The ArcGIS Platform: Security Practices and Policy

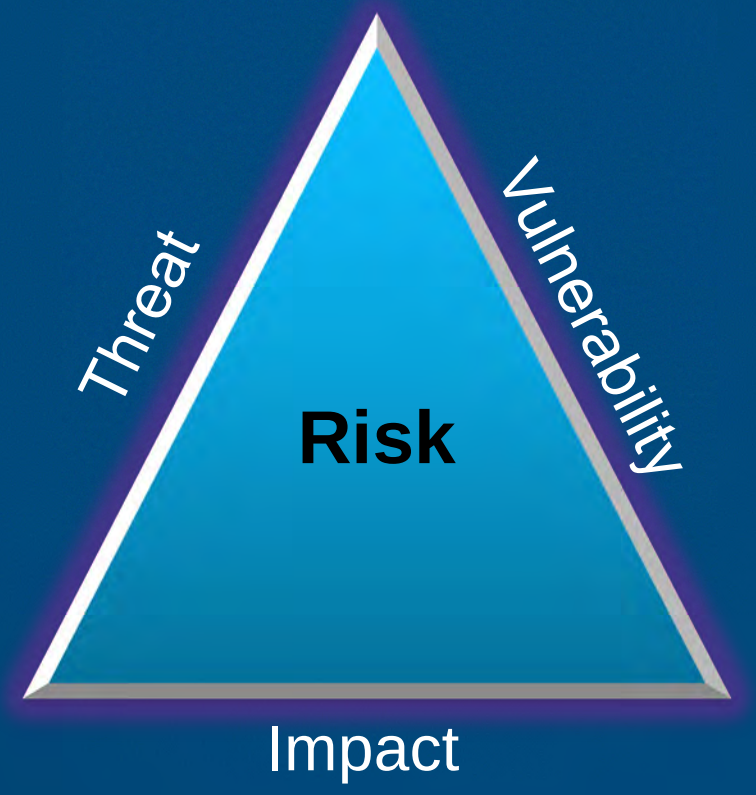
Esri Software Security & Privacy Team

Agenda

- Introduction
- Security Strategy
  - Product Based Security Initiatives
  - Solution Based Security Initiatives
- Deployment Strategy
- ArcGIS Server STIG
- Esri Managed Cloud Services (EMCS) Advanced Plus
- Summary

