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Mobile Attacks Survey and Taxonomy

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Outline

1. Objectives
2. Mobility trends
3. Attack attributes
4. Representative smartphone related attacks
5. Summary of attacks
6. General attack taxonomy
7. Using the attack taxonomy
7. Conclusions

Objectives

1. Survey and discussion of major security and privacy incidents related to smartphones reported in the general media
2. Summary of attacks by attack category, applicable platform, vulnerability, infection method, targets, impact and countermeasures
3. Mapping of these attacks to the proposed attack taxonomy
4. Demonstrate how the attack taxonomy is utilized to predict new potential attacks, possibly as an extension of existing attacks

What is a smartphone

- phone
- computer
- scanner
- sensor
- proxy
- access point
- ID card
- payment card

Future:

- centralized controller?
- personal monitoring device?
- your doctor’s assistant?

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High value

High complexity

And therefore a lot of possible threats…

Future:

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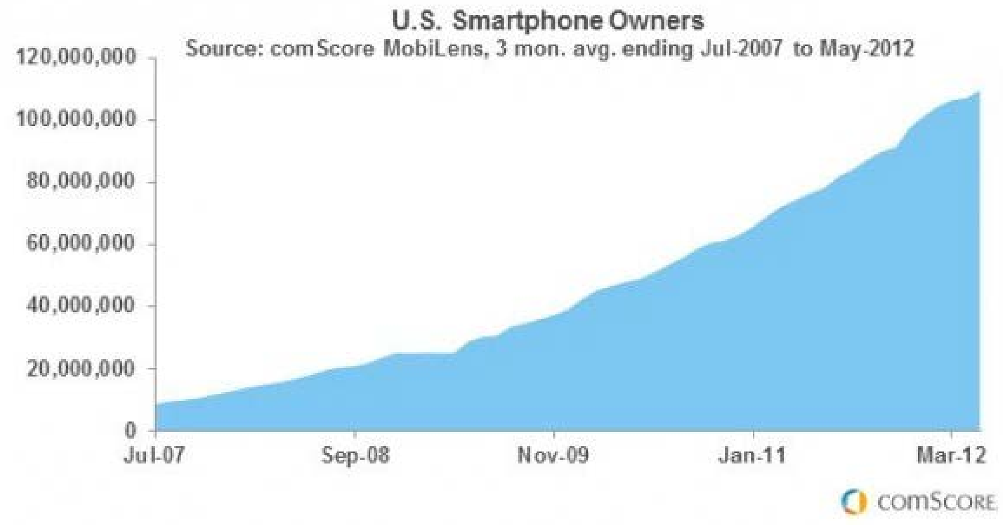
Smartphone related statistics

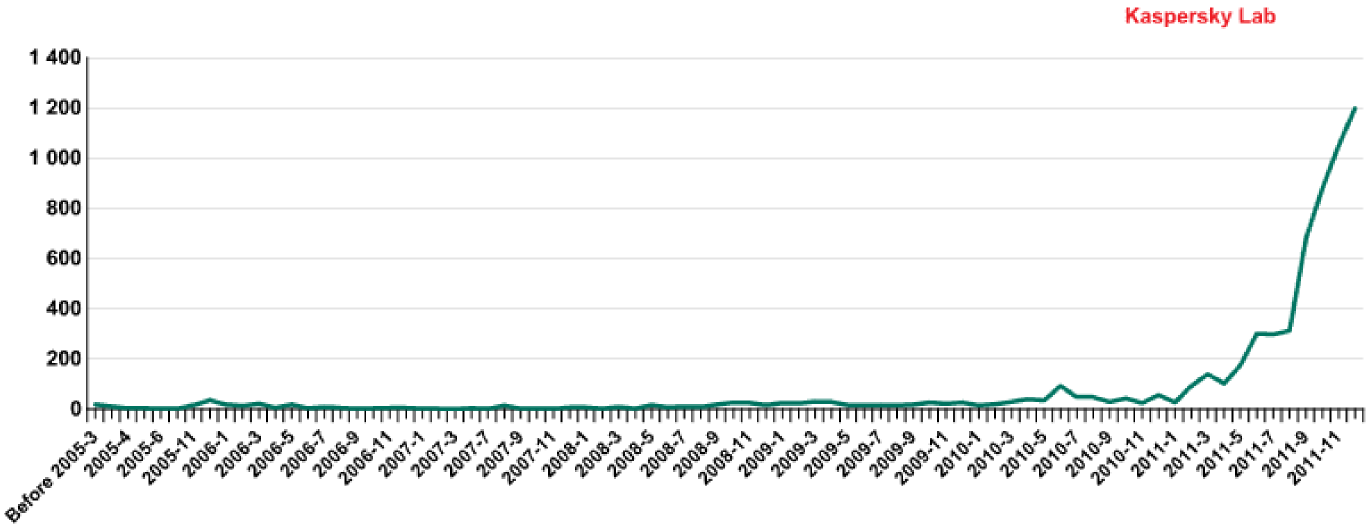
Since Apple's debut of the original iPhone in mid 2007 and the unveiling of open source Android OS in late 2007, the number of smartphone users has increased dramatically



