!**
Challenge for the IoT - Security

- IoT devices such as sensors or consumer items (Internet-connected TV) are deployed in large quantities. Depending on the criticality of the application, an outage could impact many endpoints if attacked.

- IoT devices are ubiquitous and can have wide reach into the user or household population. e.g., electrical meters that are Internet connected introduce a critical infrastructure vulnerability if an attack could be replicated and pushed to individual endpoints.

- IoT devices that are updated or maintained properly may permit vulnerabilities to become entry points into your network or organization. This is the equivalent of a vendor announcing an End of Life (EOL) support timeline for a product or software application.
Challenge for the IoT - Security

- IoT upgrades can be difficult to distribute and deploy, leaving gaps in the remediation of IoT devices or endpoints. Cars that have Wi-Fi access and onboard computers require software patches and upgrades from the manufacturer. This maintenance must be performed for all cars requiring the upgrade to remediate a software vulnerability.

- IoT devices typically do not provide the user or owner with any inside visibility or knowledge of how the device works and connects to the Internet. Vendors or service providers that have remote access to an IoT device may be able to pull information or data from your IoT device without your permission.

- IoT devices typically are not physically secure and can be located anywhere in public areas or outside your house. Your home’s electrical panel, cable TV, or fiber optic cable points of entry are typically not that secure.
Challenge for the IoT - Privacy

▶ Privacy policy statement - an actual legal definition of the user’s privacy rights as documented in the manufacturer’s privacy policy statement.

▶ Definition of data, metadata, or analytical data use and rights - what data, metadata, or analytical data are and what they may be used for, and if permission is required by the user for use of those data.

▶ Ability for a user to provide consent to a manufacturer’s or application service provider’s privacy policy statement - users must be able to read the statement online and accept or decline the privacy policy’s terms and conditions.

▶ Determine the domain of privacy - If you permit geolocation tracking of you and your smartphone or IP mobile device and another application service provider uses that information about you and where you go, is that infringing on your privacy rights?
The IoT devices is fragmented and lacks interoperability, we have to use many different apps to control all the different devices in our homes. This fragmentation can manifest as any of the following:

- Different OEMs: devices or equipment that are not made by the same manufacturer cannot integrate.
- Different OSs: inability to run on the same operating systems.
- Different versions or times of purchase: devices that weren’t made or purchased at the same time.
- Different/incommunicable types of connectors or connectivity frameworks (e.g. devices).
- Different/inconsistent communication protocol standards (i.e. rules).
- Lack of programmability needed to connect in the first place.
IoT devices introduce some concerns from a regulatory and legal perspective, some of these concerns have never existed before.

- **privacy** - The data collected from your IoT devices tell a specific story about you and your use of that IoT device. These data can be used for good things as well as used against you in a discriminating manner.

- **liability** - If a hacker can compromise a home IoT security system and video camera system and then rob that house while the owners are away, who is liable for this actual robbery and loss of possessions? Current liability laws and protection may or may not address IoT devices connected to the public Internet.
References

A large portion of the material is adapted from:

- Fundamentals of Information Systems Security - David Kim, Michael G. Solomon
- Microsoft - Addressing interoperability in IoT
  https://blogs.microsoft.com/iot/2015/06/15/addressing-interoperability-in-iot/
- Interoperability: The Challenge Facing the Internet of Things -

Image sources: quartsoft.com and joyoftech.com