构建基于密码芯片的物联网安全体系

Secure IoT architecture based on cryptographic hardware

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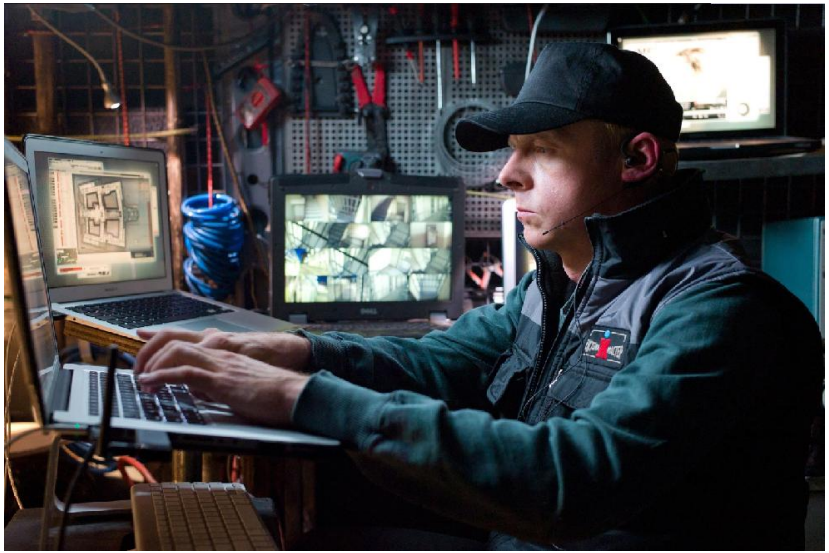
摘要

