Leviathan redux

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Hobbes

- “Every man is Enemy to every man; wherein men live without other security ... In such condition, there is no place for Industry; because the fruit thereof is uncertain [and people live in] continuall feare (his spelling, not mine), and danger of violent death; And the life of man, solitary, poore, nasty, brutish, and short.”

Are you better off than you were in 2001? (1647?)

- Yes:
  - PC infections: 1% down from >2%
  - Mobile data traffic grew 81% in 2013 with 4G devices accounting for 30% of total mobile traffic [Cisco 2013]. Reported infection rate of 0.0009% [NDSS, 2013].
  - New study
    - iPhone: infection rate .22%
    - Android phone: infection rate .39%
- But:
  - This bug shows that in 2014, your machine can still be owned by a picture

New stuff

- Situational awareness (big data)
  - Adversarial machine learning
  - Text mining
  - Suspicious URLs
- CFI/XFI
- Formal methods
- Artificial diversity
- NX, ASLR
- *Sandboxing*
- *Hardware roots*

Also new

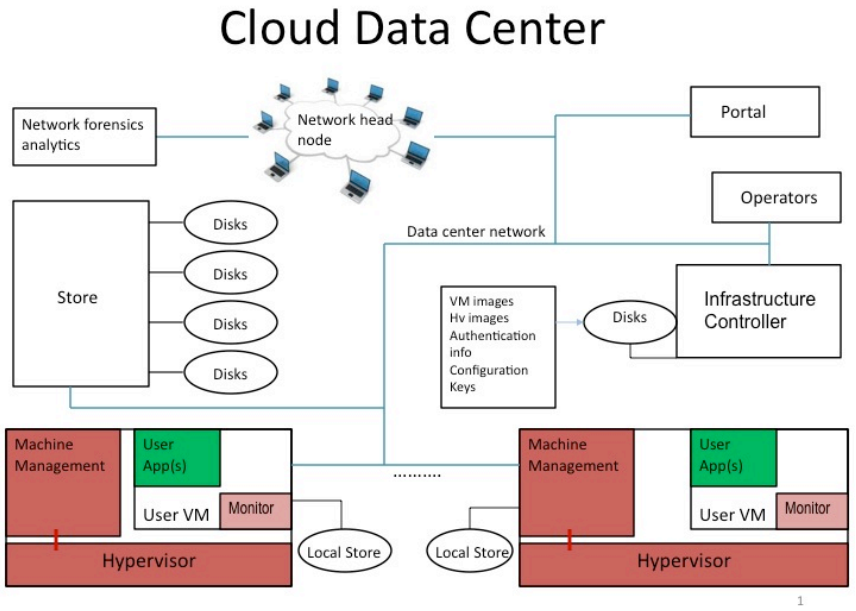
- Nation state attacks on commercial computers
  - Not *so* new
- Carders, Silk Road
- Social computing
- Wearables
  - Pictures everywhere
  - Control model?
- Embedded systems
  - Also not so new (space shuttle)
  - But ubiquitous … and connected
- Hardware attacks
  - Especially “core” parts

Were the old solutions inadequate?

- *Isolation*
- *Least privilege*
- Verification/certification

CloudProxy: protection model

- Adversaries: Co-tenants, insiders (but not “inside” developer), eavesdroppers, technicians
- Protect: Key disclosure, integrity violation, data (maybe code)
- Ensure: Correct operation, configuration (affecting confidentiality and integrity)
- Avoid: Large software services written by others, CAs



Building a secure distributed application

Currently

- Write the programs implementing the application correctly
- Deploy the program safely (no changes)
- Configure the operating environment correctly
- Ensure other programs can't (or don't) interfere with safe program execution
- Generate and deploy keys safely
- Protect keys during use and storage
- Ensure data is not visible to adversaries and cannot be changed in transmission or storage
- Add new program elements during operation
- Ensure trust infrastructure is reliable
- Manually audit to provide confidence this all happened during operations

