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HUMAN ELEMENT

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Scaling Key Management: Thousands of Clients, Trillions of Operations

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Intuit

- A global financial platform company
- Maker of turbotax quickbooks mint
- More than **50M customers** trust us with their financial data
- Steadfast commitment to security
- Strategic move to the AWS cloud
- Acquired Israeli security startup Porticor in Feb. 2015

IDPS, Intuit Data Protection Service

- Secret and Key Management service
  - Storage for secrets and encryption keys
  - Cryptographic operations

- For highly sensitive data we require both transparent disk-level and **application-level data encryption**

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Core Features

Where to Encrypt

- Fetch the key into the client, then encrypt
- Alternatively, send the data to be encrypted on the KM service

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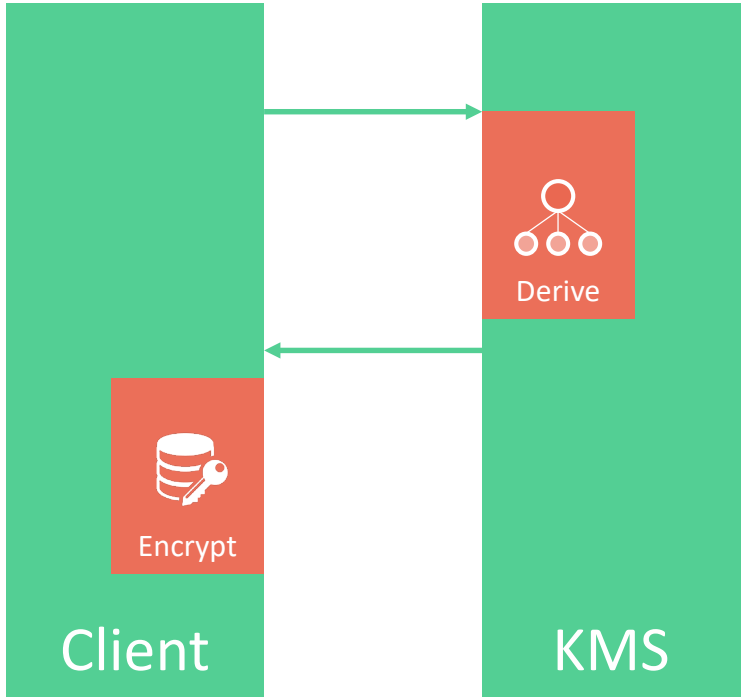
- Instead: RDLE – **Remote Derive, Local Encrypt**

- Fine-grain keys: implications on threat model
  - Spatial granularity
- Also on performance, scalability



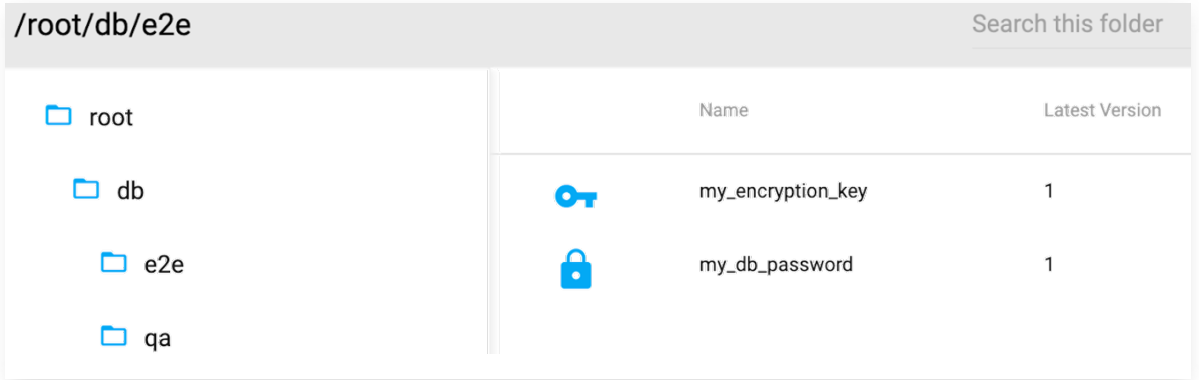
Temporal Granularity: Key Versions

- New key version every 90 days
- Key versioning vs. re-encryption (vs. “key rotation”)
- **Versioning is automated**, saved as part of a ciphertext header
  - No industry standard, sigh