Source: comScore - http://www.comscore.com/Insights/Blog/5_Years_Later_A_Look_Back_at_the_Rise_of_the_iPhone

Mobile malware statistics

Mobile malware took off as well, after a seemingly slow start



The number of new modifications of mobile threats by month, 2004–2011

Source: Kaspersky Lab - http://www.securelist.com/en/analysis/204792222/Mobile_Malware_Evolution_Part_5

The survey

- Looked at representative incidents / attacks related to smartphones reported in general media in 2006-2012
- Covering major types of attacks, but not attempting to be exhaustive
- Extracted attack attributes
- Summarized attacks

Attack related attributes

- Attack category
- Applicable platform
- Vulnerability
- Infection method
- Targets
- Behavior and Impact
- Countermeasures

Representative smartphone related attack incidents

Type: Root privilege and Data exfiltration	DroidDream Malware for Android
Time	March 2011
Category	Trojan malware
Platform	Android
Targets	Any Android users
Vulnerability	Code exploit leads to root control over the phones
Infection method	Disguised as popular games
Behavior and Impact	The malware gains root access to the device and steals sensitive data from the phone, e.g., product ID, model, partner/provider, language, country and userID, can be stolen
Countermeasure	Google removed over 50 applications found to contain the malware from the Android Market, and activated an Android app kill switch that removed the malicious apps from user devices which have already downloaded the apps

Ref: RWWeb, Dozens of Malware Apps Discovered on Android Market, http://www.readwriteweb.com/archives/over_50_droiddream_malware_apps_removed_from_android_market.php

Type: Phishing, fraud, spam	SMS Phishing
Time	June 2012
Category	Phishing
Platform	Any
Targets	Any smartphone user
Vulnerability	Phishing to human
Infection method	Victims receive a link in a SMS/MMS/email and are tricked to enter sensitive personal information on web; monetized by signing up premium services
Behavior and Impact	Spammers send SMS text messages saying “WON a FREE $1000 Giftcard! Enter "405" at www.****.com.***.biz to claim it and we can ship it to you immediately!”. After clicking the link, the web page asks the user to enter the code received in the SMS. The user then is redirected to another website to fill a form with sensitive personal information, email, home address, DOB, phone number, etc. Spammers can use this information for further attacks. Also, users are signed up for a premium service at $9.99/month.
Countermeasure	Beware of Phishing!

Ref: SMSmishing Unabated: Best Buy targeted by fake gift card campaign, http://blog.eset.com/2012/06/14/smsmishing-unabated-best-buy-targeted-by-fake-gift-card-campaign
Other examples: Frederick Felman, Smart Phishing for Smartphones, http://www.circleid.com/posts/20100205_smart_phishing_for_smartphones

Type: Snooping/privacy	**Android Phone Snooping Vulnerability**
Time	May 2011
Category	Software flaw
Platform	Android
Targets	Android users using applications based on Google’s ClientLogin Protocol such as Google calendar and contacts synchronization service
Vulnerability	Google’s ClientLogin Protocol issues an authentication token which is valid for a maximum duration of 2 weeks, for any subsequent requests to the data service API
Infection method	Applicable to pre-2.3.4 Android smartphone versions and pre-3.0 Android tablet versions
Behavior and Impact	Attacker eavesdrops AuthToken (transmitted in clear text) and impersonates the user to access or modify user personal information in calendar, contacts, private web albums through Google services
Countermeasure	Limit the lifetime of AuthToken; mandate https for the services; switch to more secure authentication services. Google has fixed the problem in the latest Android releases, and delivered updates to old Android devices.