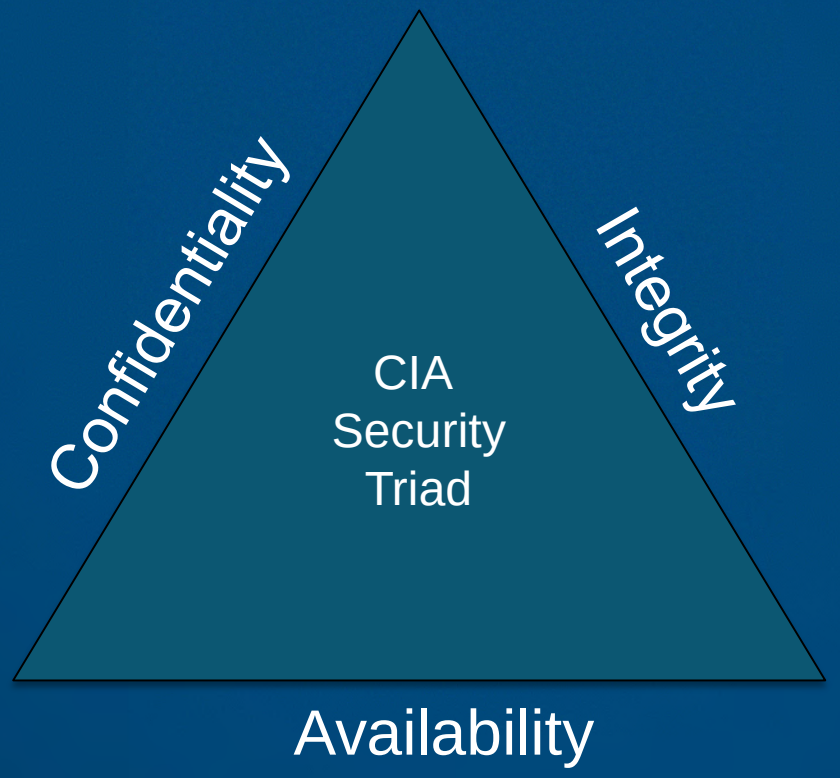
Introduction

It’s all about reducing risk



Introduction

Security Principles – CIA Triad



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Security Strategy

Security Strategy

Evolution of Esri Products & Services

Desktop GIS

Server GIS

Web GIS

Distributed Web GIS

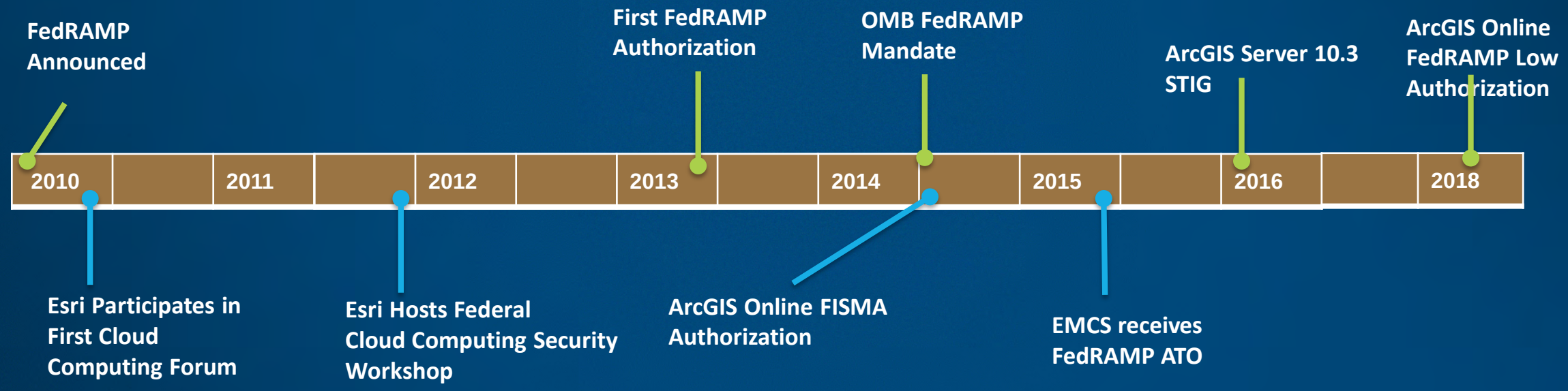
3rd Party Security

Embedded Security

Shared Responsibility Security

Security Strategy

Extensive security compliance history



Esri has actively participated in hosting and advancing secure compliant solutions for over a decade

Security Strategy

Authorization levels across products and services

- **Product Based Initiatives**
  - ArcGIS Desktop
  - ArcGIS Server
  - ArcGIS Enterprise

- **Solution/Service Based Initiatives**
  - ArcGIS Online
  - Esri Managed Cloud Services Advanced Plus

Product Based Security Initiatives

Desktop Clients

- Esri performs self-certification of desktop products
  - Ensures smooth product deployments on hardened systems

- FDCC
  - Federal Desktop Core Configuration
  - Versions 9.3-10
  - Deprecated due to Windows XP focus

- USGCB
  - United States Government Configuration Baseline
  - ArcGIS Desktop Version 10.1+
  - ArcGIS Pro 1.4.1 +

Product Based Security Initiatives

ArcGIS Server – DISA STIG

- First Esri product Security Technical Implementation Guide (STIG)
  - Sponsored by government to work with DISA
  - STIG is publically accessible
  - First STIG Windows 2008/2012R2 ArcGIS Server 10.3 (2016)
  - Other STIGs will be performed based on demand

- STIG usage
  - STIG input for providing a more general Server hardening guide
  - Enterprise component integration testing and best practices incorporation
  - Immediately implemented by multiple customers upon release in 2016

Product Based Security Initiatives

DISA STIG Creation Process

Planning

- Project Kickoff
- SME and Government POC Assignment
- FSO provides materials
- Detailed Process explanation

Development

- Requirements Analysis Checkpoint
- Check and Fix Procedure Development Checkpoint
- SME support as needed
- Vendor Submission

Validation

- Compliance Evaluation
- STIG simulation
- Review of Vendor-provided Documents
- Attestation

Review and Approval

- FSO Internal Reviews
- Styleguide Review
- MAE Briefing
- MAE Approval
- Vendor Notification
- STIG publication

STIG Approved by DISA

Product Based Security Initiatives

ArcGIS Server – Awareness of Relative Risk

- **Security hardening best practices provide insights into relative risk of different services, and optional mitigation measures to reduce risk**

Relative Service Risk

Service	Capability	Default when Enabled	Security Hardened
Map	Mapping		
Map	Query		
Feature	Read		
Feature	Edit		
Feature	Sync		
Geocoding	Geocode		
Geodata	Query		
Geodata	Data Extraction		
Geodata	Replica		
Geoprocessing	Geoprocessing		
Image	Imaging		
Image	Edit		
Image	Upload		

