



# Building Trust in the Era of Cloud Computing

ICMC 2017 Conference

May 17, 2017

v1.0

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# TRUST

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A FIRM belief in the...

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- ✓ Reliability
  - ✓ Truth
  - ✓ Ability
- 


...of someone or something.

# Cloud Computing Drivers & Inhibitors

## Market Opportunities and Challenges



**Security** and **Regulatory** continue to be top concerns, **Privacy** emerging..

### Market Drivers\*

2011	2016
Scalability	Scalability
Cost	Agility 
Innovation	Cost 

- Customers continue to see value in cloud technologies
- Self-service and on-demand
- US government “cloud first” policy
- Several cloud security and privacy standards maturing

### Market Inhibitors\*

2011	2016
Security	Security
Interoperability	Lock-in 
Regulatory	Privacy 

- Security continues to be #1 inhibitor
- Privacy is an emerging concern post-Snowden and EU Safe Harbor decision
- Regulations are evolving but still fragmented

**50% Barrier**



**50% Benefit**

**Cloud Security**

# A Rigged Game

## The Game is Rigged...

**Black Hats:** ...initiate the game  
...don't play fair  
...can (and do) change the rules  
...know your defenses  
...need only to score once  
...leverage time to their advantage  
...are clearly incentivized



**Risk**

$$\begin{aligned} &= \frac{h \nabla_h}{(1 - \nabla_h) \log(1 - \nabla_h)} f(a) \approx h \left( 1 + \frac{1}{2} \nabla_h + \frac{5}{12} \nabla_h^2 + \frac{3}{8} \nabla_h^3 \right) f(a) = \\ &= hf(a) + h \frac{1}{2} (f(a) - f(a - h)) + h \frac{5}{12} (f(a) - 2f(a - h) + f(a - 2h)) + \\ &\quad + h \frac{3}{8} (f(a) - 3f(a - h) + 3f(a - 2h) - f(a - 3h)) = \\ &= h \left( 1 + \frac{1}{2} + \frac{5}{12} + \frac{3}{8} \right) f(a) - h \left( \frac{1}{2} + \frac{2 \cdot 5}{12} + \frac{3 \cdot 3}{8} \right) f(a - h) + \\ &\quad + h \left( \frac{5}{12} + \frac{3 \cdot 3}{8} \right) f(a - 2h) - h \left( \frac{3}{8} \right) f(a - 3h) = \\ &= h \frac{55}{24} f(a) - h \frac{59}{24} f(a - h) + h \frac{37}{24} f(a - 2h) - h \frac{3}{8} f(a - 3h) = \\ &= \frac{h}{24} (55f(a) - 59f(a - h) + 37f(a - 2h) - 9f(a - 3h)) \end{aligned}$$



$$\text{Probability} = \frac{\text{Incentive} \times \text{Opportunity}}{\text{RISK}}$$



## Ooops, your files have been encrypted!

English

### Payment will be raised on

5/16/2017 00:47:55

Time Left

02:23:57:37

### Your files will be lost on

5/20/2017 00:47:55

Time Left

06:23:57:37

[About bitcoin](#)[How to buy bitcoins?](#)[Contact Us](#)

### What Happened to My Computer?

Your important files are encrypted.

Many of your documents, photos, videos, databases and other files are no longer accessible because they have been encrypted. Maybe you are busy looking for a way to recover your files, but do not waste your time. Nobody can recover your files without our decryption service.

### Can I Recover My Files?

Sure. We guarantee that you can recover all your files safely and easily. But you have not so enough time.

You can decrypt some of your files for free. Try now by clicking <Decrypt>.

But if you want to decrypt all your files, you need to pay.

You only have 3 days to submit the payment. After that the price will be doubled.

Also, if you don't pay in 7 days, you won't be able to recover your files forever.

We will have free events for users who are so poor that they couldn't pay in 6 months.

### How Do I Pay?

Payment is accepted in Bitcoin only. For more information, click <About bitcoin>.

Please check the current price of Bitcoin and buy some bitcoins. For more information, click <How to buy bitcoins>.

And send the correct amount to the address specified in this window.