With CloudProxy

- Write the programs implementing the application correctly

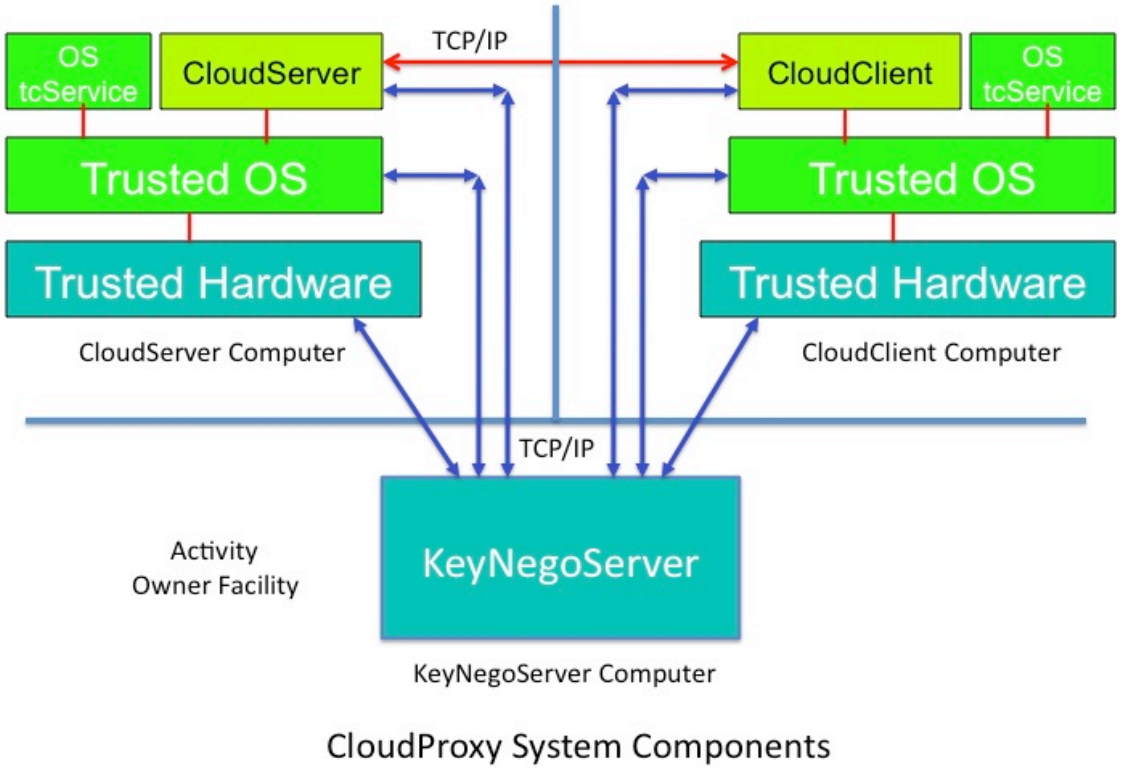
- Properties
  - Fail safe *remotely* verifiable operation
  - Simple programming model
    - Support multiple layers of familiar software stack (Application, OS, Hypervisor, Hardware)

The “secret sauce”

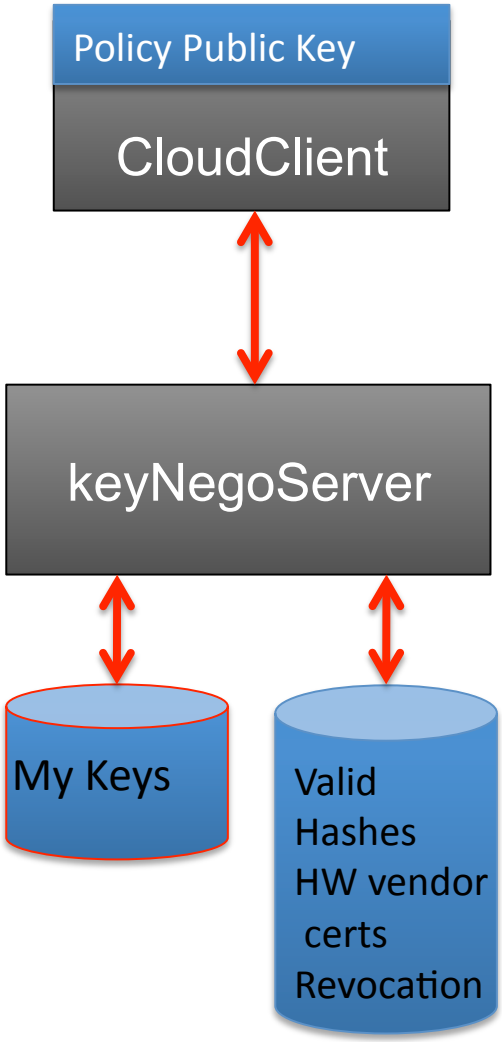
Host system provides:

- Isolation for measurement-based principals
  - Hosted programs
- Services for measurement-based principals (the Tao)
  - Restricted use of cryptographic keys to encrypt and decrypt secrets for a measurement-based principal
  - Key management for the principals
  - Policy enforcement anchor (authentication and authorization)
  - Tao services same at all levels of the stack (hypervisor, OS, app)
  - *Base layer rooted in hardware (CPU, chipset, TPM)*

Initialization

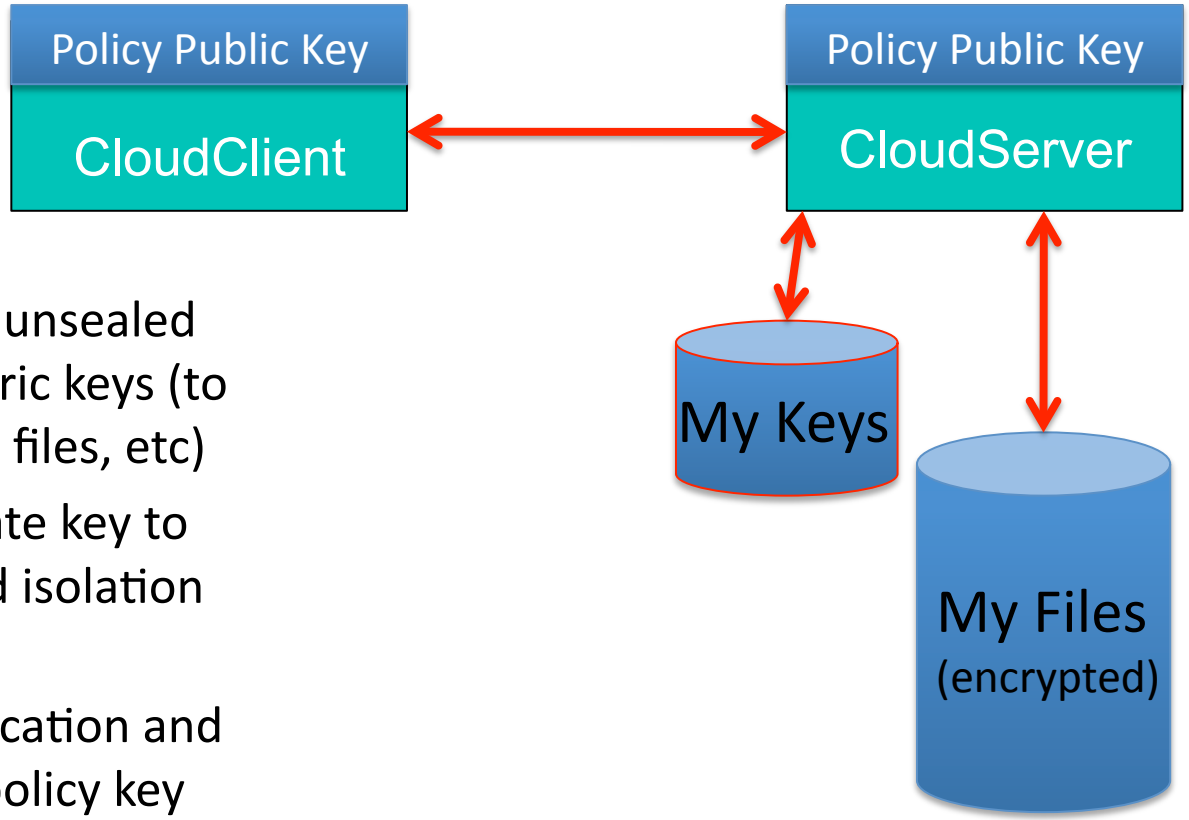


CloudProxy System Components



- CloudClient has private key that only it can access, while isolated and Policy principal signed certificate for the public key.
- Policy principal signed certificate can be used to
  1. Establish SSL channel
  2. Authenticate program and isolation regime