- IoT黑客长什么样？
- IoT设备有哪些脆弱性？
- 怎样提升IoT安全性？
- 密码芯片能贡献什么？

网络黑客……在地球的另一端

近场黑客……邻居、路人甲或面包车

上天入地无所不能的入室型黑客



用户型黑客

威胁程度 - 对用户而言

网络黑客

近场黑客

>

入室黑客

>

用户黑客

威胁程度 - 对产品企业而言

软件攻击

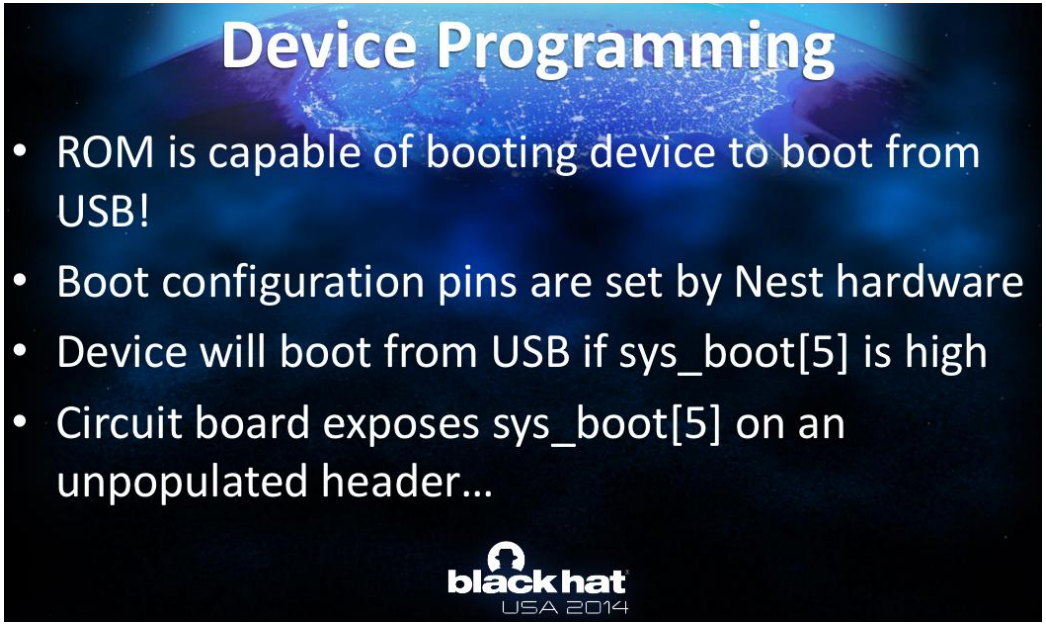
>

硬件攻击

……除非，硬件Hack可以被低成本复制……

案例-1： Nest温控器

- “Smart Nest Thermostat: A Smart Spy in Your Home”, Blackhat 2014

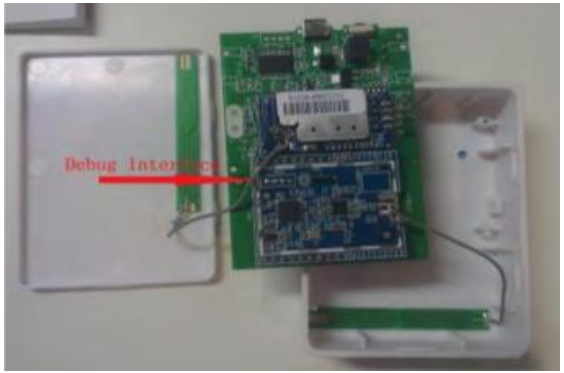


案例-2: ZigBee系统

- "I'M A NEWBIE YET I CAN HACK ZIGBEE", Defcon 2015

Zigbee Bulb

Gateway



案例-3: 酒店门锁

- “My Arduino can beat up your hotel room lock”, Blackhat 2012

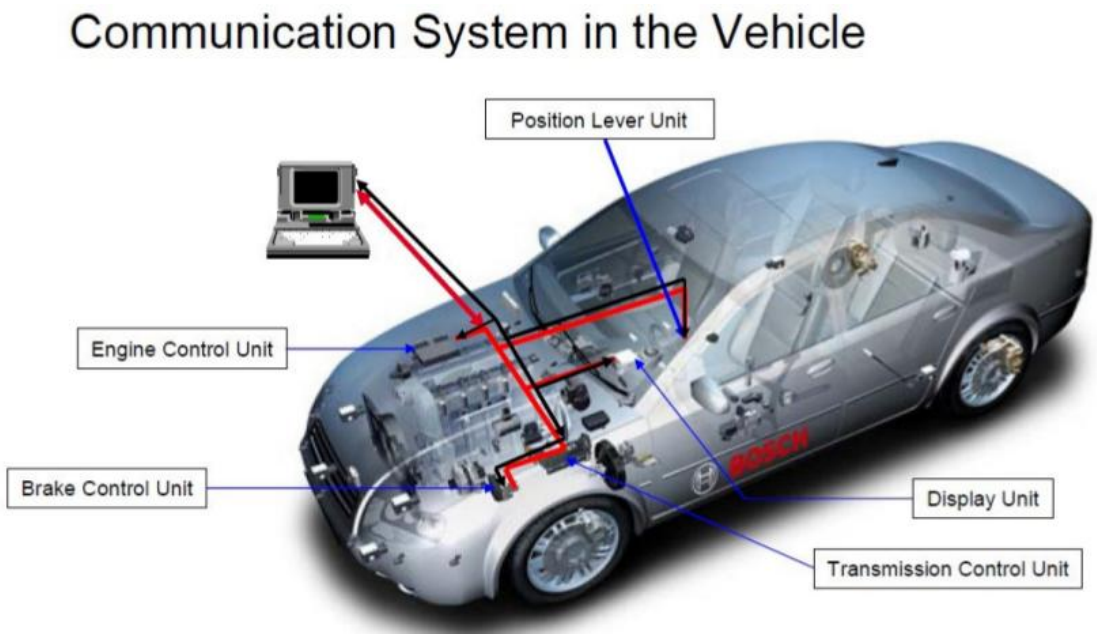
Open command

- All you need is the sitecode
  - We got that from memory
- Complete time for reading the memory and opening the lock is about 200 milliseconds
  - This can be longer if you need to try different addresses, due to supporting multiple door types
- Creates an entry in the audit report that shows the PP having been used to open the lock
  - But it doesn't alter any data on the lock or inhibit normal functioning

trappedorbit research

案例-4: 汽车ECU

- “Dude, WTF in my car?”, Blackhat 2013



案例-5: 监控摄像头

- “海康威视“黑天鹅”惊魂两天”, 新华网

这些弱口令包括“123456”、“888888”等初始密码

“所有暴露在互联网环境下的设备都会面临黑客攻击的风险。”

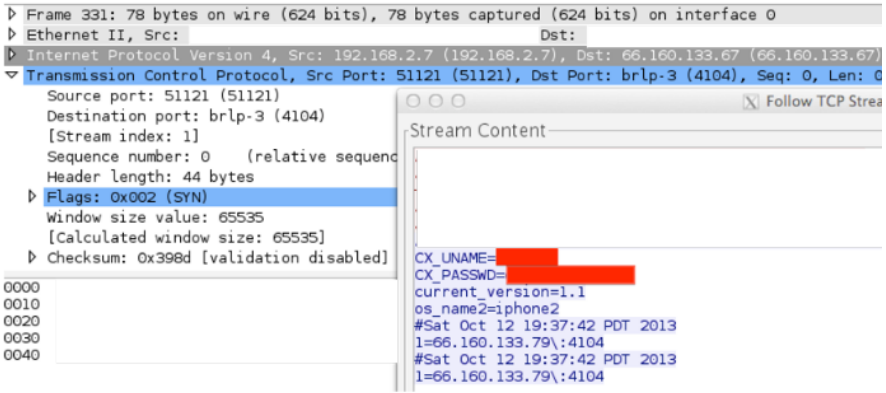
海康威视称，早在去年3月，公司就已经在官网上提醒用户修改初始密码。

案例-6: IP摄像头

- “Abusing the Internet of Things - BLACKOUTS. FREAKOUTS. AND STAKEOUTS”, Blackhat 2014