After your payment, click <Check Payment>. Best time to check: 9:00am - 11:00am

CMT from Monday to Friday

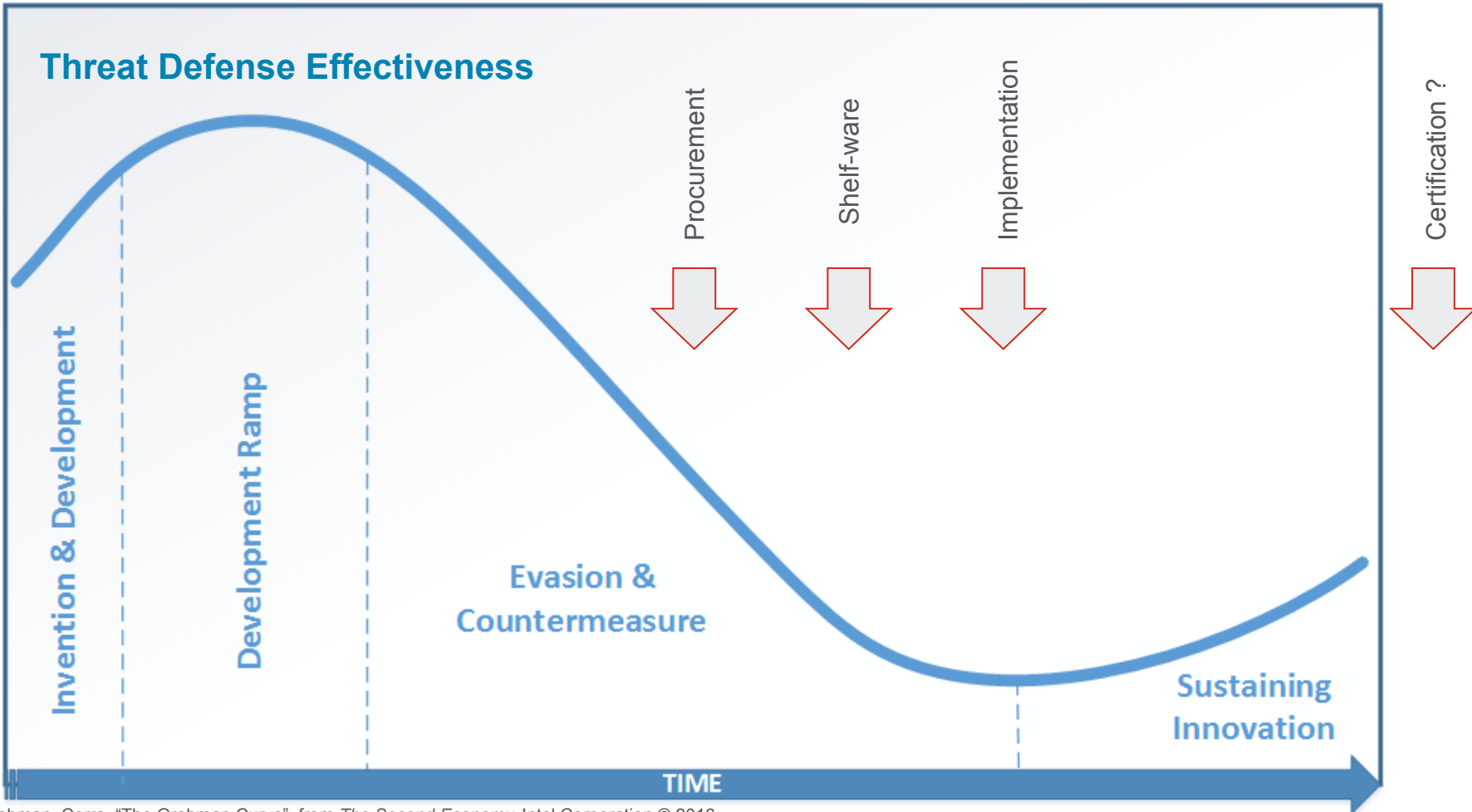


Send \$300 worth of bitcoin to this address:

12t9YDPgwueZ9NyMgw519p7AA8isjr6SMw

Copy

[Check Payment](#)[Decrypt](#)



Source: Grobman, Cerra, "The Grobman Curve", from *The Second Economy*, Intel Corporation © 2016

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# Cloud ?