Red = Higher Risk
Yellow = Average Risk
Green = Low Risk

Security Hardened Settings

- Map Services
  - Disable “Feature Access”
  - Disable “Mobile Data Access”
  - Disable “WFS”
  - Disable “Query”
  - Publish File Geodatabases
- Feature Services
  - Always Secure
  - Use Versioned Data
  - Disable “Sync”
  - Disable “Insert, Update, Delete”
- Geocoding Services
  - Publish File Geodatabases
- Geodata Services
  - Always Secure
  - Use Versioned Data
  - Grant ArcGIS Account Read-Only (RBDMS)
- Geoprocessing Service
  - Risk Varies by Script/Model Design
  - Limit Inputs
- Globe Service
  - Publish File Geodatabases
  - Disable “Query”
- Image Service
  - Disable “Edit”
  - Disable “Upload”

Providing new insights

Product Based Security Initiatives

Security validation and monitoring

- **ArcGIS Server and Portal security scan tool**
  - **Validates best practices**
  - **Server and Portal 10.4 +**
  - **Python script**

SS05	**Critical**	**Filter web content** enabled	Generates a list of feature services where the **filter web content** property is disabled. Disabling this property allows a user to enter any text into the input fields, which exposes the service to potential cross-site scripting (XSS) attacks. This property is enabled by default and unless unsupported HTML entities or attributes are required, it should not be disabled.
SS06	**Critical**	System folder permissions	Determines if non-default permissions are applied to the System folder in Server Manager. By default, only administrators and publishers should have access to the services in the System folder.
SS07	**Important**	REST services directory	Determines if the REST services directory is accessible through a web browser. Unless being actively used to search for and find services by users, this should be disabled to reduce the chance that your services can be browsed, found in a web search, or queried through HTML forms. This also provides further protection against cross-site scripting (XSS) attacks.
SS08	**Important**	Cross-domain limitations	Determines if cross-domain requests are limited to specific domains. To reduce the possibility of an unknown application sending malicious commands to your web services, it is recommended to restrict the use of your services to applications hosted only in domains that you trust.

Solution Based Security Initiatives

ArcGIS Online

- **ArcGIS Online**
  - **FISMA Low ATO by USDA (2014)**
  - **FedRAMP Tailored Low by DOI (2018)**

- **Cloud Infrastructure Providers are ISO 27001 and FedRAMP Moderate compliant**
  - **Amazon Web Services**
  - **Microsoft Azure**

Solution Based Security Initiatives

ArcGIS Online Assurance Layers

AGOL SaaS
FISMA Low
(USDA)