Ref: Elinor Mills, Android phones vulnerable to snooping attack, http://news.cnet.com/8301-27080_3-20063646-245.html

Type: Infrastructure	**BBproxy Blackberry Trojan**
Time	August 2006
Category	Trojan malware
Platform	RIM/Blackberry
Targets	Enterprise internal network and data
Vulnerability	Exploits the trust relationship between a Blackberry and a company internal server to hijack a connection to the network. Since the data tunnel between the Blackberry and the server is encrypted, intrusion detection systems at the perimeter of the network cannot detect the attack.
Infection method	Embedded the malware into a game and downloaded to the Blackberry, or delivered through email
Behavior and Impact	Malware makes BlackBerry to open a communications channel between the attacker and the company's internal network. Attacker can get into the company’s internal network and steal information or scan for more vulnerabilities.
Countermeasure	It is recommended that the Blackberry server is placed in a separate DMZ. The communication between Blackberry server and other internal network hosts should be very limited.

Ref: Kim Zetter, BlackBerry a Juicy Hacker Target, http://www.wired.com/science/discoveries/news/2006/08/71548

Type: Generic OS attacks	SSL Renegotiation DoS
Time	March 2011
Category	DoS based on asymmetric processing
Platform	Any
Targets	SSL/TLS servers
Vulnerability	Basic TLS operations impose much more processing load on the server side than on the client side
Infection method	N/A
Behavior and Impact	The client side can generate a lot of TLS renegotiation requests to exhaust the server resources
Countermeasure	Disable SSL/TLS renegotiation; rate-limit both incoming and renegotiation SSL/TLS requests; use SSL accelerator to offload processing. Existing DoS detection and mitigation methods do not work in this case because the initial SSL handshake is legitimate and renegotiations are done directly with the server.

Ref: J. Orchilles, SSL Renegotiation DoS, http://permalink.gmane.org/gmane.ietf.tls/8335

Type: Sensors	Spy Smartphone Software Tracks 'Every Move'
Time	October 2011
Category	Spy software
Platform	Any
Targets	Any end users
Vulnerability	Phishing to human
Infection method	The user opens a (personalized) email and a document, a picture, or pdf file. A program embedded in the attached document takes the hacked user's phone off to a secret website site which covertly downloads spying software onto the smartphone.
Behavior and Impact	Software designed to completely mine every secret on a smartphone can track its users, record their calls, copy their emails, read their text messages and bug the rooms the phones are sitting in. Sensors such as microphone and GPS are activated and used without user's knowledge.
Countermeasure	Beware of phishing!

Ref: Sam Kiley - Sky News, http://news.sky.com/story/894890/spy-smartphone-software-tracks-every-move

Note: There are many tools for sale with similar features – a few examples include FlexiSpy, OmegaSpy, GMSSMSSpy, Spy Bubble, Spy Control, Spy Phone Tap, Mobile-Spy

Summary of attack incidents

Time reported	Fast increasing since 2006
Category	Software flaw, Trojan malware, botnet, access control flaw
Platform	All mobile platforms
Vulnerability	1. Improper infrastructure placement and management (e.g., lack of domain isolation, extended trust-relationship between servers which do not need it) 2. Asymmetric processing load between client and server (e.g., TLS/SSL renegotiation) 3. Default root password exploitation, especially apps from untrusted sources 4. Inadequate app permission checking, especially for android apps 5. Software implementation flaw (e.g., buffer overflow, sensitive information not encrypted, lack of access control or authentication protocol defects, prolonged local and backup copy, certificate management flaw) 6. Physical signal property (e.g. power signal strength variation during cryptographic operations) 7. Physical exploitation of sensors on smartphone (e.g., start microphone or camera on smartphone without user’s knowledge; capture GPS location; etc)