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# Cloud Computing Terminology

## NIST SP 800-145

*“Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.”*

### Service Models

- Software as a Service (SaaS)
- Platform as a Service (PaaS)
- Infrastructure as a Service (IaaS)

### Isolation Models

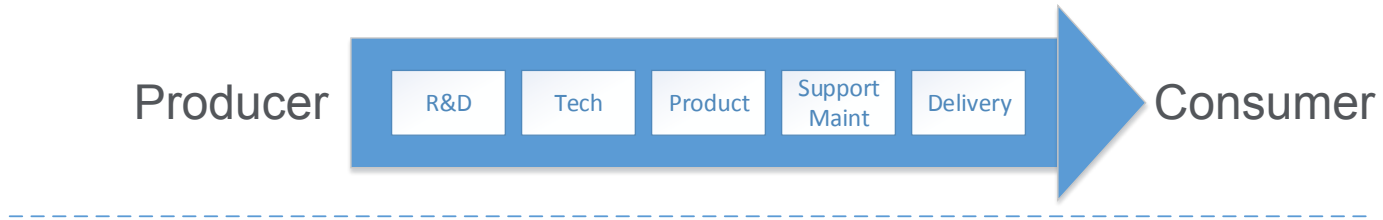
- Dedicated
- Multi-Tenant

### Deployment Models

- Private Cloud
- Community Cloud
- Public Cloud
- Hybrid Cloud