Cloud Provider
ISO 27001
SSAE16
FedRAMP Mod

Customer

Esri

Cloud Providers

Web App Consumption

ArcGIS Management

Web Server & DB software

Operating system

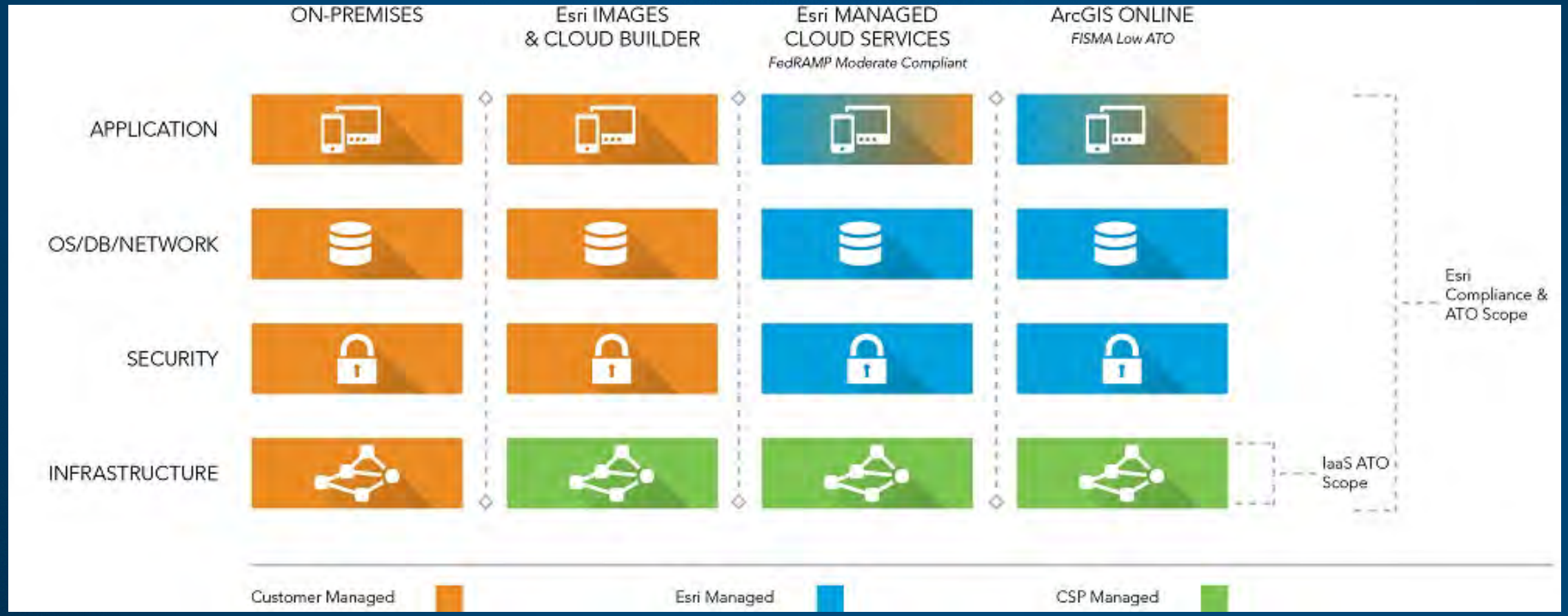
Instance Security Management

Hypervisor

Physical

Solution Based Security Initiatives

Cloud deployment model responsibility



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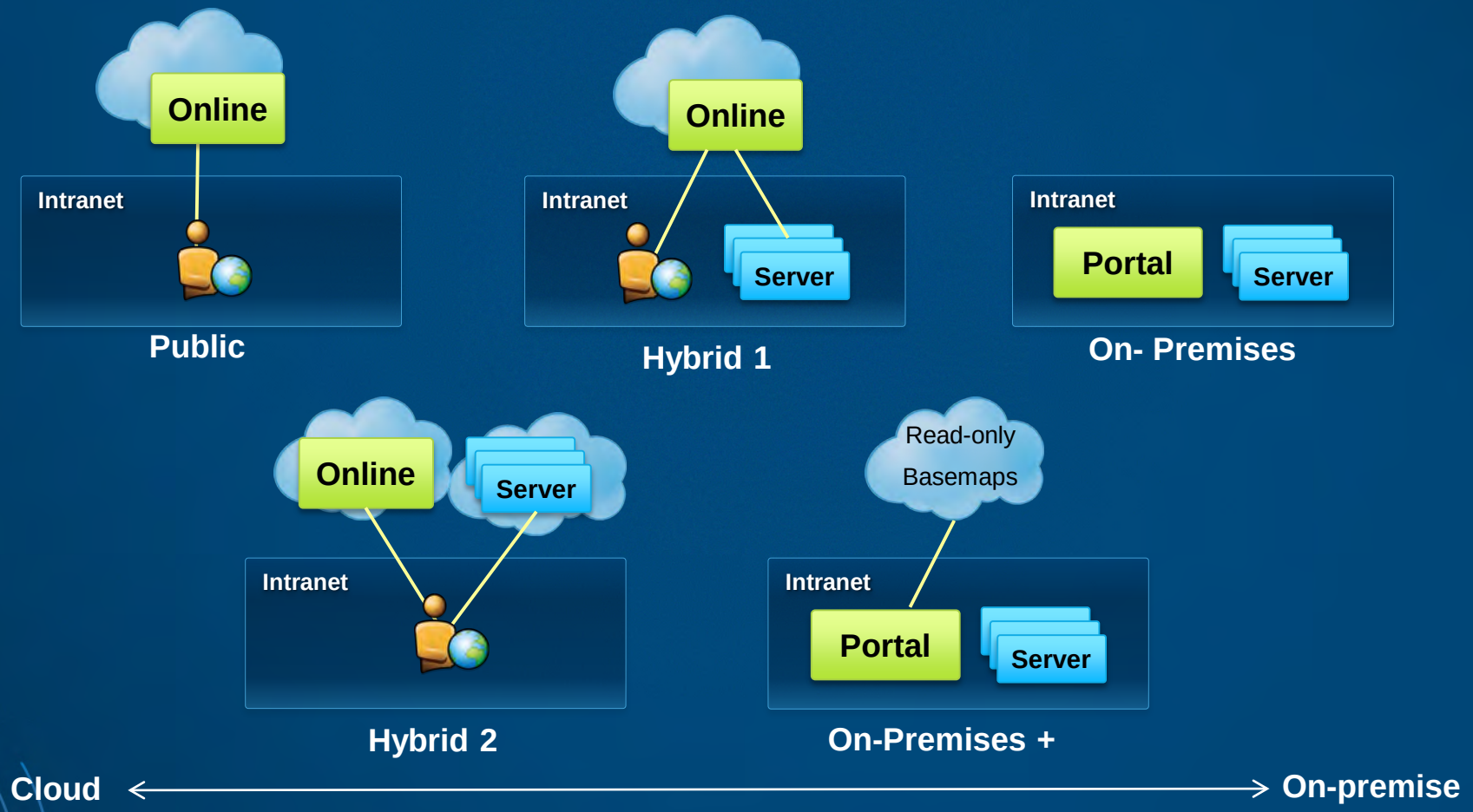
Deployment Strategy