Infection method	1. Malware disguised as legitimate application for download 2. Existing app with default root password, especially apps from untrusted sources 3. Delivered through SMS/MMS/PUSH/email link or attachment 4. Propagate through Bluetooth
Targets	1. Enterprise IT infrastructure 2. Mobility network 3. Data from users and enterprises: contact book, user information, location, phone call, video of proximity 4. Configuration data on the device, e.g., phone info/settings 5. Physical components of phone (e.g., battery)
Behavior and Impact	1. Data access: accessing existing data 2. Data collection: voice, camera, location, keystroke 3. Data exfiltration: e.g., through SMS or Email 4. Billing fraud: Trojan malware sending SMS texts / redirecting calls to premium numbers, and incurring costs to victims 5. Clone the smartphone to carry out various malicious activities 6. Mobile botnets 7. DoS/DDoS attacks

Countermeasure	1. Better practice in IT infrastructure placement and management 2. Software / protocol implementation bug fixes 3. Proper server resource planning/rate limiting (especially for asymmetric processing operations) and anomaly response 4. Resource monitoring from end users’ perspective 5. Anti-virus / anti-malware for mobile apps 6. High caution (plus user awareness) for application download, especially from untrusted sources

General attack taxonomy

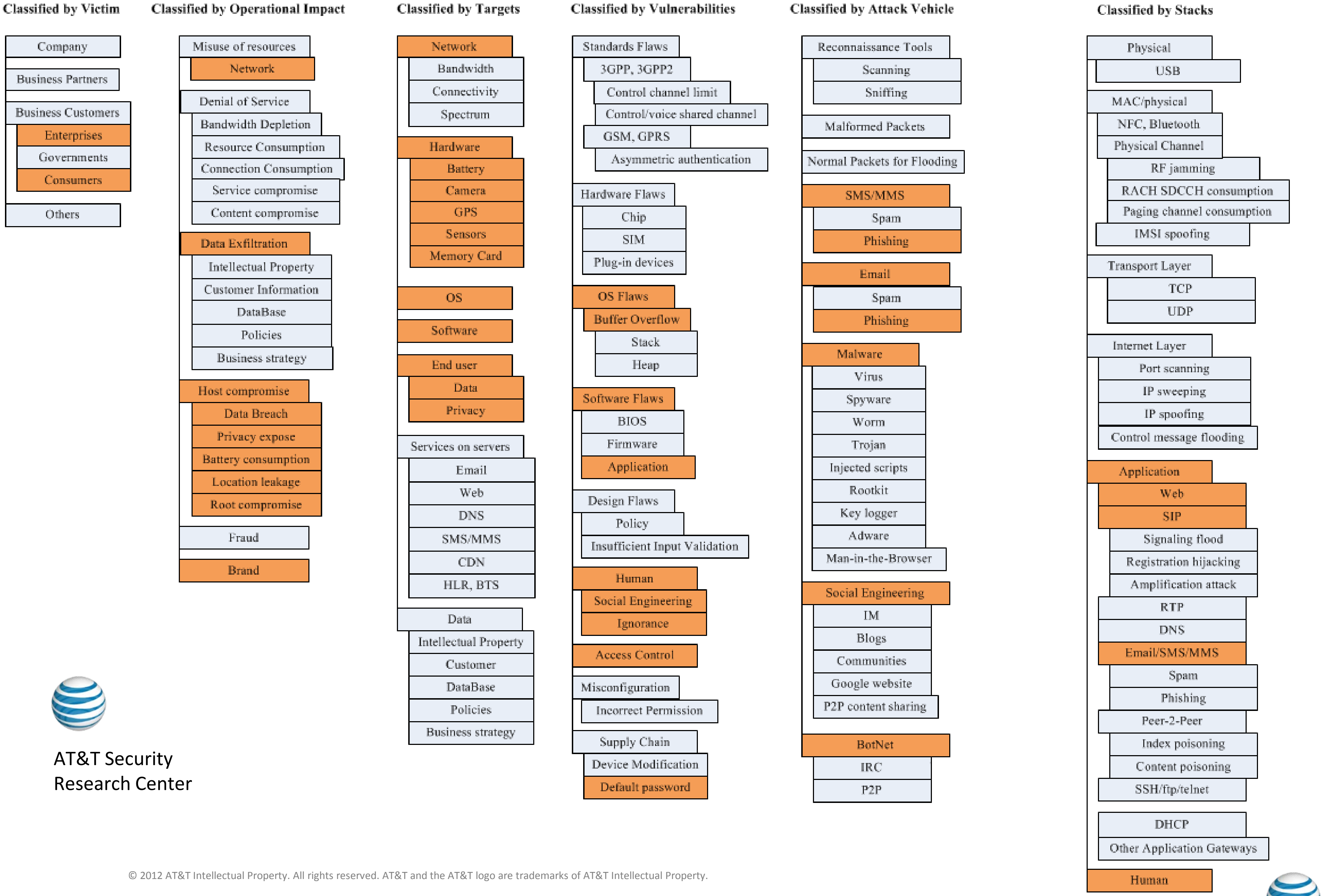
Six categories in the taxonomy

- victim
- operation impact
- targets
- vulnerability
- attack vehicles
- protocol stacks