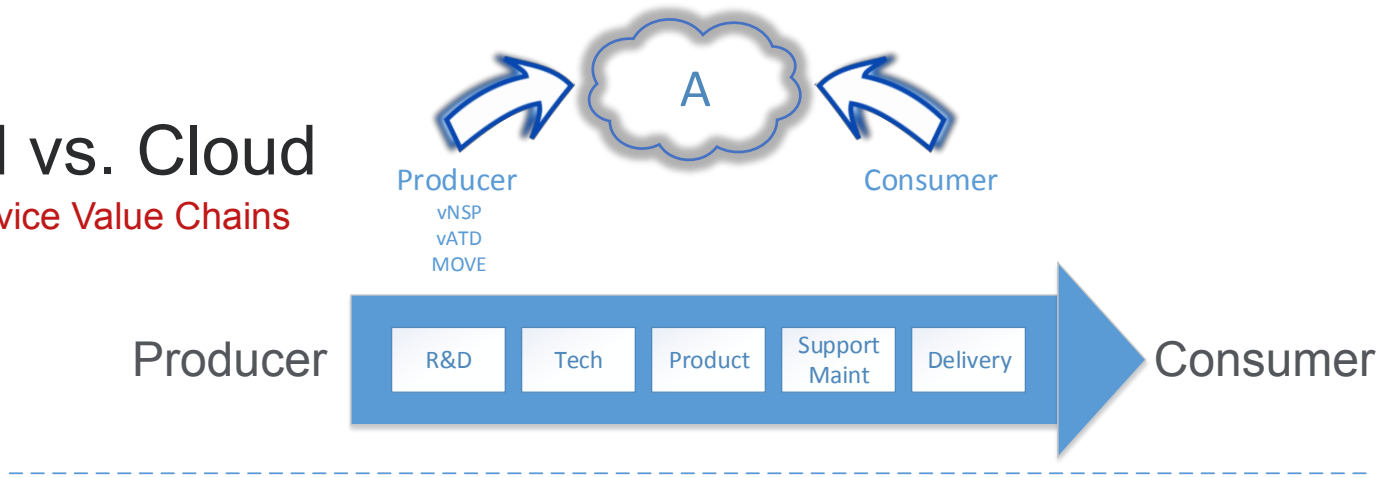
# Cloud vs. Cloud

## Cloud Service Value Chains



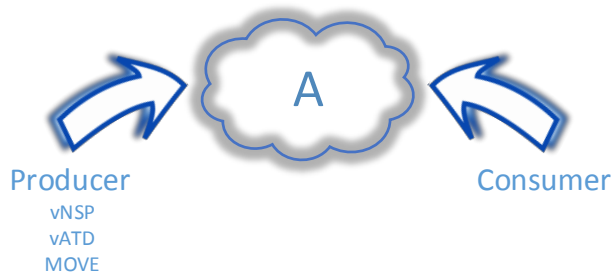
# Cloud vs. Cloud

## Cloud Service Value Chains



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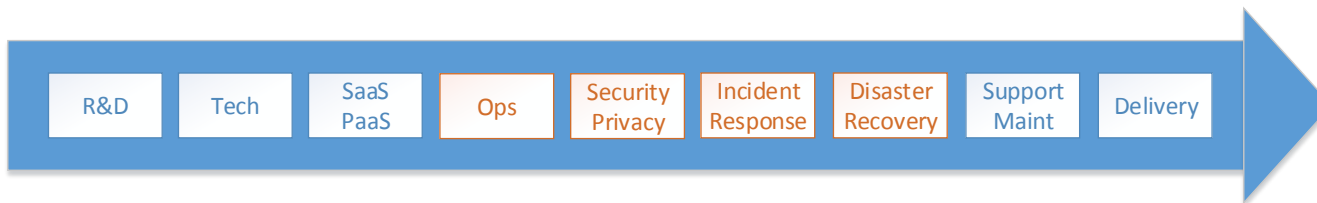


Producer



Consumer

Producer

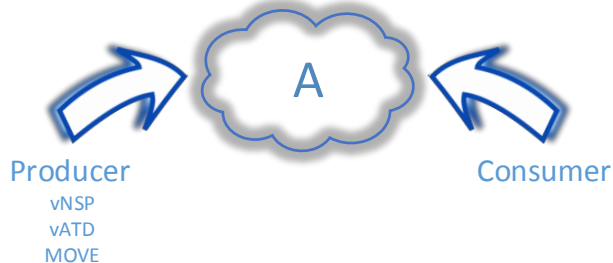


Consumer

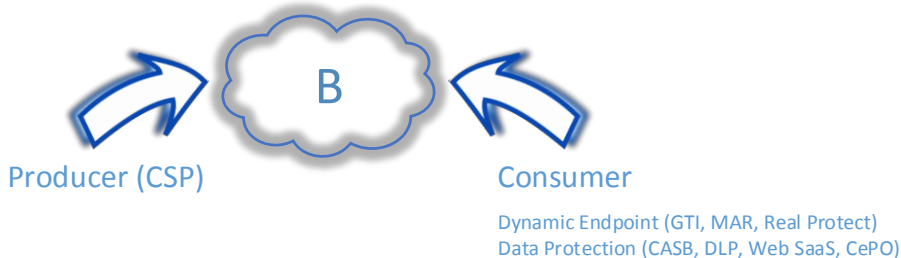
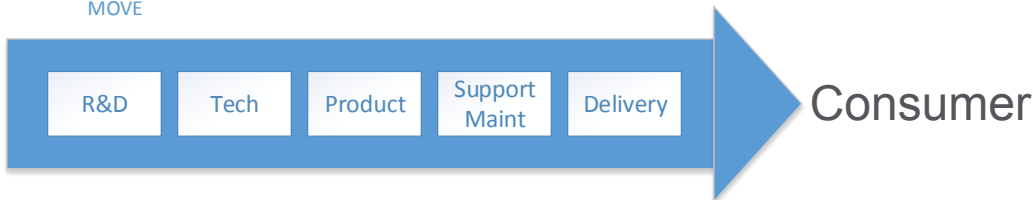