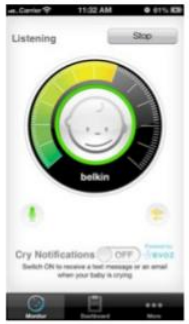
NetCam connects to local Wi-Fi

Traffic is secured using SSL except sometimes it’s not and your credentials are sent to a remote server in clear



案例-7: 婴儿监控器

- "Abusing the Internet of Things - BLACKOUTS. FREAKOUTS. AND STAKEOUTS", Blackhat 2014



Baby monitor connects to local Wi-Fi

Connects to monitor using local Wi-Fi to obtain authorization

Connects to external SIP proxy to communicate with iOS app

Connects to external SIP proxy to communicate with monitor

smartUniqueID and serialNumber are basically the authentication tokens.

案例-8: 无人机

- “Knocking my neighbor’s kid’s drone offline”, Defcon 2015


```
telnet 192.168.42.1
# ardrone3_shutdown.sh
shutdown: Shutdown Dragon
shutdown: Asking Dragon to stop...
shutdown: Stopping users of eMMC
eMMC_release: Releasing eMMC...
MTP: stopping service
shutdown: Synchronise filesystems
eMMC_umount: Umounting eMMC...
Connection closed by foreign host.
```

案例-9: 吉普切诺基远程攻击

- “Remote Exploitation of an Unaltered Passenger Vehicle”, Blackhat 2015

脆弱点

- 弱登陆认证 or 无登陆认证
- 固件未签名 or 外部固件
- 固件未加密 or 固件弱加密
- 秘钥未保护 or 秘钥弱保护
- 芯片测试接口未关闭
- 使用“自行临时设计”的密码协议
- 假定“设备处在安全内部wifi”

那么，

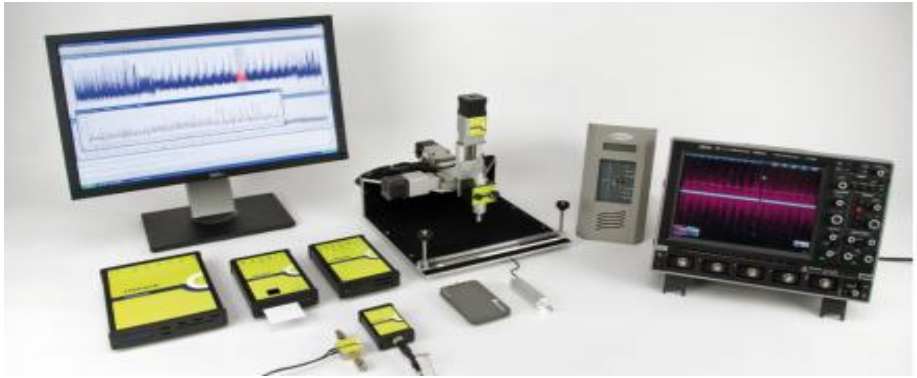
密码芯片能贡献点啥？

密码芯片

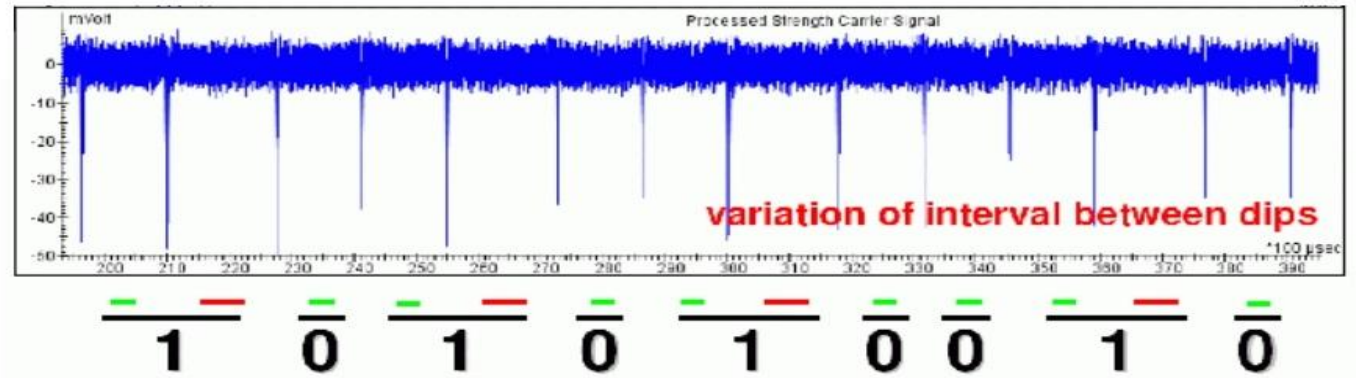
- 约2000年开始，开始在欧洲大量应用
- 中国2015年不再发行磁条卡
- 15年的攻击/防护技术研究
  - 秘钥生成
  - 秘钥保存
  - 加密、解密
  - 签名、验签
  - 安全存储

