Hacking Measured Boot and UEFI

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WWJBD?

Don’t let h@xors keep you from getting the girl…

Introduction

- What is UEFI?
- What is a TPM?
- What is “secure boot”?
- What is “measured boot”?
- What is “remote attestation”?

Hardware Landscape

- BYOD
- Capability standards
  - Phones
  - Tablets
  - PCs

Why the UEFI lock down?

- OEM & ISV revenue streams
- Importance of app store based user experience
- Defense against rootkits & bad drivers
- Screw the Linux community

State of UEFI

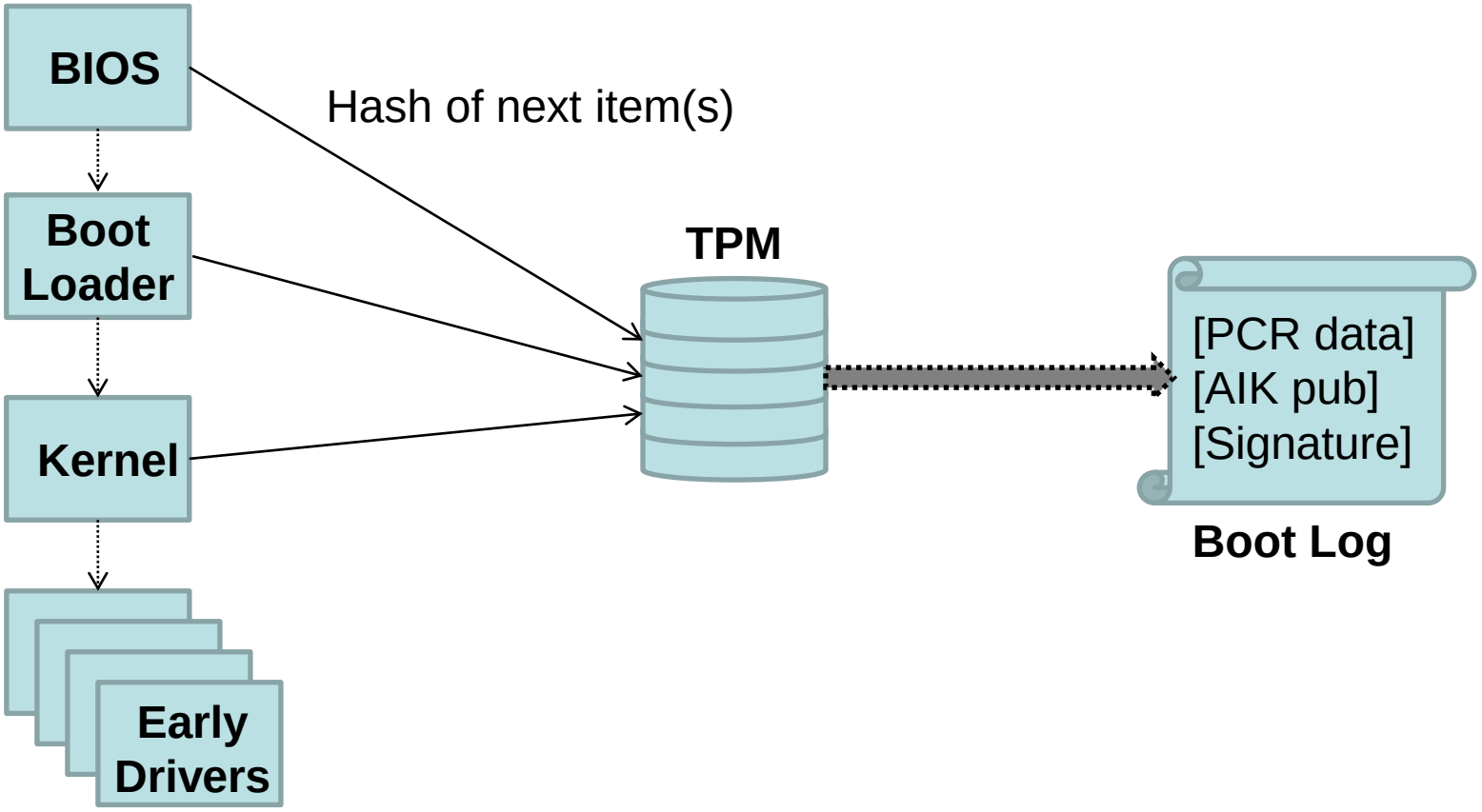
- Not new
- Full featured – can even include a network stack (yikes!)
- Software dev kits are available (Intel TianoCore)
- Test hardware is available (Intel; BeagleBoard)

UEFI secure boot

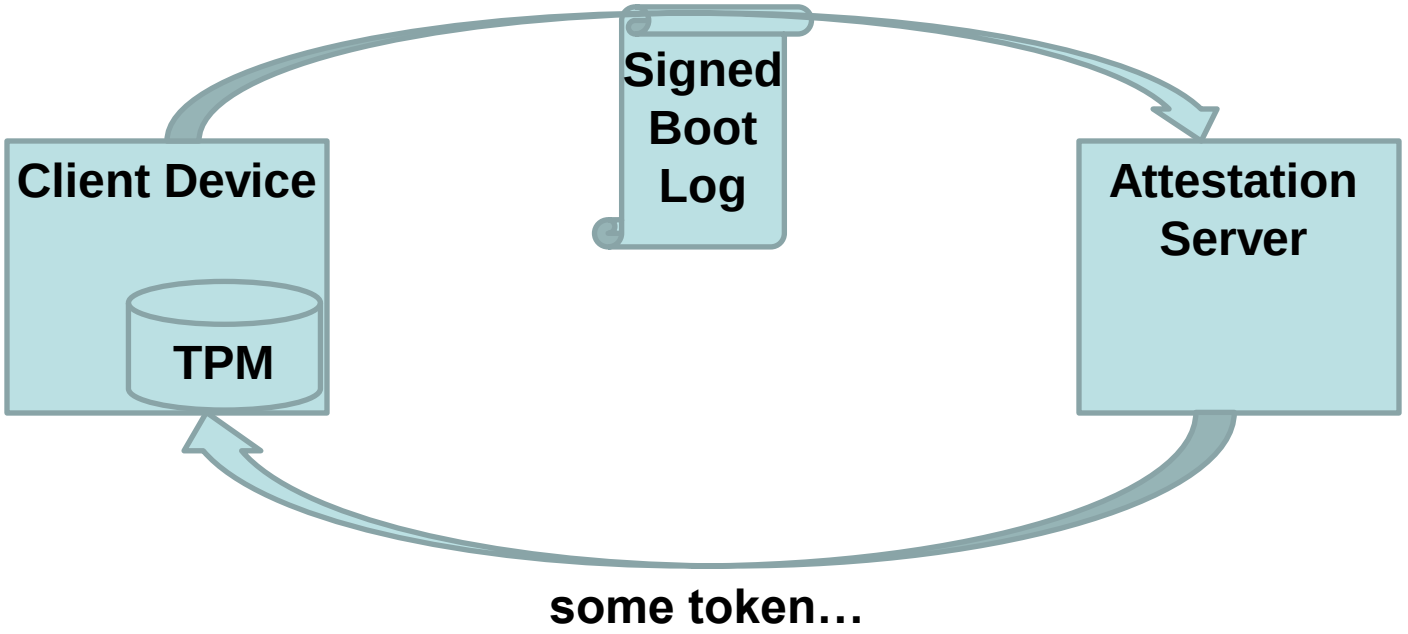
- Usually can be disabled/modified by user
  - Behavior varies by implementation
  - Complicated, even for power users
- But not on Windows 8 ARM. Options:
  - Buy a $99 signing certificate from VeriSign
  - Use a different ARM platform
  - Use x86

Measured Boot + Remote Attestation

What is measured boot?



