USB attacks need physical access right?
Not any more...

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Agenda

• The problem with USB bugs
• The USB bugs I’ve found and how I found them
• **Demo:** iOS 7 bug
• A contrived example of a remote USB bug via Bluetooth
• **Demo:** Windows hidparse.sys bug
• USB redirection via RDP
• **Demo:** Windows 2012 usbaudio.sys bug (triggered remotely)
• The implications for future USB bugs
• Mitigation strategies to reduce the risks
• Conclusions and further research
The problem with USB bugs

• Physical access required

• Vendors aren’t really interested

• Local bugs have their place, but have a limited impact
Recent high profile USB host bugs

- **CVE-2011-2295**: Oracle Sun Solaris USB Local Buffer Overflow Vulnerability
- **CVE-2012-3723**: Apple Mac OS X USB Hub Descriptor bNbrPorts Heap overflow
- **MS13-027**: The Windows 8 RNDIS kernel pool overflow
- **CVE-2013-3200**: Microsoft Windows USB Descriptor Handling Local Privilege Escalation
How I first started finding USB bugs (2011)

- Arduino microcontroller
- Fuzzer written in C++
- Only emulates USB HID devices
- Only allows semi-automated fuzzing
- Has found bugs in:
  - Windows 7
  - Windows XP
  - OS X
- Limitations – not really fast enough to emulate most USB devices
USB fuzzer – the next generation (2012)

- Dedicated USB test equipment hardware
- USB capture and playback
- Emulates any USB host or device
- Understands and analyses the different USB device classes
- Uses a scripting language to generate USB traffic
- Costs approx. USD1200 (plus specific class analysis options)
- Limitations – doesn’t have a software API to control it
How I find them now (2013...)

- Facedancer and umap

https://github.com/nccgroup/umap
What has umap found most recently?

- CVE-2014-1287: iOS 7 arbitrary code execution in kernel mode
Demo: iOS 7 bug
Contrived example of remote USB bug

- Discovered a null-pointer dereference in `hidparse.sys` in 2011

- Microsoft not interested – not really a security issue

- Triggered by inserting a malicious device

- HID report descriptor is parsed during enumeration phase

- Blue screen occurs
Contrived example of remote USB bug

Windows (all versions) – not patched
What else uses HID report descriptors?

- Bluetooth keyboards!
- During pairing, report descriptor is parsed
- Very tenuous, as this isn’t really a USB bug it’s a HID parsing bug
- First attempt to move away from direct physical access
I have a spare Arduino…

Small, portable, programmable USB device to trigger USB vulnerabilities:
Demo: *hidparse.sys* bug via Bluetooth
USB Redirection via RDP

Numerous legacy “High-level” redirection capabilities:

• Easy Print
• Drive Redirection
• Smart Card Redirection
• Plug-and-Play Device Redirection
• Input Redirection
• Audio Redirection
• Port Redirection
Problem with High-level USB redirection
Problem with High-level USB redirection
Problem with High-level USB redirection
Enter “RemoteFX USB Redirection”…
# RemoteFX USB Redirection

<table>
<thead>
<tr>
<th>RemoteFX USB Redirection...</th>
<th>RDP High-Level Device Redirection...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does not require drivers on the client</td>
<td>Requires drivers for the device to be installed on the client</td>
</tr>
<tr>
<td>Requires the device driver to be installed on the server</td>
<td>Generally does not require drivers on the server</td>
</tr>
<tr>
<td>Uses one redirection method for many types of devices</td>
<td>Uses a specific, unique method for each type of device being redirected</td>
</tr>
<tr>
<td>Forwards URBs to and from the device over the RDP connection</td>
<td>Exposes high-level device functionality in the remote session by using an optimized protocol for the device type</td>
</tr>
<tr>
<td>Enables only one session to use a device at a given time; the local client cannot use the device while an RDP session is using it</td>
<td>Enables any number of sessions to access the device simultaneously, including the local client</td>
</tr>
<tr>
<td>Is optimized for the LAN, like the rest of RemoteFX</td>
<td>Works with both LAN and WAN</td>
</tr>
</tbody>
</table>
Enable RemoteFX on the client

Computer Configuration\Administrative Templates\Windows Components \Remote Desktop Services\Remote Desktop Connection Client\RemoteFX USB Device Redirection

C:\> gpupdate /force
Enable RemoteFX on the client

1. Open Remote Desktop Connection.
2. Go to the 'Local Resources' tab.
3. Check 'Other supported RemoteFX USB devices'.
4. Select 'USB camera'.
5. Click 'More...'.
6. Enable 'Other supported Plug and Play (PnP) devices'.
7. Click 'OK'.
8. Connect.
Remote FX USB redirection attack
Remote FX USB redirection attack
Remote FX USB redirection attack
Remote FX USB redirection attack
Remote FX USB redirection attack
Demo: *usbaudio.sys* bug via RDP
The implications for future USB bugs

• Windows USB bugs no longer need local physical access

• Remote exposure of the Windows kernel has been increased

• What were local DoS bugs can now remotely “blue-screen” a server

• May apply to other (non-Windows) remoting technologies
How can you reduce the risks?

- If RemoteFX is not required on the server, turn it off
- If RemoteFX is required specify GUIDs of authorised USB devices
- Do not enable RemoteFX USB remoting on clients
- Minimise the use of USB “High-level” remoting via RDP
- Be more cautious of “local” vulnerabilities and apply the patches
Conclusions and further research

• Physical access is no longer a requirement to trigger Windows USB bugs

• RemoteFX USB remoting has exposed more of the Windows kernel to attackers

• Need to investigate other remoting technologies e.g. Citrix

• The Internet of Things is full of USB possibilities 😊
Questions?

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