# Cloud vs. Cloud

## Cloud Service Value Chains



Producer

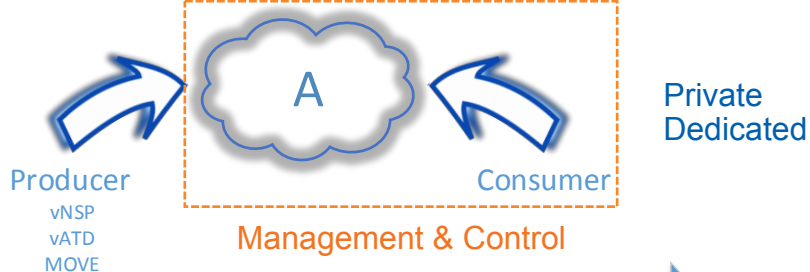


Producer

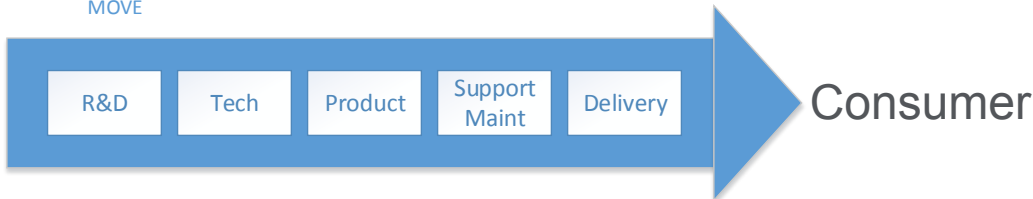


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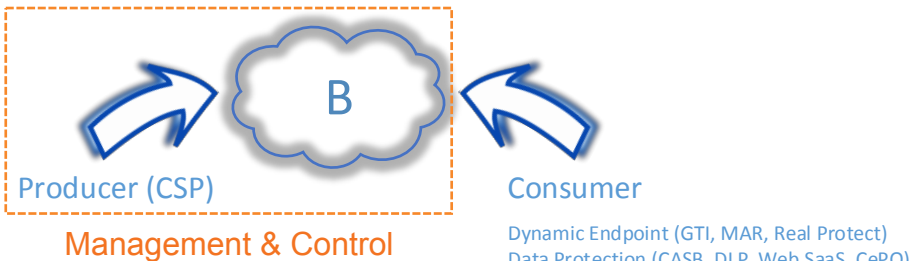
## Cloud Service Value Chains



Producer



Public  
Multi-tenant



Producer



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# Shift to Cloud

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# Product Delivery vs. Service Delivery

## A Paradigm Shift

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### Product Delivery

- Comprised of finished good (hardware, software, etc.)
- Long development cycles, versioned releases
- Customer on-premise deployment
- Perpetual + Maintenance

### Certifications

- Common Criteria, FIPS 140-2 ...
- Specific release (version)
- Build/release, then certify