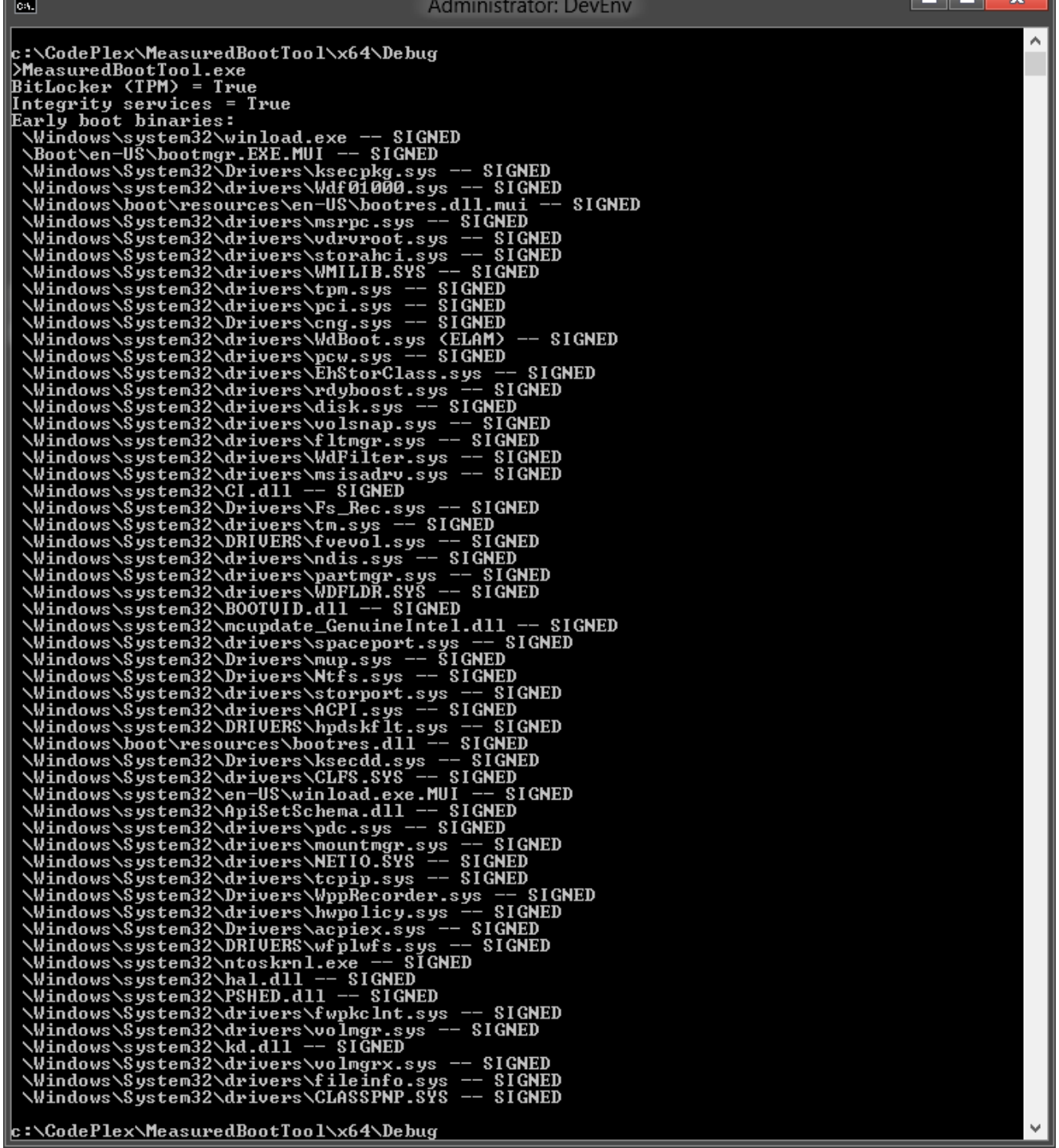
What is remote attestation?



Demo

Measured Boot Tool
(http://mbt.codeplex.com/)

Part 1: What's in the boot log?