- Versioning works well with probabilistic encryption
- More challenging with deterministic encryption

Managing Keys

- Each project receives a **strictly segregated namespace**
- A namespace is a hierarchy of folders and keys
  - Keys consist of multiple key versions
- Keys can be created, listed etc. with a UI and a REST API
- Role-based access control at the folder level
- Custom permissions
  e.g. read public-key only



Client Authentication

- Initially, had an OAuth1-like message signing
  - Assert long-term credentials, obtain a short-term bearer token
- Found out this is not workable: turtles all the way down
- Built a separate **policy authentication** service
  - Policy: AWS role plus additional properties
  - Good for: EC2 instances, Lambda functions, Docker containers, more
- Now being reused for other internal services

The Customer View

- IDPS only used by *internal* customers

- SDK: Java, Python, Go, JavaScript
  - Using the REST API directly is hard
- UI and a CLI tool for secret management

- No manual handling of keys
- Enterprise-wide governance

Why Have Your Own KMS?

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Service Architecture

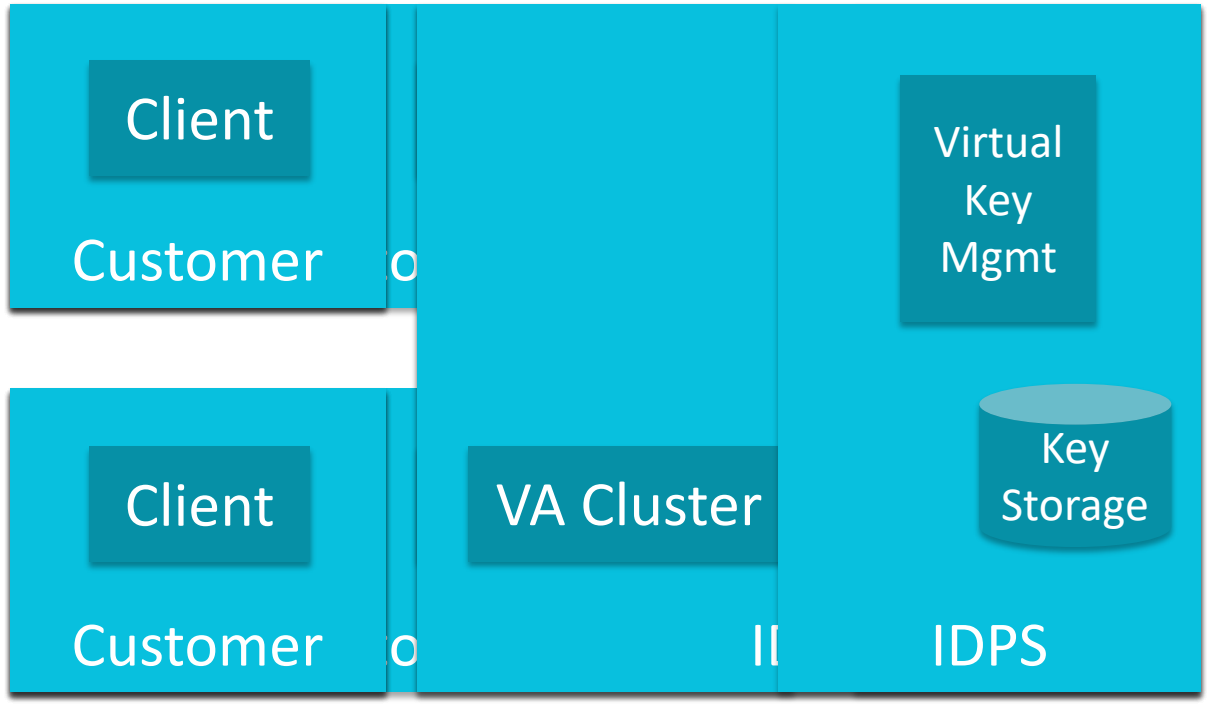
The Architectural Journey

1. Virtual Appliance (VA) owned by customer, master key

2. Fully managed service, including VA clusters

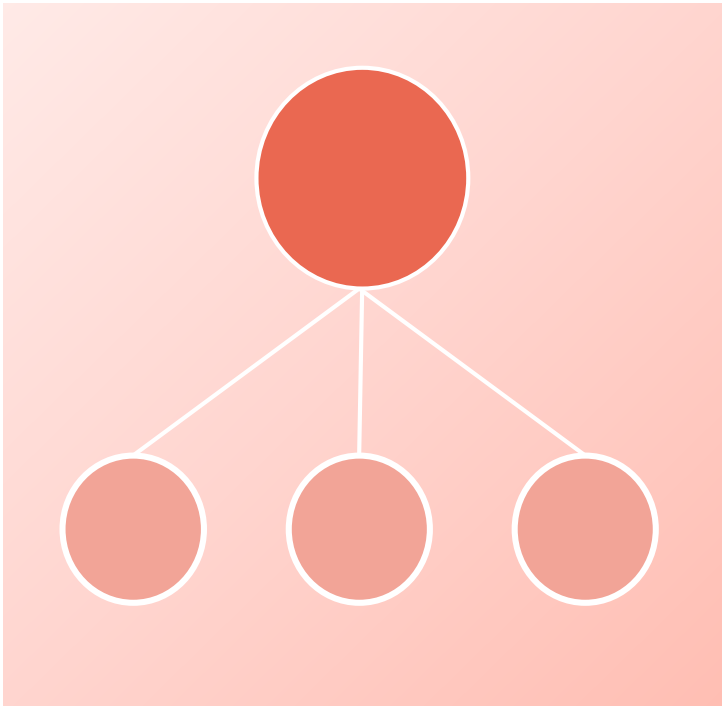
3. End-to-end secrecy

4. Multitenant key derivation



Evolving Key Derivation

- Need a deterministic function of a secret (“root key”) and a non-secret input, returning a secret derived key
  - With several security guarantees
- HKDF, RFC 5869
- How to do it in a shared environment? **Oblivious PRF**!
- The service uses a blinded version of the root key to derive a subkey
  - Which is then unblinded by the client



IDPS Technology

- EC2 instances
  - Formerly also hosted in a traditional data center
- RHEL, moving to Amazon Linux 2
- Go
  - Including most crypto code
- On the client side, primarily Java
  - Bouncy Castle for the crypto code
  - Apache Commons Crypto for performance