An attacker picks a ***victim***, and ***operation impact***, then explores ***vulnerability*** of the ***targets*** by ***attack vehicles***.

Protocol stacks define where the attack can be detected or mitigated.

General attack taxonomy



Classified by Victim

- Company
- Business Partners
- Business Customers
  - Enterprises
  - Governments
  - Consumers
- Others

Classified by Operational Impact

- Misuse of resources
  - Network
- Denial of Service
  - Bandwidth Depletion
  - Resource Consumption
  - Connection Consumption
  - Service compromise
  - Content compromise
- Data Exfiltration
  - Intellectual Property
  - Customer Information
  - DataBase
  - Policies
  - Business strategy
- Host compromise
  - Data Breach
  - Privacy expose
  - Battery consumption
  - Location leakage
  - Root compromise
- Fraud
- Brand

Classified by Targets

- Network
  - Bandwidth
  - Connectivity
  - Spectrum
- Hardware
  - Battery
  - Camera
  - GPS
  - Sensors
  - Memory Card
- OS
- Software
- End user
  - Data
  - Privacy
- Services on servers
  - Email
  - Web
  - DNS
  - SMS/MMS
  - CDN
  - HLR, BTS
- Data
  - Intellectual Property
  - Customer
  - DataBase
  - Policies
  - Business strategy

Classified by Vulnerabilities

- Standards Flaws
  - 3GPP, 3GPP2
    - Control channel limit
    - Control/voice shared channel
  - GSM, GPRS
    - Asymmetric authentication
- Hardware Flaws
  - Chip
  - SIM
  - Plug-in devices
- OS Flaws
  - Buffer Overflow
    - Stack
    - Heap
- Software Flaws
  - BIOS
  - Firmware
  - Application
- Design Flaws
  - Policy
  - Insufficient Input Validation
- Human
  - Social Engineering
  - Ignorance
- Access Control
- Misconfiguration
  - Incorrect Permission
- Supply Chain
  - Device Modification
  - Default password

Classified by Attack Vehicle

- Reconnaissance Tools
  - Scanning
  - Sniffing
- Malformed Packets
- Normal Packets for Flooding
- SMS/MMS
  - Spam
  - Phishing
- Email
  - Spam
  - Phishing
- Malware
  - Virus
  - Spyware
  - Worm
  - Trojan
  - Injected scripts
  - Rootkit
  - Key logger
  - Adware
  - Man-in-the-Browser
- Social Engineering
  - IM
  - Blogs
  - Communities
  - Google website
  - P2P content sharing
- BotNet
  - IRC
  - P2P

Classified by Stacks

- Physical
  - USB
- MAC/physical
  - NFC, Bluetooth
  - Physical Channel
    - RF jamming
    - RACH SDCCH consumption
    - Paging channel consumption
  - IMSI spoofing
- Transport Layer
  - TCP
  - UDP
- Internet Layer
  - Port scanning
  - IP sweeping
  - IP spoofing
  - Control message flooding
- Application
  - Web
  - SIP
    - Signaling flood
    - Registration hijacking
    - Amplification attack
  - RTP
  - DNS
  - Email/SMS/MMS
    - Spam
    - Phishing
  - Peer-2-Peer
    - Index poisoning
    - Content poisoning
  - SSH/ftp/telnet
  - DHCP
    - Other Application Gateways
- Human

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Using the attack taxonomy: Looking at APTs