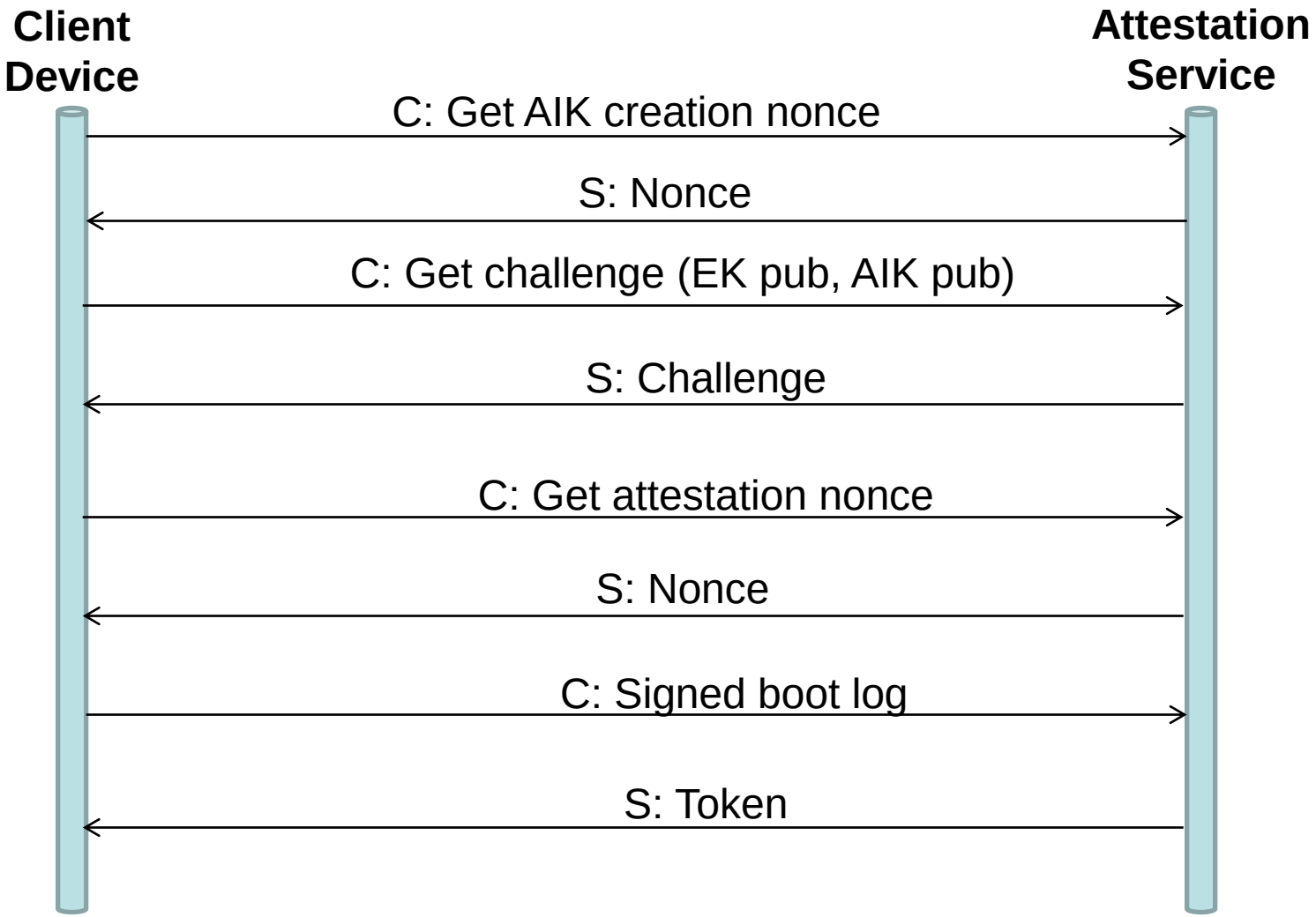

Administrator: DevEnv
c:\CodePlex\MeasuredBootTool\x64\Debug
>MeasuredBootTool.exe
BitLocker (TPM) = True
Integrity services = True
Early boot binaries:
 \Windows\system32\winload.exe -- SIGNED
 \Boot\en-US\bootmgr.EXE.MUI -- SIGNED
 \Windows\System32\Drivers\ksecpkg.sys -- SIGNED
 \Windows\system32\drivers\Wdf01000.sys -- SIGNED
 \Windows\boot\resources\en-US\bootres.dll.mui -- SIGNED
 \Windows\System32\drivers\msrpc.sys -- SIGNED
 \Windows\System32\drivers\vdrvroot.sys -- SIGNED
 \Windows\System32\drivers\storahci.sys -- SIGNED
 \Windows\System32\drivers\WMILIB.SYS -- SIGNED
 \Windows\system32\drivers\tpm.sys -- SIGNED
 \Windows\System32\drivers\pci.sys -- SIGNED
 \Windows\System32\Drivers\cng.sys -- SIGNED
 \Windows\system32\drivers\WdBoot.sys (ELAM) -- SIGNED
 \Windows\System32\drivers\pcw.sys -- SIGNED
 \Windows\System32\drivers\EhStorClass.sys -- SIGNED
 \Windows\System32\drivers\rdyboost.sys -- SIGNED
 \Windows\System32\drivers\disk.sys -- SIGNED
 \Windows\System32\drivers\volsnap.sys -- SIGNED
 \Windows\system32\drivers\fltmgr.sys -- SIGNED
 \Windows\system32\drivers\WdFilter.sys -- SIGNED
 \Windows\System32\drivers\msisadrv.sys -- SIGNED
 \Windows\system32\CI.dll -- SIGNED
 \Windows\System32\Drivers\Fs_Rec.sys -- SIGNED
 \Windows\System32\drivers\tm.sys -- SIGNED
 \Windows\System32\DRIVERS\fvevol.sys -- SIGNED
 \Windows\system32\drivers\ndis.sys -- SIGNED
 \Windows\System32\drivers\partmgr.sys -- SIGNED
 \Windows\system32\drivers\WDFLDR.SYS -- SIGNED
 \Windows\system32\BOOTVID.dll -- SIGNED
 \Windows\system32\mcupdate_GenuineIntel.dll -- SIGNED
 \Windows\System32\drivers\spaceport.sys -- SIGNED
 \Windows\System32\Drivers\mup.sys -- SIGNED
 \Windows\System32\Drivers\Ntfs.sys -- SIGNED
 \Windows\System32\drivers\storport.sys -- SIGNED
 \Windows\System32\drivers\ACPI.sys -- SIGNED
 \Windows\system32\DRIVERS\hpdskflt.sys -- SIGNED
 \Windows\boot\resources\bootres.dll -- SIGNED
 \Windows\System32\Drivers\ksecdd.sys -- SIGNED
 \Windows\System32\drivers\CLFS.SYS -- SIGNED
 \Windows\system32\en-US\winload.exe.MUI -- SIGNED
 \Windows\system32\ApiSetSchema.dll -- SIGNED
 \Windows\system32\drivers\pdc.sys -- SIGNED
 \Windows\System32\drivers\mountmgr.sys -- SIGNED
 \Windows\system32\drivers\NETIO.SYS -- SIGNED
 \Windows\System32\drivers\tcpip.sys -- SIGNED
 \Windows\System32\Drivers\WppRecorder.sys -- SIGNED
 \Windows\System32\drivers\hwpolicy.sys -- SIGNED
 \Windows\System32\Drivers\acpiex.sys -- SIGNED
 \Windows\system32\DRIVERS\wfplwfs.sys -- SIGNED
 \Windows\system32\ntoskrnl.exe -- SIGNED
 \Windows\system32\hal.dll -- SIGNED
 \Windows\system32\PSHED.dll -- SIGNED
 \Windows\System32\drivers\fwpkclnt.sys -- SIGNED
 \Windows\System32\drivers\volmgr.sys -- SIGNED
 \Windows\system32\kd.dll -- SIGNED
 \Windows\System32\drivers\volmgrx.sys -- SIGNED
 \Windows\System32\drivers\fileinfo.sys -- SIGNED
 \Windows\System32\drivers\CLASSPNP.SYS -- SIGNED
c:\CodePlex\MeasuredBootTool\x64\Debug

Demo

Measured Boot Tool

(http://mbt.codeplex.com/)

Part 2: How do you do remote attestation?


Client Device
Attestation Service
C: Get AIK creation nonce
S: Nonce
C: Get challenge (EK pub, AIK pub)
S: Challenge
C: Get attestation nonce
S: Nonce
C: Signed boot log
S: Token

Demo

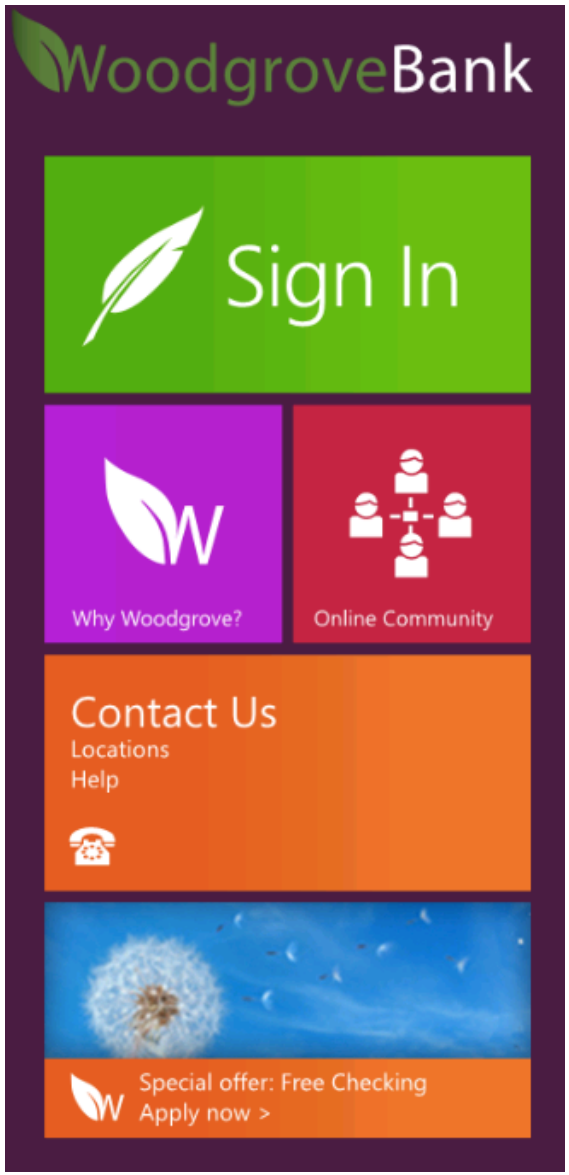
Sample application #1: reduce fraud, protect the bank from h@xors, get the girl

Cloud Services Demand ID

- Enterprise: BYOD
- Consumer
  - Targeted advertising
  - eCommerce, mobile banking, etc.
- But most user IDs are static & cached on device
  - That only works for low-value purchases
  - How to improve ID for high-value purchases?

