Defeating the Scourge!

Of the Undertested Automatic Software Update

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Introduction

- You buy a car
- Six days later, in the night, someone from the dealership breaks into your garage
  - He removes the tires on the car
  - He installs "updated" tires that have holes in them
  - He leaves, taking the original tires with him
- In the morning, you have an undriveable car
- That's a crime, but it happens all the time—with software
- Let's look at some infamous examples, and then talk about how we can stop doing this

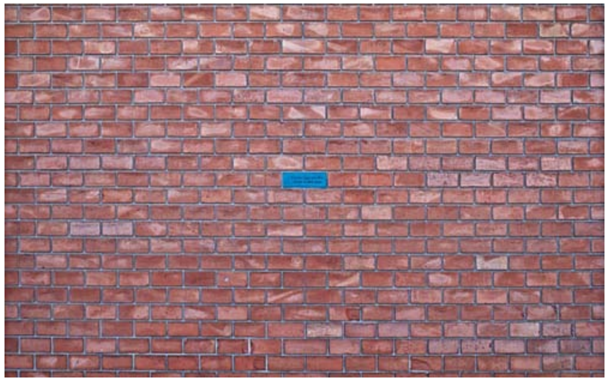
Some Background

- In late 1990s, I managed testing of a device with early automatic update features
- We ran thousands of updates to check for bricking and other bad behaviors
- We found and fixed a number of bugs that would have bricked the devices
- We respected the risks inherent in pushing updates to apps and OSes
- Recently, people have clearly become nonchalant about what can go wrong…

Full Speed Ahead, the Wrong Way

- Apple, in a fit of pique over Android, decided to drop Google Maps
- Sep 2012, iPhones automatically "upgraded" to Apple Maps when they installed iOS 6
- As Techradar wrote, "But very quickly iOS 6 upgraders began to notice problems: directions took them the wrong way, a phantom airport appeared near Dublin and Aukland's main train station appeared to be located in the middle of the sea."
- Tim Cook issued an apology, threw two people under the bus (said bus might have just been going the wrong way, though)
- I suspect Jobs would have just built the new Dublin airport and flooded downtown Auckland rather than admit the goof
- Dec 2012, Google's Google Maps free app became available for the iPhone, and was soon the most popular free app
- But hey, Apple Maps had that really cool 3D view thingee…

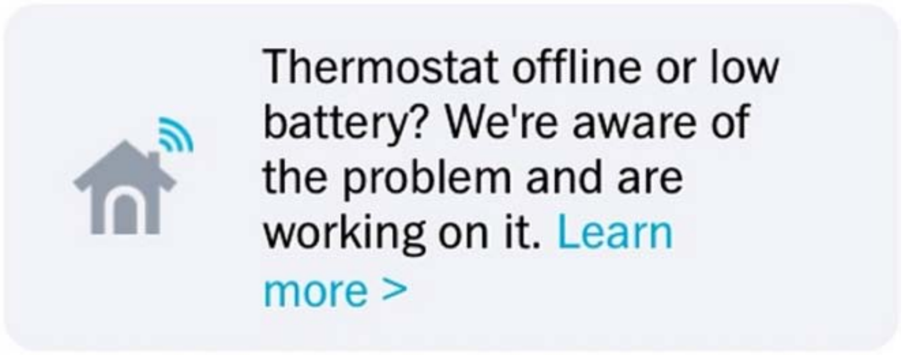
Another Brick in the Wall…



- Sept 2015, five months after initial release, Apple almost pushed bad software onto their Watch
- Bugs delayed the release by a week
- As Cnet wrote, "The delay of Watch OS 2 echoed the setback a year ago when Apple's iOS 8 mobile software…launched with numerous bugs [in] Wi-Fi, the Touch ID system and other functions. An update that quickly followed caused even more issues. Apple finally resolved the problems more than a week after iOS 8 launched."
- The iOS 8 release left about 10mm people unable to use their phones, which were effectively bricked during that period
- It might seem like I'm picking on Apple, but I'm not…

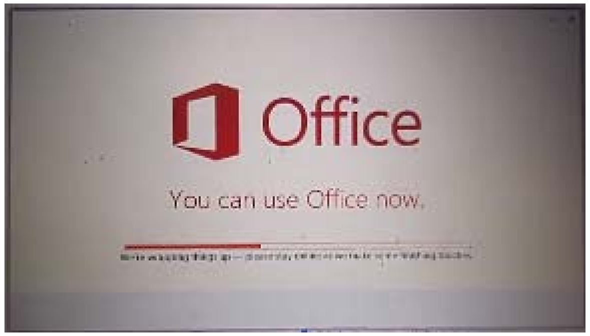
A Frozen Pipe in Your Wall?

- Dec 2015, Nest (a Google company) pushed an update for their IoT device, the Nest thermostat
- The update caused some units to drain their batteries and turn off
- Some houses got pretty cold in January
- The workaround was so confusing that Nest offered to pay for an electrician to come do it for confused customers
- While this sounds like a one-percenter problem, consider potential health impacts for infants or the elderly
- Suppose your house froze and a pipe broke?
- Tough luck, an arbitration clause prohibits you from suing for damages


Thermostat offline or low battery? We're aware of the problem and are working on it. Learn more >

How Much Is that Dog Crap on Windows?