- Moved from CloudFormation to Terraform

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Developed for Security

Security Principles

- IDPS is primarily about securing applications, not users
- Keys are only in the clear when used
- Cryptography is bog standard
  - When in doubt, call a cryptographer

Security Principles

- Humans are fallible
  - Dev/ops separation
  - No access to encryption keys, by anybody

Security Infrastructure: Intuit

- Large scale AWS account management
  - Including centralized SSO
- Automated policy enforcement
  - Both via tickets and real-time technical intervention
- Internal red team
- Strong compliance org/culture
- Cost tracking tools

Security Infrastructure: Unique to IDPS

- Zoning and containment: multiple separate AWS accounts
- SELinux
  - A strict custom policy reduces risk from code vulns and Golang zero days
- Dedicated instances
  - They come at a cost
- The Meltdown/Spectre family of issues validated these decisions

Security Infrastructure: Unique to IDPS (Cont.)

- Very conservative: no Lambda functions, no containers
  - But we support any *customer* deployment model
- Short term key backup allows rapid recovery of customer keys
- Custom disaster recovery aimed primarily at **malicious service interruption**

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Wrap Up

Apply What You Have Learned Today: Recommendations

- In the next **two weeks** verify:
  - That you have a valid key management strategy, one that applies to modern automated key use
  - That you can identify its true security value, beyond “compliance”

- In the next **two months** make sure:
  - That this strategy remains relevant when you transition to the cloud
  - That security-critical infrastructure in the cloud is built with cloud ab/use cases in mind

Summary

- **Security-sensitive services can be run in the cloud**
- Consider, in depth, your particular cloud threat model
- But remember it's a moving target
- Security-optimized architecture, without hindering developer productivity

Security software in the cloud: Not easy but definitely fun!