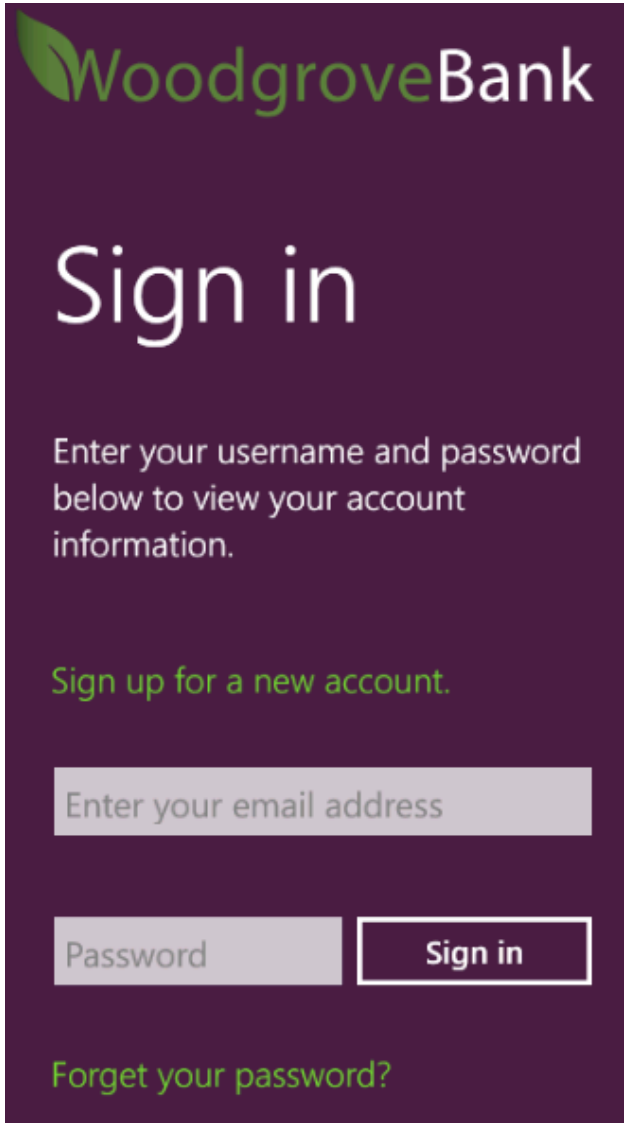
Low Friction Authentication

- Each additional screen requiring user input
  - Slows down the process while user reorients
  - Causes more users to abandon the web site
- In contrast, Progressive Authentication:
  - Let users investigate a site using just cookies
  - Defers questions until information is needed
  - Reduces user drop out from frustration



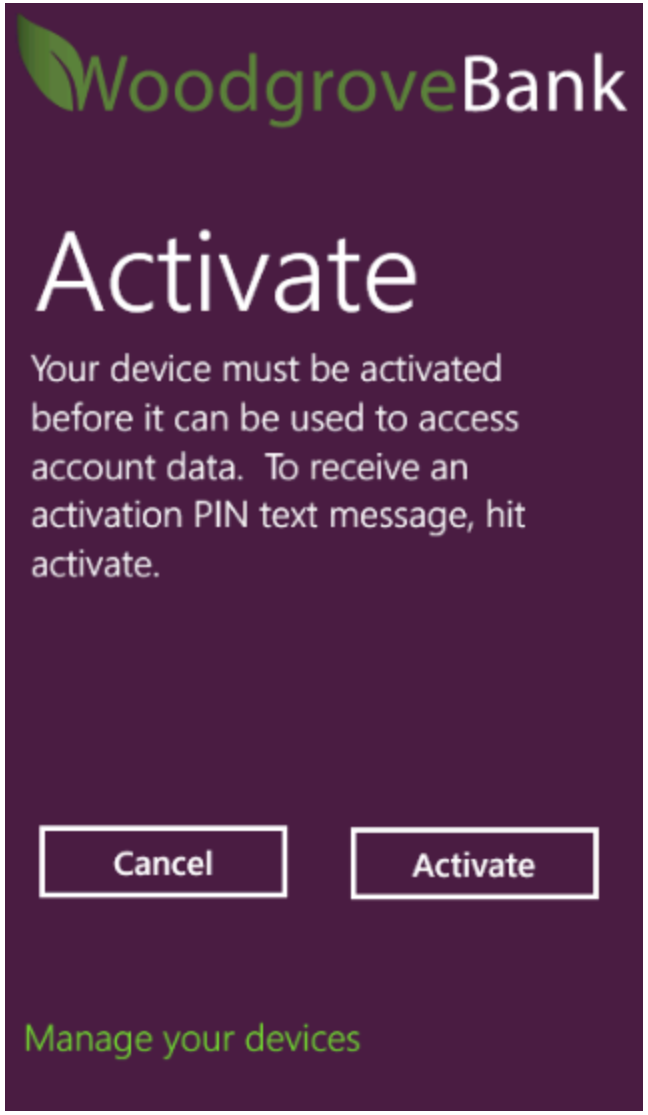
Splash Screen

- The screen a user sees when app launched
- With similar data in the launch tile



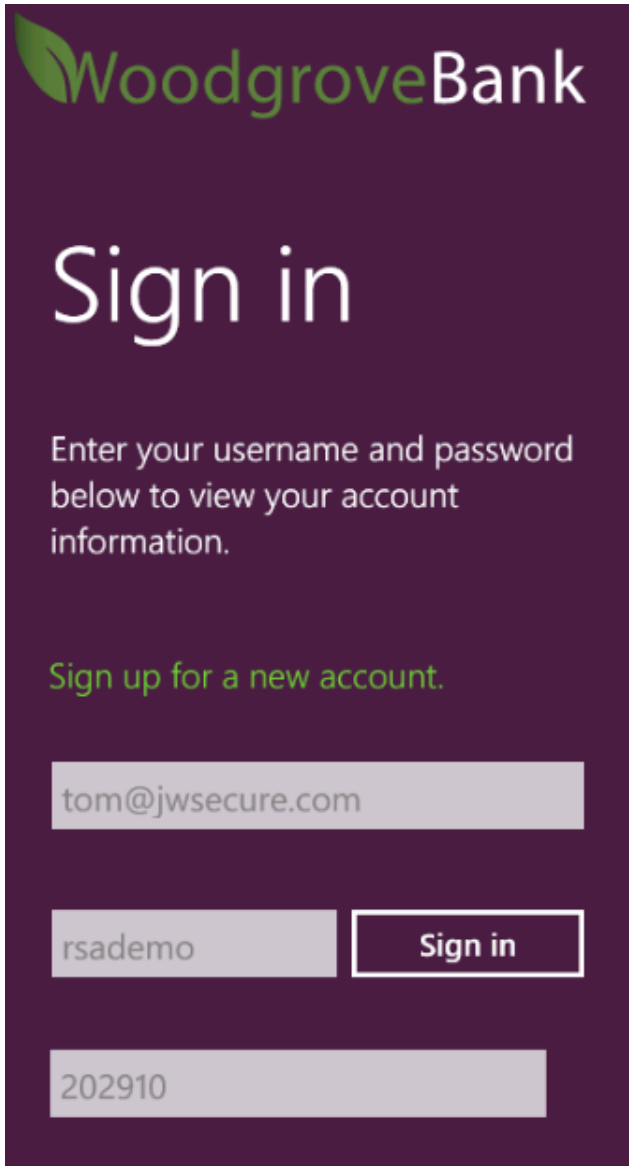
User Sign in

- User name can be taken from cookie
- But account details are hidden until the user enters a password