Operation

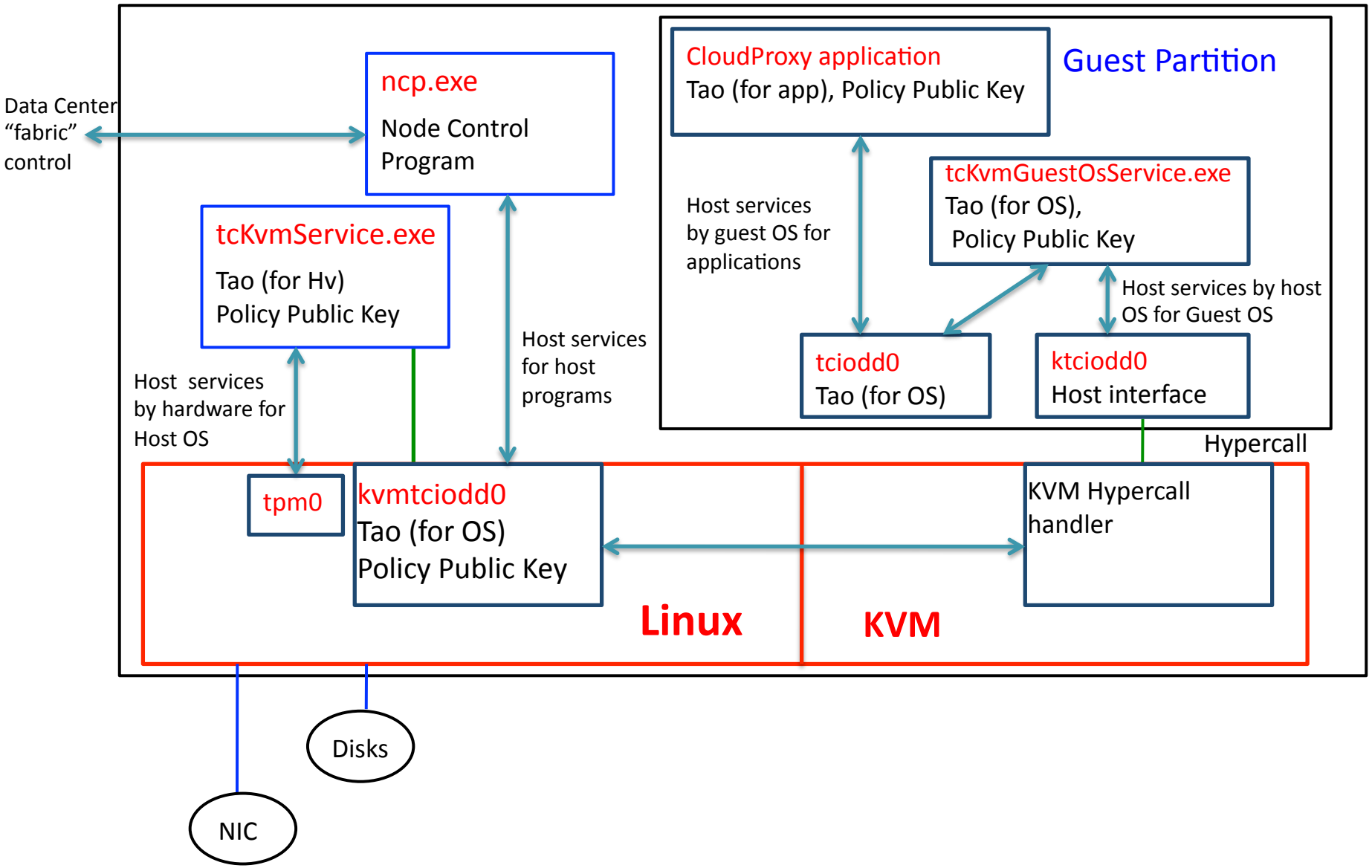


- Programs have access to unsealed private keys and symmetric keys (to encrypt/integrity protect files, etc)
- Program can use its private key to authenticate identity and isolation regime
- Program can do authentication and authorization rooted in policy key
- Trusted programs have authenticated, encrypted integrity protected channel to communicate.

Properties

- All trust rooted in "Policy Key"
- All private keys sealed to code identity
- Policy key is part of identity

KVM Hypervisor (old)



You get what you deserve

- You get what you deserve instead of what you're dealt.
- Maybe it's not what you want but it's what you need.