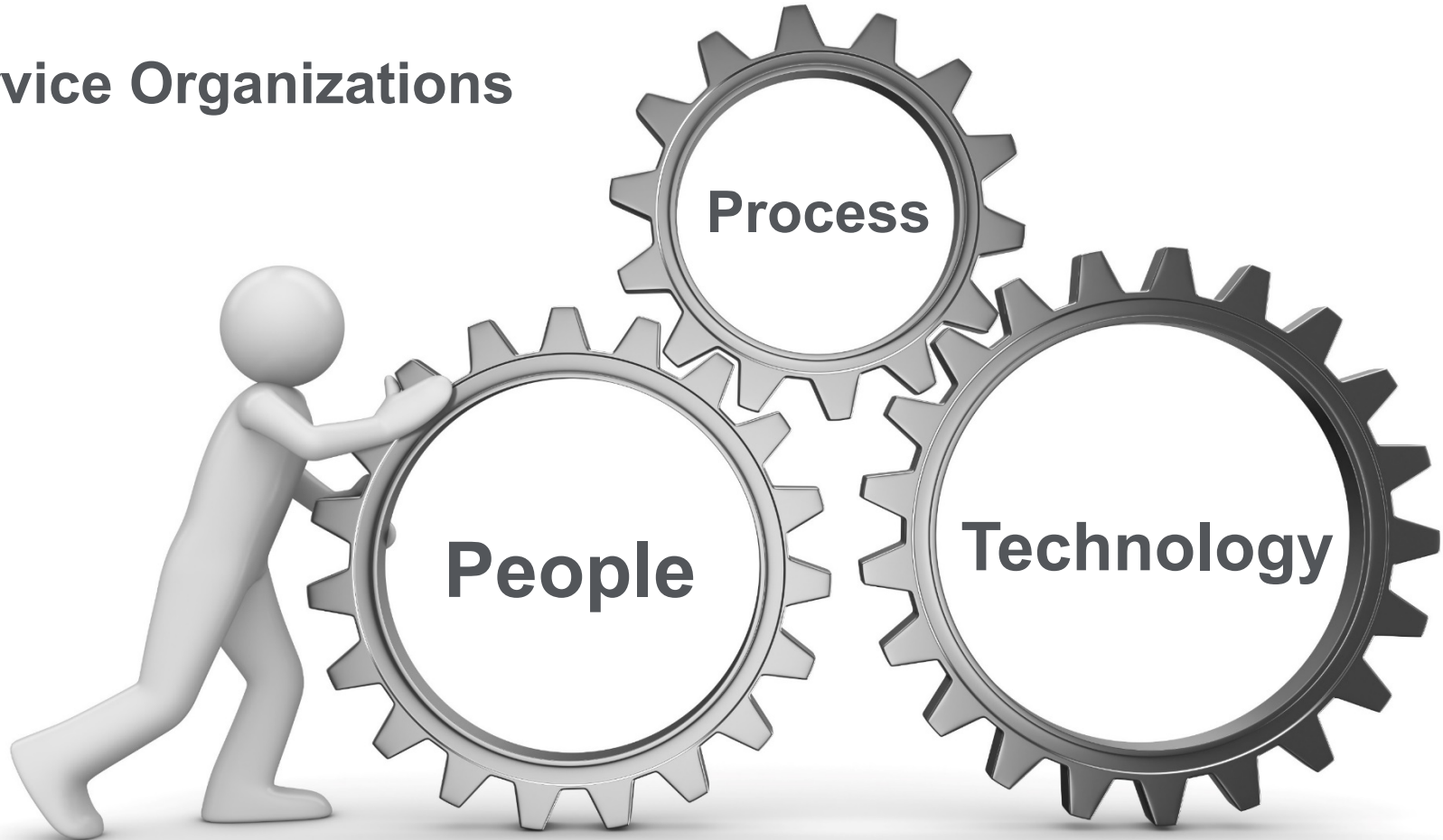
### Service Delivery

- Comprised of people, process, and technology
- Continuous delivery (DevOps)
- Hosted by service provider
- Service Level Agreements
- Subscription. Metered.

### Certification/Accreditation

- FedRAMP, ISO 27001 ...
- Entire service boundary in scope
- Continuous commitment