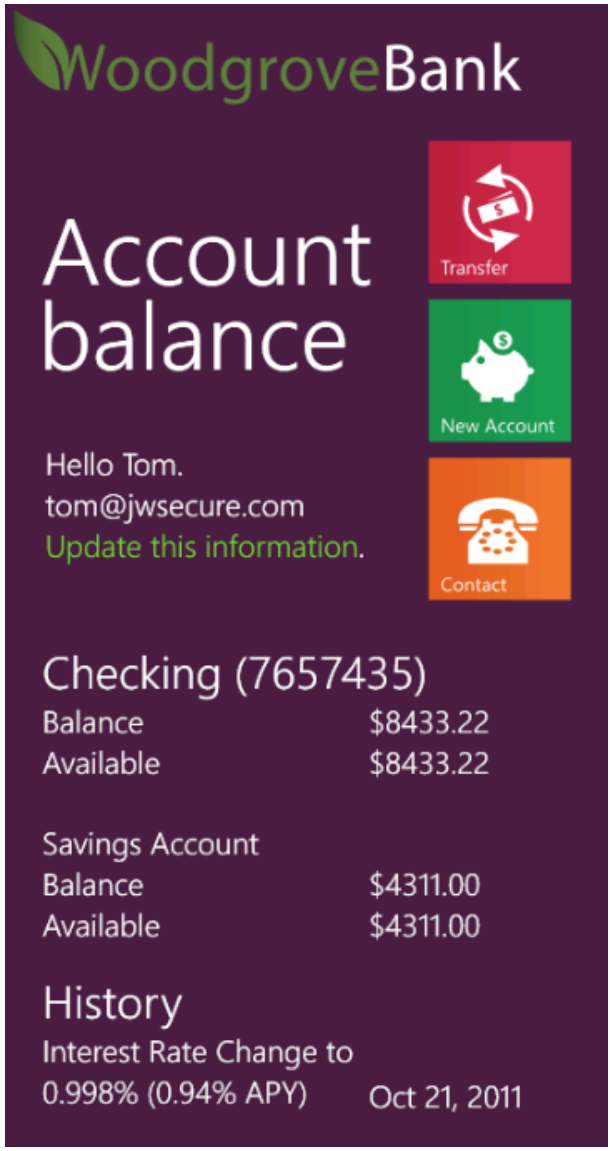
Enrollment - 1

- The first time the app is used the user must active the app
- When this button is pressed an SMS message is sent to the phone # on file



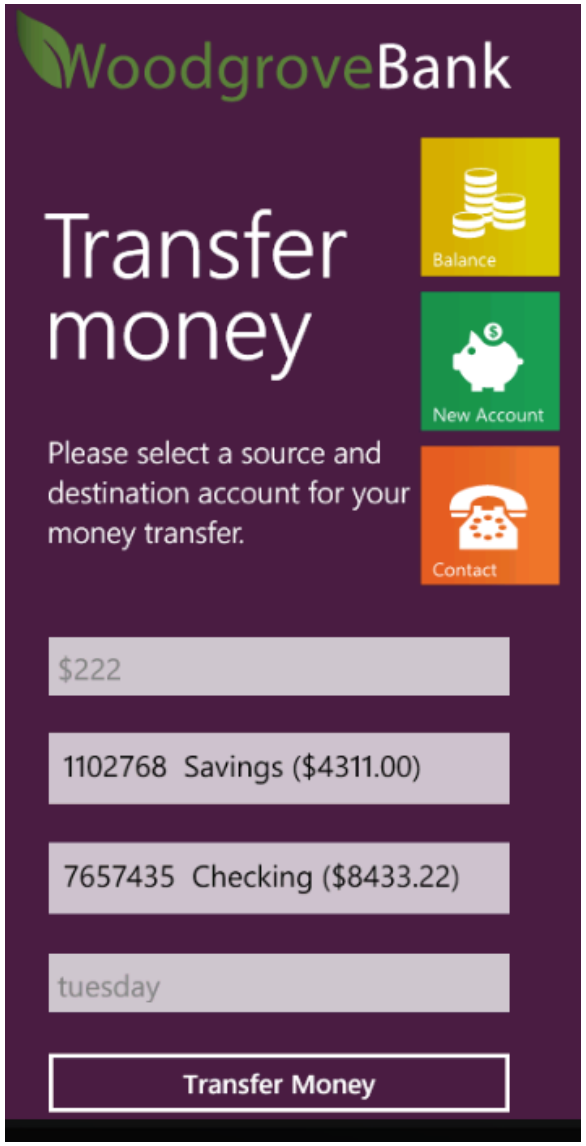
Enrollment - 2

- After the user gets the pin from the SMS message, it is entered
- After this the user proceeds as with a normal sign-in procedure