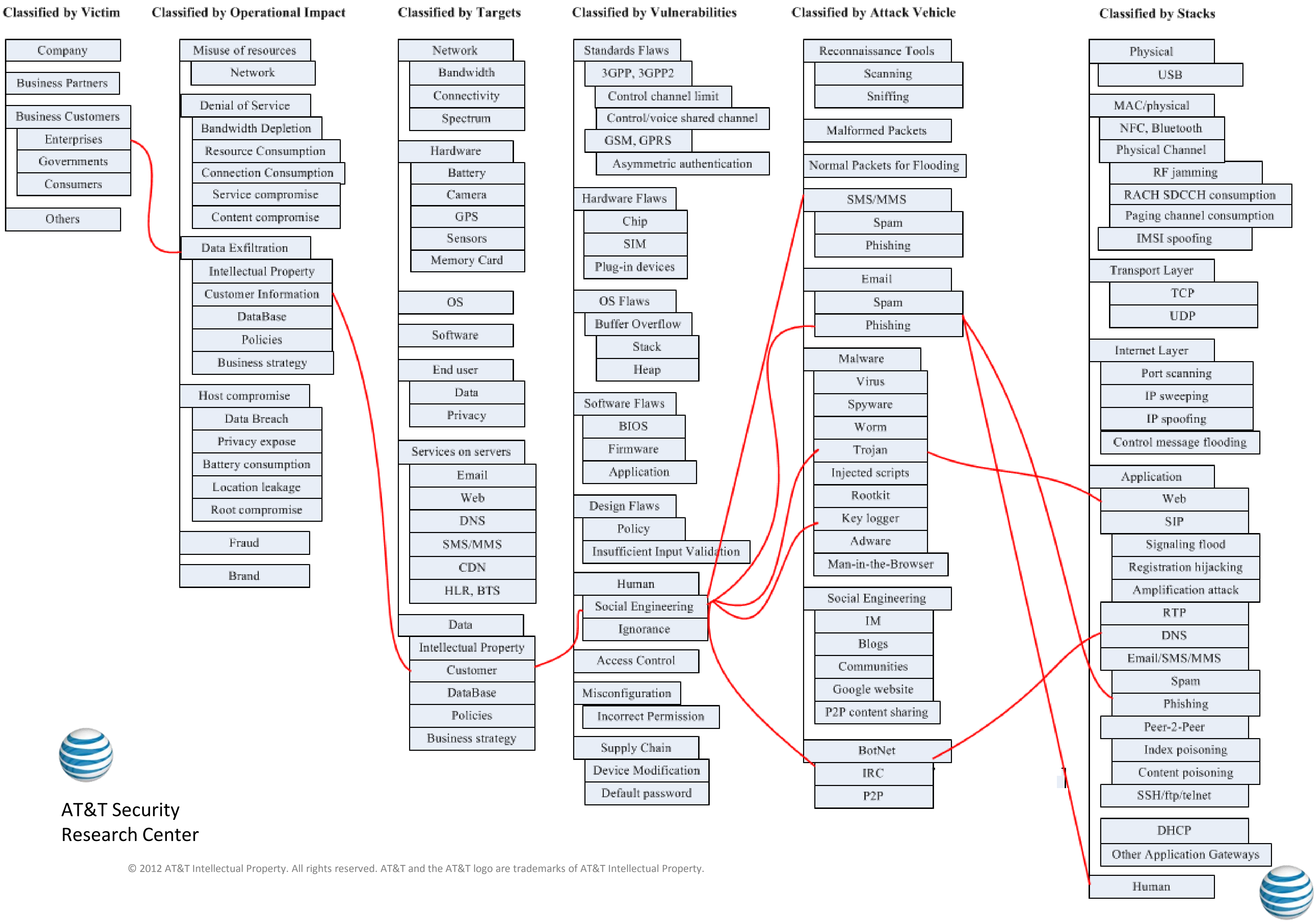
Advanced Persistent Threats (APT) –

- Fast growing
- Difficult to prevent / detect / remediate
- Causing significant losses

APT goals:

- Steal intellectual property (IP) from the targeted organization
- Gain access to sensitive data or strategic business information
- Blackmail, embarrassment, data poisoning, illegal insider trading
- Disrupt organization's business

APT Scenario



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Conclusions

The case study is focused on mobile attacks, and the taxonomy includes attacks that are specific to mobility, and not found in general cyber security attacks – such as SMS/MMS-based attacks.

The taxonomy is especially helpful for reasoning about attacks and threats, to identify all potential vulnerabilities and design countermeasures in the new area of mobile security.

Thank you!

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