抗旁路攻击

旁路攻击设备



芯片密钥

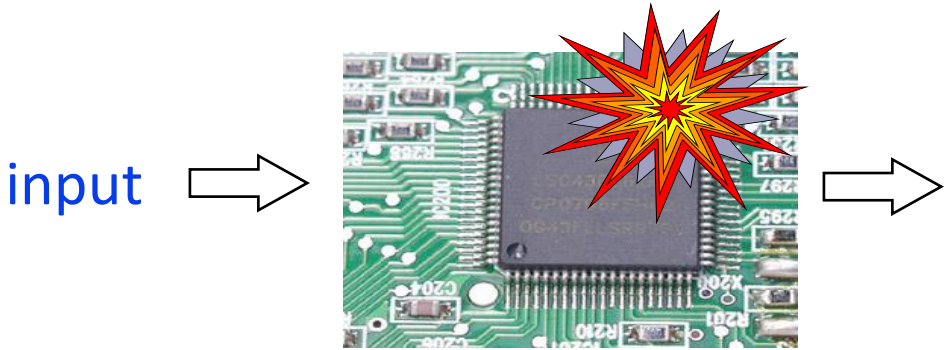


抗故障攻击

故障攻击

- 在芯片运行时注入故障，通过分析错误结果获得密钥
  - 电压毛刺、时钟毛刺、高低温
  - 激光、电磁场、射线
  - 对公钥、对称密码体制都有效

Riscure高精度激光错误注入平台

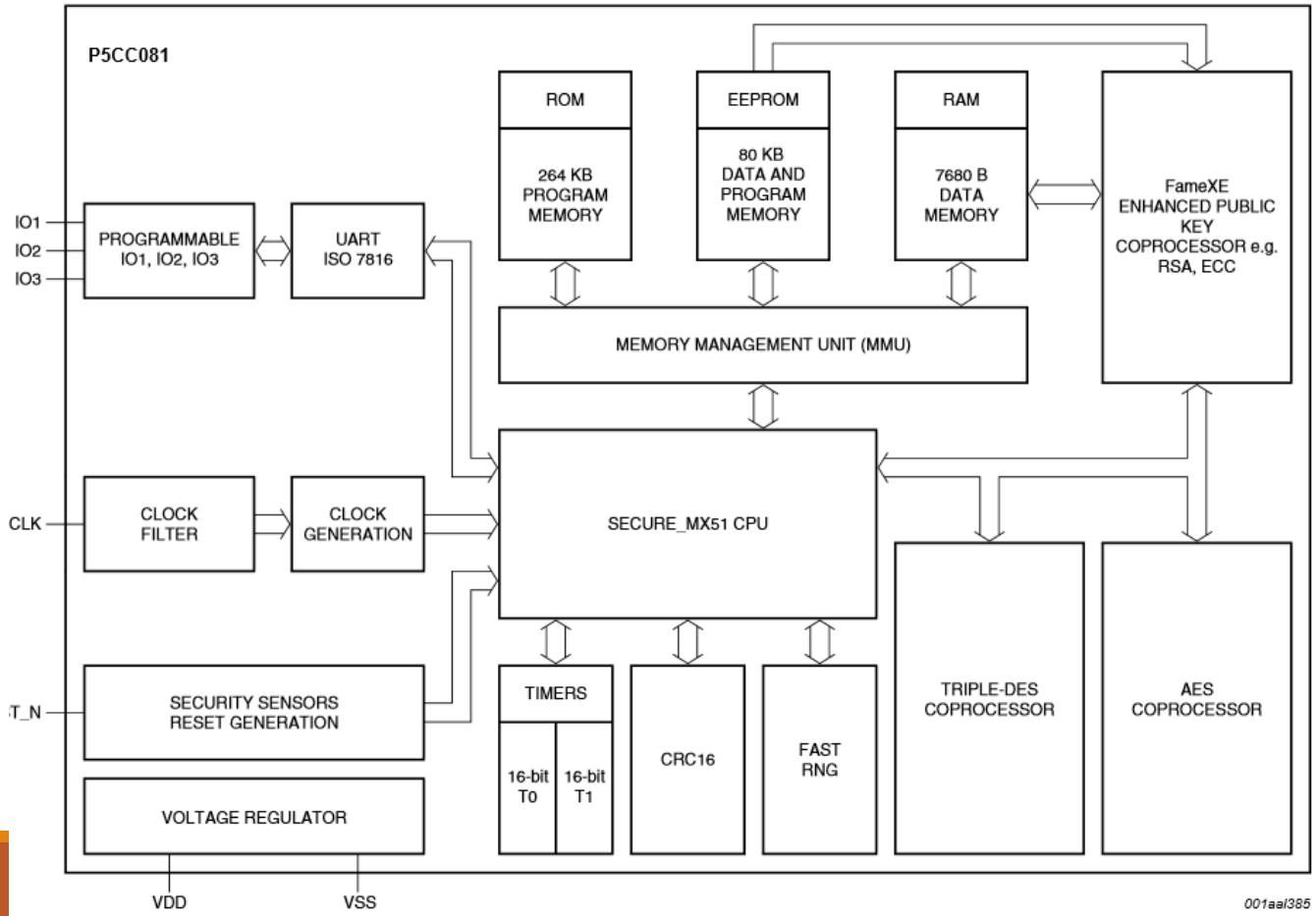


抗侵入式攻击

The chip analysis studio of Christopher Tarnovsky

其他安全功能

- 固件加密
- 总线加密
- 安全CPU
- 传感器
- 测试封口