After Sign-in

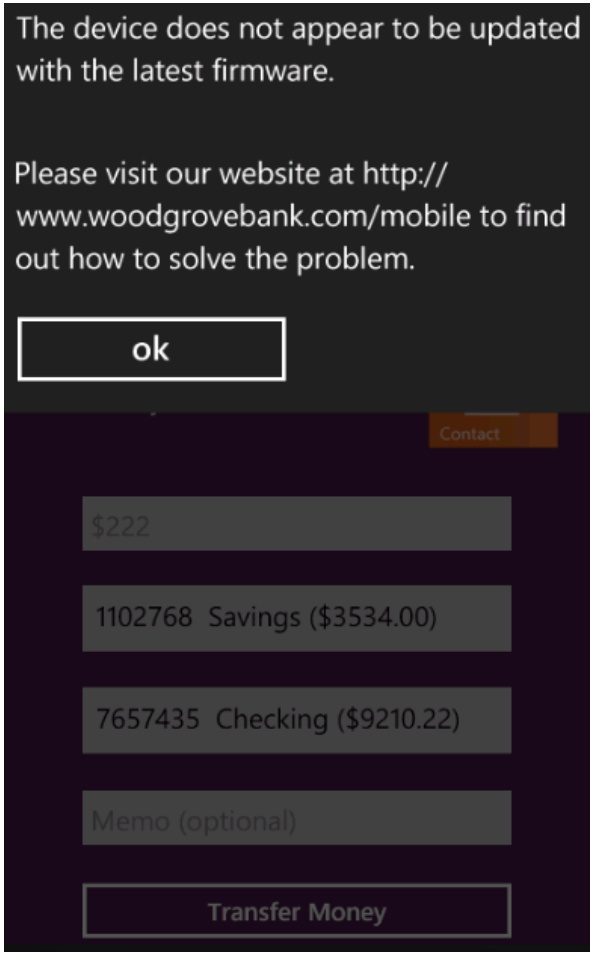
- The user sees all account information



User tries to move money

- When user goes to move $ out of account
- The health of the device is checked

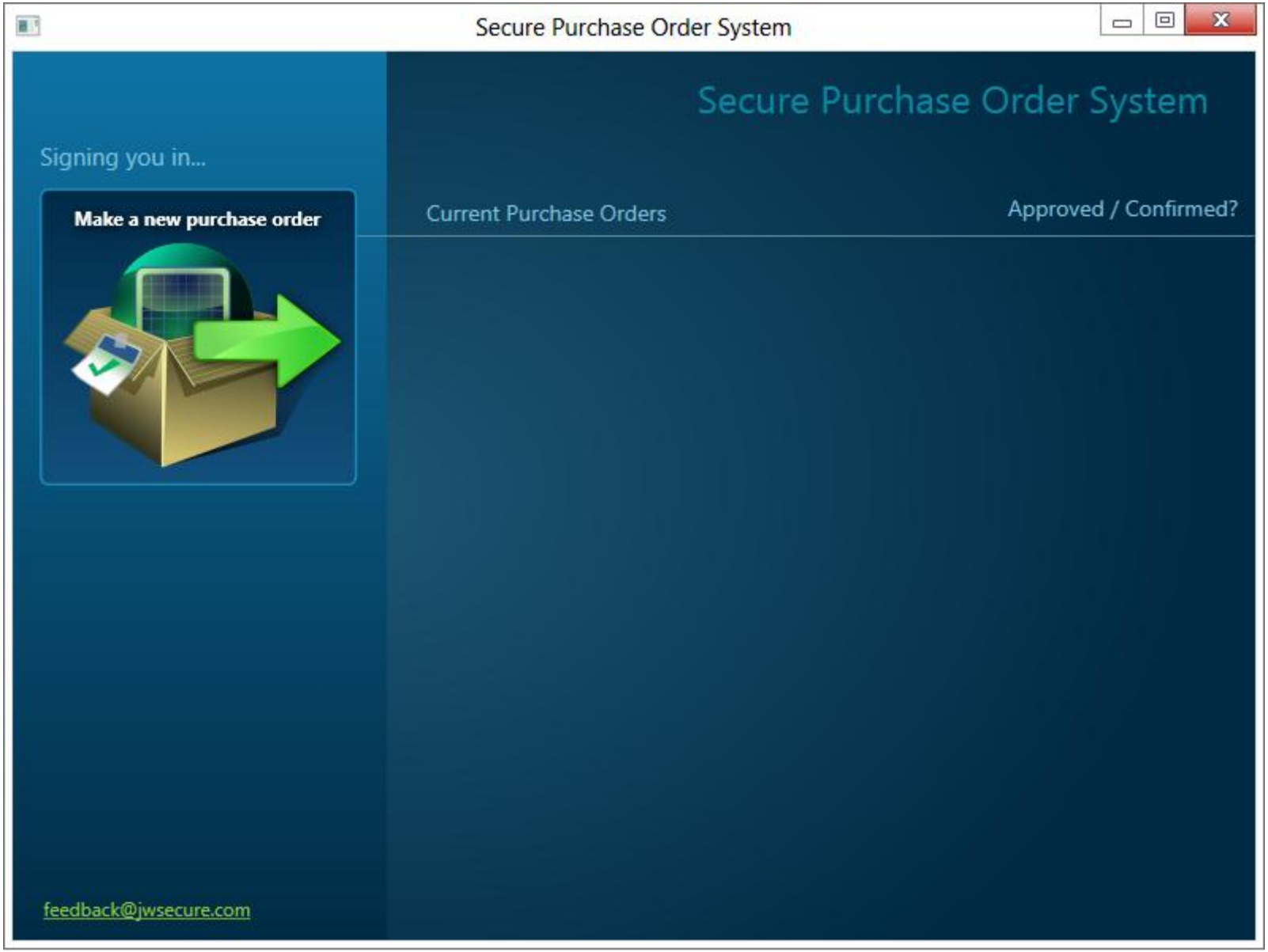