# Service Organizations



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# Security vs. Compliance

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**ISO 27001**

**HIPAA**

**PCI DSS**

**ISO 27018**

**soc FedRAMP**

**HITRUST**

**CSA**

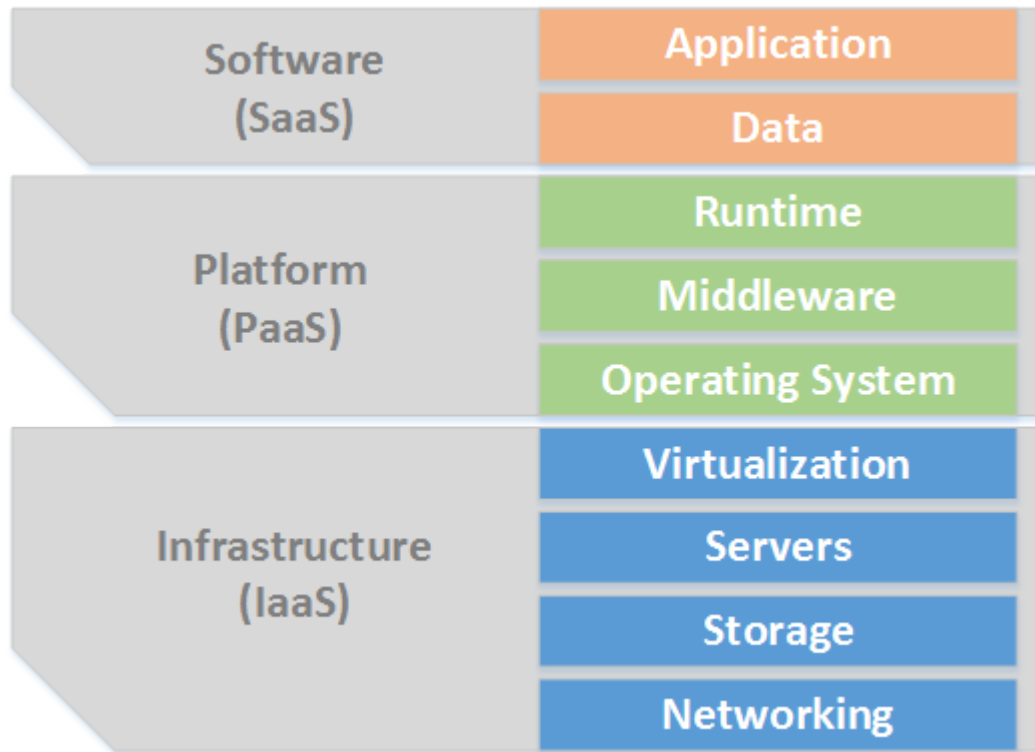
**CCM 3.0**

**SSAE 16**

**GDPR**

# Cloud Stack

## Infrastructure, Platform, and Software as a Service



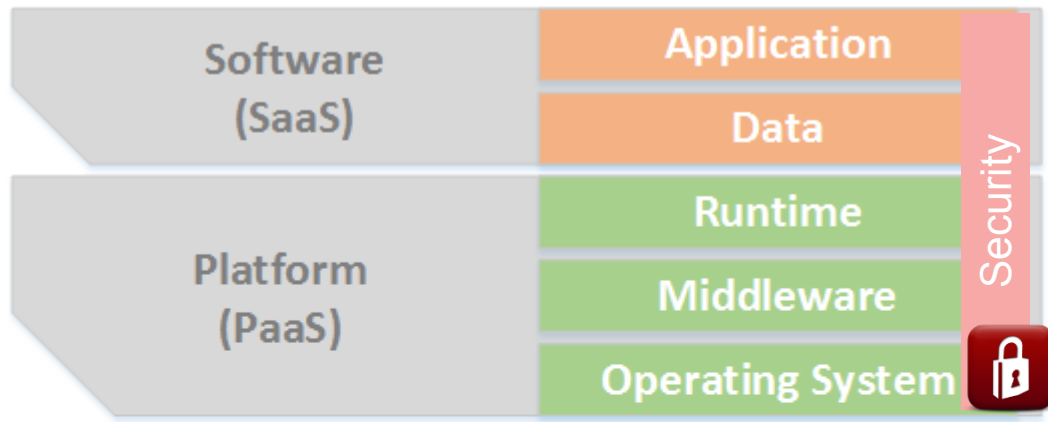
- ✓ FedRAMP
- ✓ ISO 27001
- ✓ SOC1/2/3
- ✓ FIPS 140-2
- ✓ HITRUST
- ✓ Others...

- 
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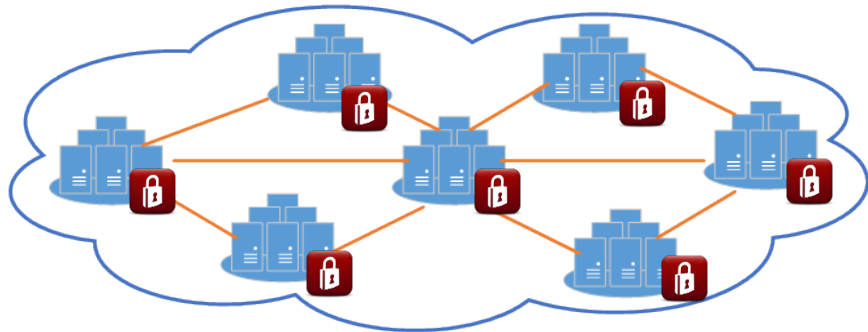


# Cloud Stack

Infrastructure, Platform, and Software as a Service



**FIPS 140-2**



- **Crypto Boundary ?**
- **Operating Environment ?**
- **Processor Types ?**
- **Hardware ?**
- **Dynamic – Elastic Platform ?**

# Security Control Families

**NIST SP 800-53**

<b>Access Controls</b>	<b>Media Protection</b>
<b>Awareness &amp; Training</b>	<b>Physical &amp; Environmental Protection</b>
<b>Audit &amp; Accountability</b>	<b>Planning</b>
<b>Security Assessment &amp; Authorization</b>	<b>Personnel Security</b>
<b>Configuration Management</b>	<b>Risk Assessment</b>
<b>Contingency Planning</b>	<b>System &amp; Service Acquisition</b>
<b>Identification &amp; Authentication</b>	<b>System &amp; Communication Protection</b>
<b>Incident Response</b>	<b>System &amp; Information Protection</b>
<b>Maintenance</b>	

## Double-digit Growth in Public Cloud to Continue

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	2015 Revenue	CAGR
<b>SaaS</b>	<b>66%</b>	<b>19%</b>
<b>PaaS</b>	<b>3%</b>	<b>33%</b>
<b>IaaS</b>	<b>31%</b>	<b>18%</b>

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**Total 2015 – 2016 Public Cloud CAGR = 19%**

Welcome to the Future...

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*By 2018, at least half of IT spending will be Cloud-based, reaching 60% of all IT infrastructure, and 60–70% of all Software, Services, and Technology Spending by 2020.*

*-IDC FutureScape: Worldwide Cloud 2016 Predictions*

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