PUF: 芯片指纹

- PUF： Physically Unclonable Function (物理不可克隆函数)
- 基本思想
  - 使用芯片生产过程中的随机性
  - 同样的设计，在不同的die上特征不同
  - 仅在上电时才产生

安全检测

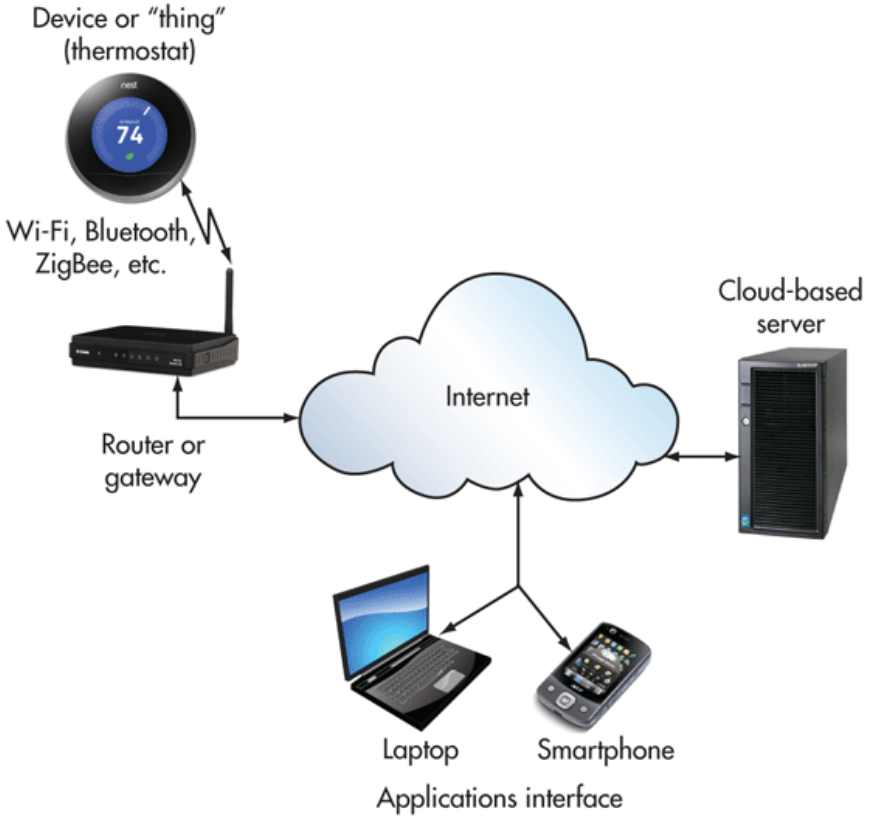
- 国密、BCTC/EMV、Common Criteria、FIPS 140-2等
  - 随机数发生器
  - 密码算法（DES/RSA/ECC/SHA/SM2/SM3/SM4）
  - 芯片抗物理攻击能力
  - 嵌入式软件安全
  - 芯片生命周期管理
  - 配置管理
  - …