Remediation Needed

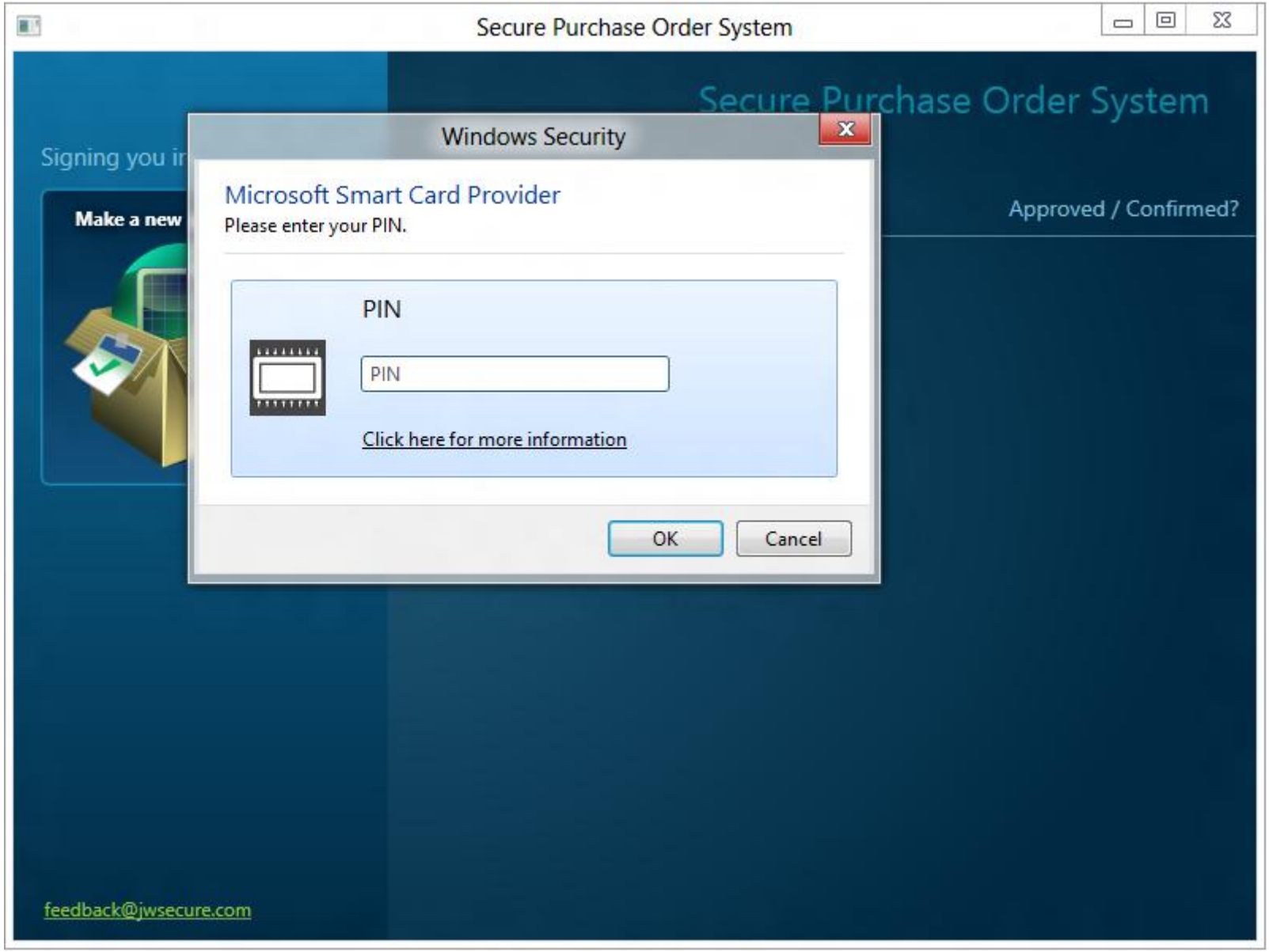


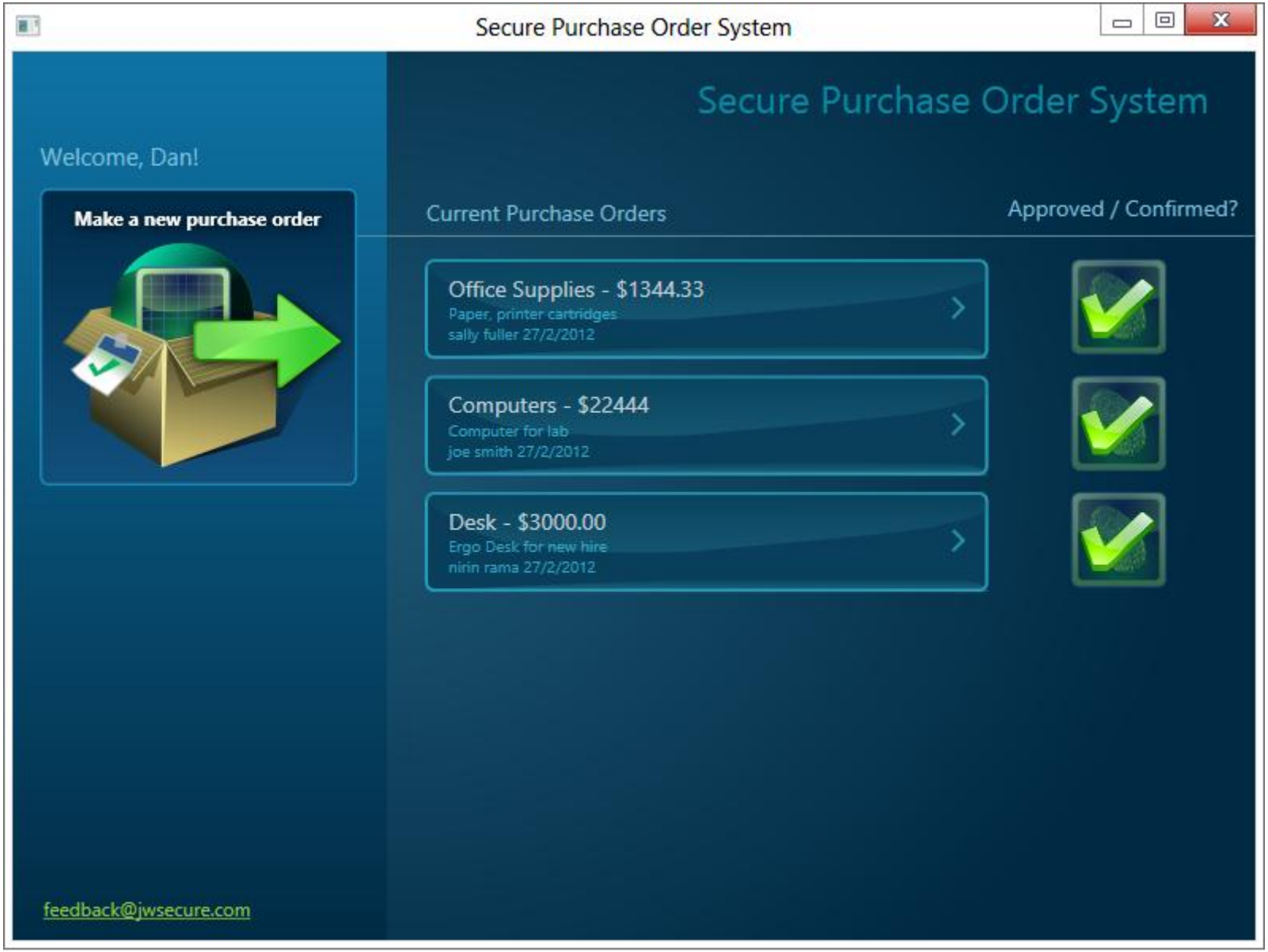
- If the device is not healthy enough to allow money transfer
- The user is directed to a site to fix the problem