- Nov 2015, Microsoft pushed a Windows 7 "security" update, which didn't give Outlook 2013 or me a waggly tail
- I spent over 3 hours fixing problem
- Microsoft knew for days yet said nothing
- Microsoft reports that 1bn people use Office, so assume half of them use Outlook
- Over half of people use Windows 7, so figure about 250mm people were affected
- If everyone suffered the same productivity hit I did, over 300,000 person-years lost
- Did Microsoft have to repay businesses and individuals who lost time this way?



Actually, no, I couldn't, not for two more days, at least not Outlook

40 min call, no fix, lousy sound, tech hung up on me

"Houston, We Have a Problem. Houston?"

- Even when updates are tested thoroughly, bad stuff can happen
- Feb 2013, an annual software update killed safety-critical, mission-critical, and comms software on the International Space Station
- According to Marcy Kerr, SW Dev Manager, two years of development and testing didn't catch the underlying data allocation bug in one line (out of 4.5mm) of code
- It took a couple hours to fix, a week to upload
- Lessons
  - Software is not linear—small changes can have huge effects
  - Even when best practices are followed, there is still some risk
  - This is not an excuse not to follow best practices, as NASA software bugs have never killed anyone, though they have caused mission failures
  - Ultimately, software engineering must evolve to true engineering

"Dude, I Pwned your Jeep!"

- The risks posed by auto-update channels go beyond functionality and reliability
- Auto manufacturers are starting to do over-the-air updates to cars
- Tesla already updates core systems, not just telematics and maps
- Jul 2015, Wired published an article where two hackers miles away high jacked a moving Jeep
- Similar weaknesses exist for implanted medical devices
- Jun 2013, Vice published an interview with Barnaby Jack, who said he could hack into pacemakers and insulin pumps and cause fatal events
- Jack died, aged 35, one week before he was to present his findings at the Black Hat conference for hackers
- It turns out he had ODed on cocaine, heroin, Xanax, and alcohol – unless you believe the conspiracy theories

Not Updating? Not an Option!

- So, if updating is so risky, how about we don’t do it?
- Two historic software failures resulted from not *enough* updating
- Therac-25 nuclear medicine device reused code from previous versions
- Previous Therac devices had hardware safety interlocks not present on the Therac-25
- A bug lead to software-initiated overdosing that the safety systems could have prevented, killing three people
- Ariane 5 re-used software from a previous rocket, but the data sizes for integers and decimal numbers were different
- An overflow failure during decimal-to-integer conversion caused the rocket to tip over, requiring its destruction

Ariane 501: $500mm bottle rocket

Ways to Mitigate the Risk

- In addition to careful adherence to known best practices related to quality and testing, some more ideas…
    - Thorough automated regression testing at all levels, including SIT tests through APIs and shared data
    - Wider use of A/B testing, beta testing, and other forms of staged releases
    - Testing skills for programmers and vice versa
    - Less-frequent, larger releases wherever possible
    - Enabling true end-user control over updates
    - Order-of-magnitude improvements in software security, so updates aren't urgently needed so often
- Put not your trust in lifecycles nor in languages, from which we have not gotten salvation…

Some (im)Modest Legislative Suggestions

- Public reporting of all regression bugs
- Banning of arbitration clauses in contracts of adhesion
- Implied warranty of fitness for software, with legal recourse for damages
- SOX-like requirement for executives to approve all software releases
- An SEI 2.0 initiative that goes beyond just looking at software development process

How Likely Is That Stuff?

- On the non-legislative side, employee and consumer pressure can drive those improvements
- This is especially true in hyper-competitive markets
- On the legislative side, tech companies have too much money for those to happen
- In the 1990s, we barely avoided the opposite situation, due to tech efforts to pass UCITA
- A tester named Cem Kaner helped lead the fight against UCITA
- Sadly, people may have to start dying (in larger numbers) from software bugs before sufficient public pressure will drive legislative changes

Stuff My Fellow Software Professionals Say

- In addition, let's take our role seriously
- Let's stop saying stupid stuff that encourages lackadaisical quality attitudes, such as…
  - "If you are not embarrassed by the first version of your product, you've launched too late"
  - Even if you have only "one hour to test" an application, you can be confident in your work
  - Given a set of TDD-based automated unit tests, programmers can change software without incurring regression risk
- These statements, and many others like them, push our profession in exactly the wrong direction

Conclusions

- Software updates carry significant risks to the quality of the updated systems
- The frequency of problems indicates inadequate care in managing these risks
- The very ability to do automated software updates also creates significant security risks
- Solutions are necessary, as not updating software is not an option
- Until software engineering becomes true engineering, the application of known best practices can help manage the risk
- If we as professionals don’t manage the risks, we’ll be regulated into managing them
- At the very least, let’s start talking like we really care about these risks

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