如果，

IoT设备都使用安全芯片……

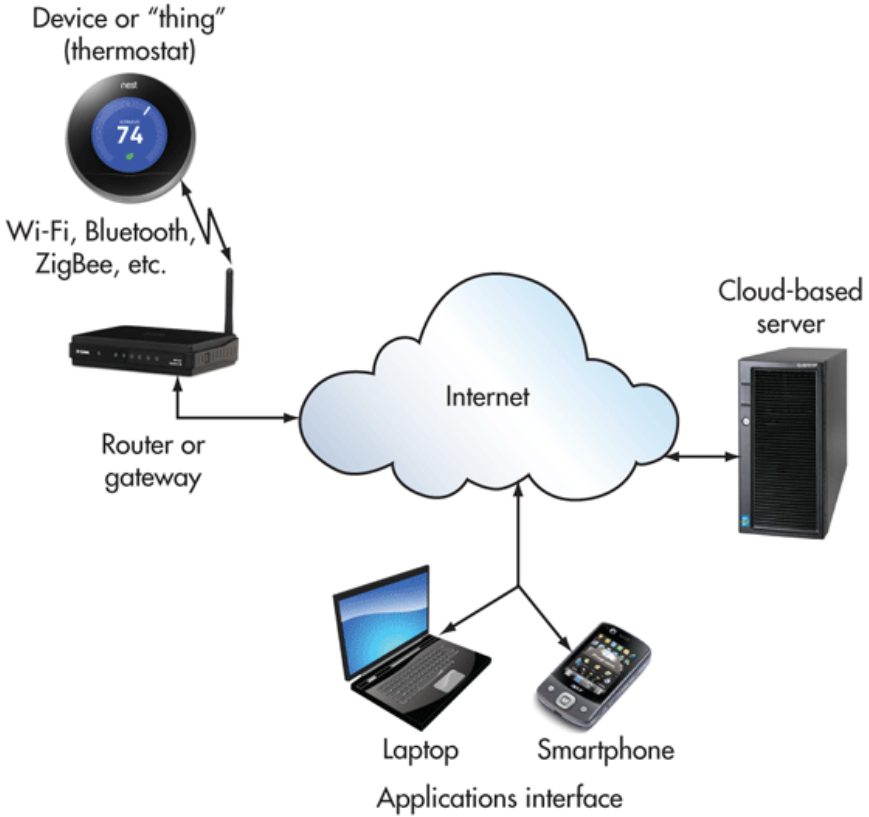
基于密码芯片的IoT

- 基于密码协议的身份认证
  - 基于PKI ✓
  - 基于PUF ✓
  - **Password** ✗



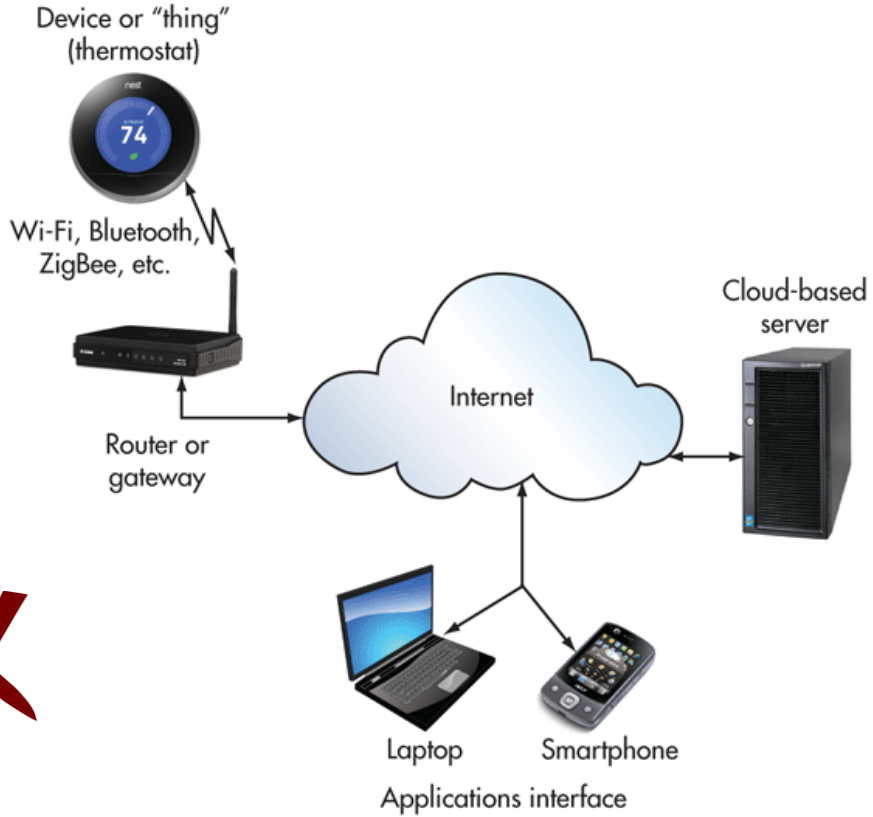
基于密码芯片的IoT

- 端到端秘钥协商
  - 安全密钥协商 ✓
  - 安全TLS ✓
  - 预置密码 ✗
  - 明文秘钥协商 ✗



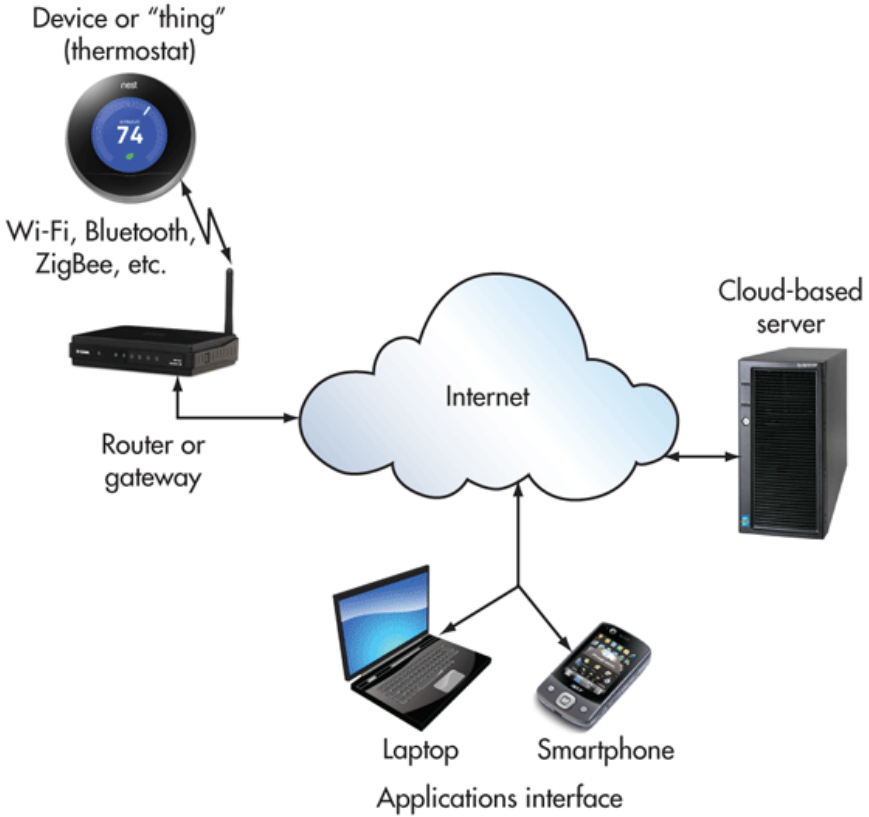
基于密码芯片的IoT