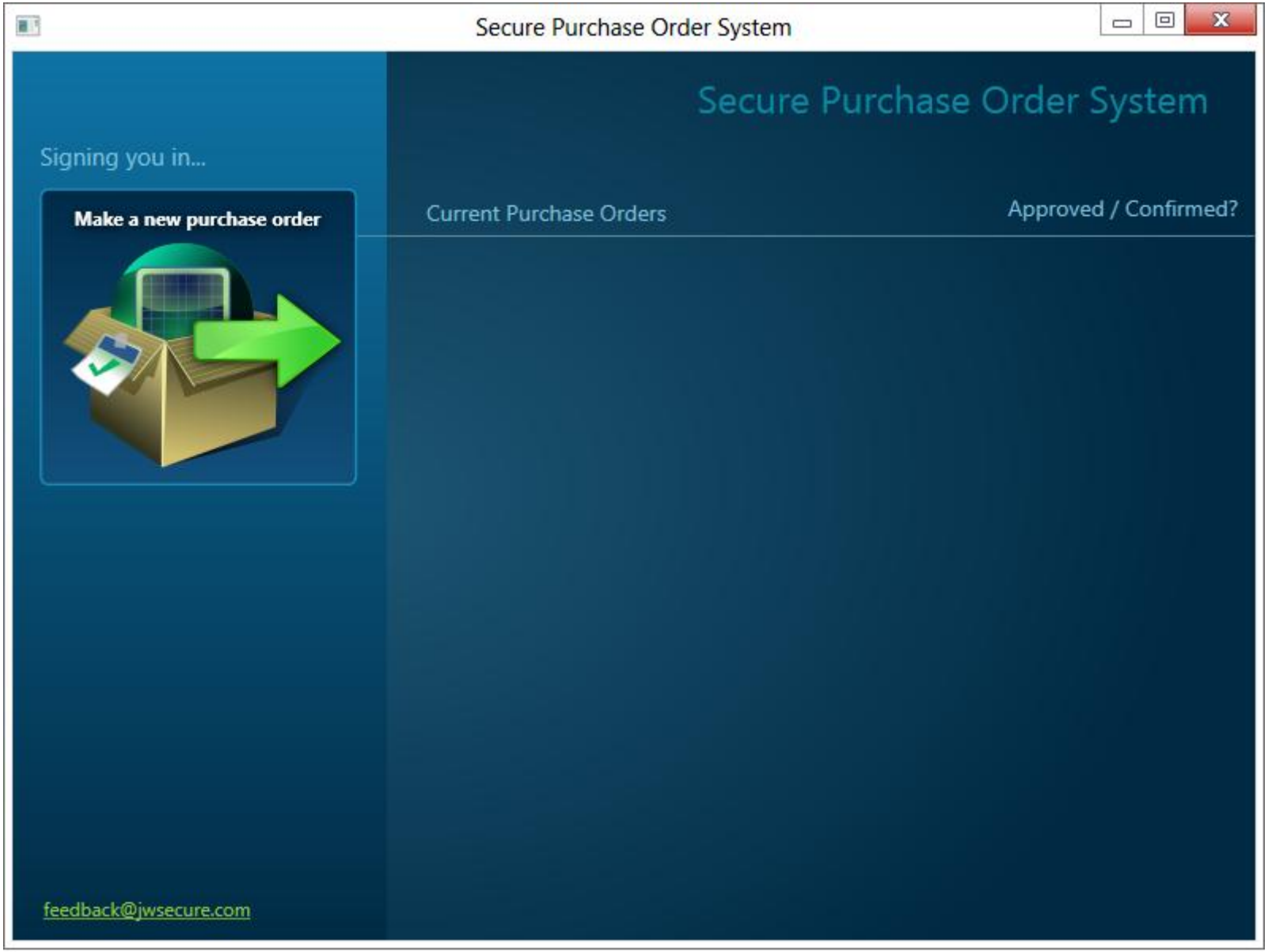
Demo

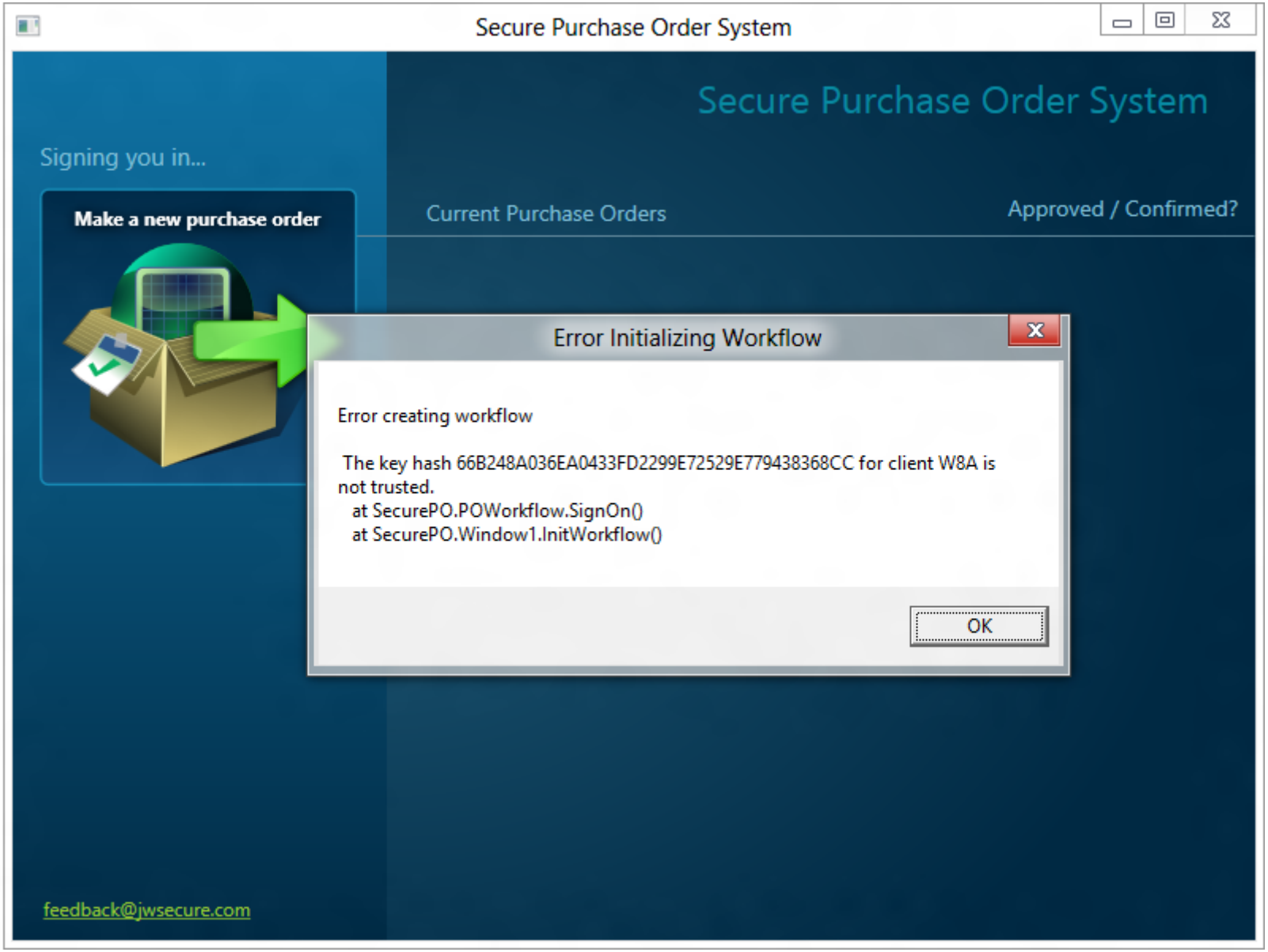
Sample application #2: reduce fraud, protect MI6 from h@xors, get the girl


Secure Purchase Order System
Secure Purchase Order System
Signing you in...
Make a new purchase order
Current Purchase Orders
Approved / Confirmed?
feedback@jwsecure.com


Secure Purchase Order System
Secure Purchase Order System
Signing you in
Make a new
Approved / Confirmed?
Windows Security
Microsoft Smart Card Provider
Please enter your PIN.
PIN
PIN
Click here for more information
OK
Cancel
feedback@jwsecure.com


Secure Purchase Order System
Secure Purchase Order System
Welcome, Dan!
Make a new purchase order
Current Purchase Orders
Approved / Confirmed?
Office Supplies - $1344.33
Paper, printer cartridges
sally fuller 27/2/2012
Computers - $22444
Computer for lab
joe smith 27/2/2012
Desk - $3000.00
Ergo Desk for new hire
nirin rama 27/2/2012
feedback@jwsecure.com


Secure Purchase Order System
Secure Purchase Order System
Signing you in...
Make a new purchase order
Current Purchase Orders
Approved / Confirmed?
feedback@jwsecure.com


Secure Purchase Order System
Secure Purchase Order System
Signing you in...
Make a new purchase order
Current Purchase Orders
Approved / Confirmed?
Error Initializing Workflow
Error creating workflow
The key hash 66B248A036EA0433FD2299E72529E779438368CC for client W8A is not trusted.
at SecurePO.POWorkflow.SignOn()
at SecurePO.Window1.InitWorkflow()
OK
feedback@jwsecure.com

Pseudo-Demo

Sample application #3: protect the data from h@xors, etc…

Policy-Enforced File Access

- BYOD
- Download sensitive files from document repository
- Leave laptop in back of taxi

Weaknesses

- UEFI toolkits evolving rapidly
- Provisioning; TPM EK database
- Integrity of the TPM hardware
- Hibernate file is unprotected
- Trend of migration from hardware to firmware
- Patching delay & whitelist maintenance

Conclusion

- Likelihood of mainstream adoption?
- What the consumerization trend means for hackers
- Opportunities in this space

Questions?

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