- 安全固件
  - 固件加密 ✓
  - 固件签名 ✓
  - 安全固件升级 ✓
  - 灾难恢复 ✓
  - **固件破解、反向、非法修改** ✗



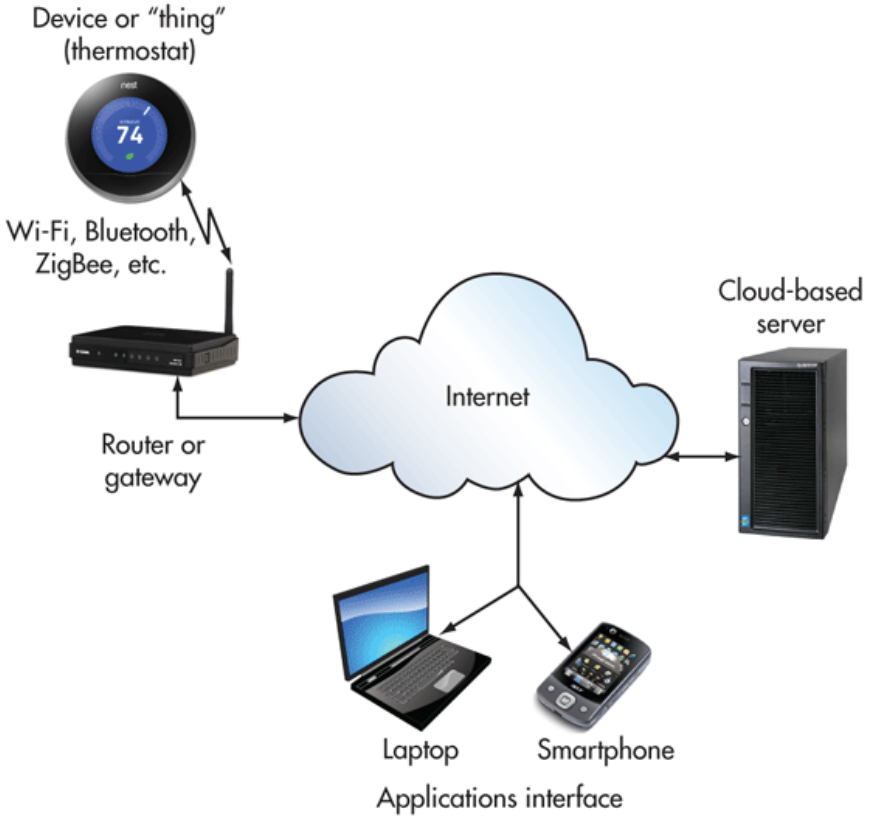
基于密码芯片的IoT

- 安全加解密运算
  - 高性能 ✓
  - 低能耗 ✓
  - 抗物理攻击 ✓
  - 数据加密保存 ✓
  - **加解密、签名软件漏洞** ✗
  - **物理攻击** ✗



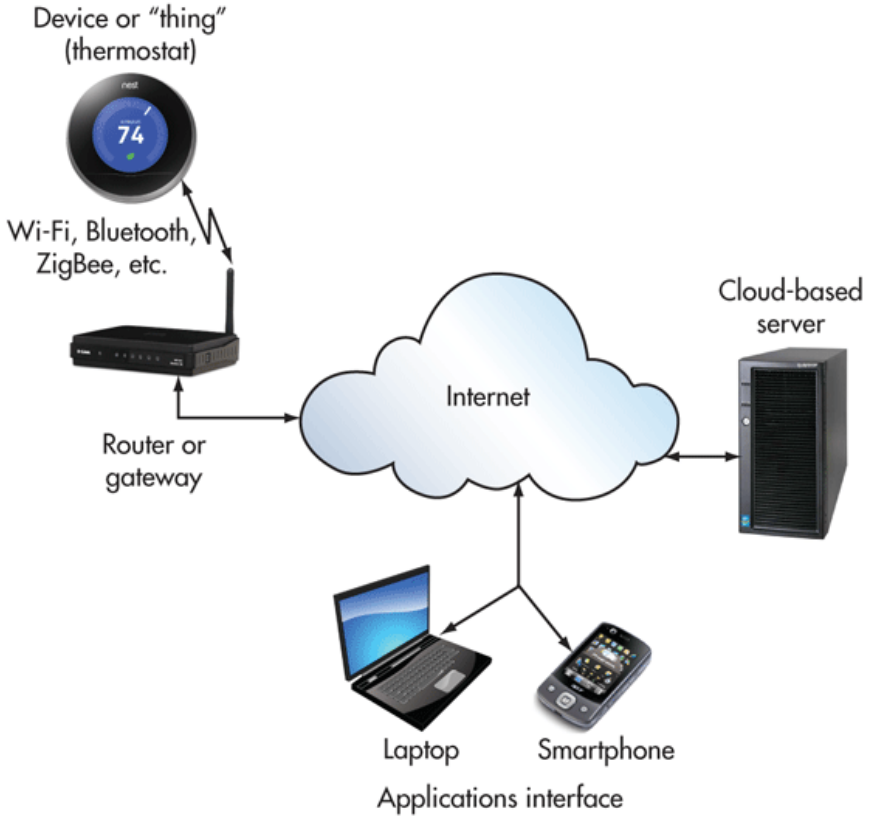
基于密码芯片的IoT

- 安全组网 & 灾难恢复
  - 基于硬件Root-of-Trust
  - 灾难恢复和自愈网
  - **被破解，然后扔掉**



基于密码芯片的IoT

- 安全固件(加密/签名)
- 安全秘钥存储
- 端到端加密
- 强用户认证
- 安全存储
- 设备唯一识别
- 灾难恢复



安全测评


2014 KIA FORTE
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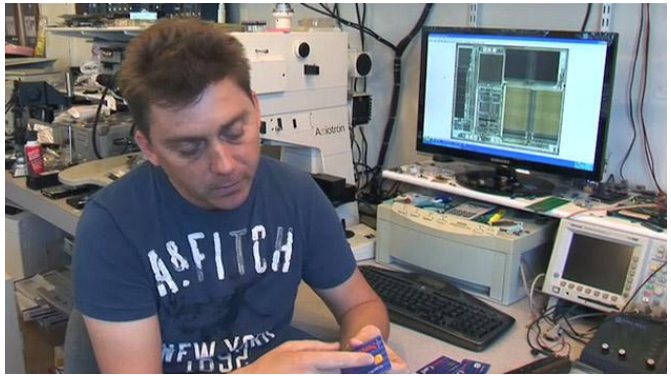
CEN1318

终极目标



- This, Jen, is the Internet of things. -