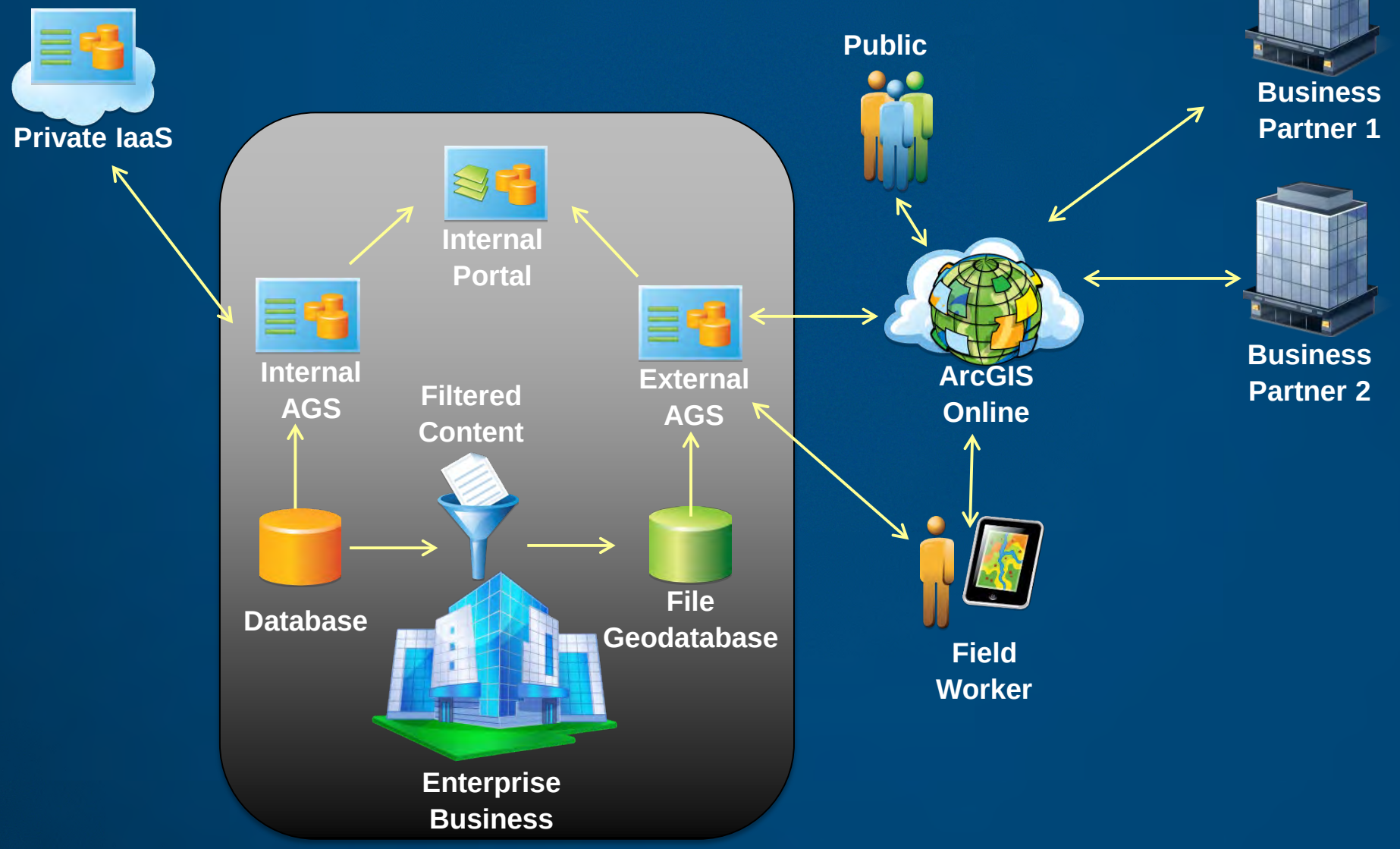
Deployment Strategy

Deployment Models



Deployment Strategy

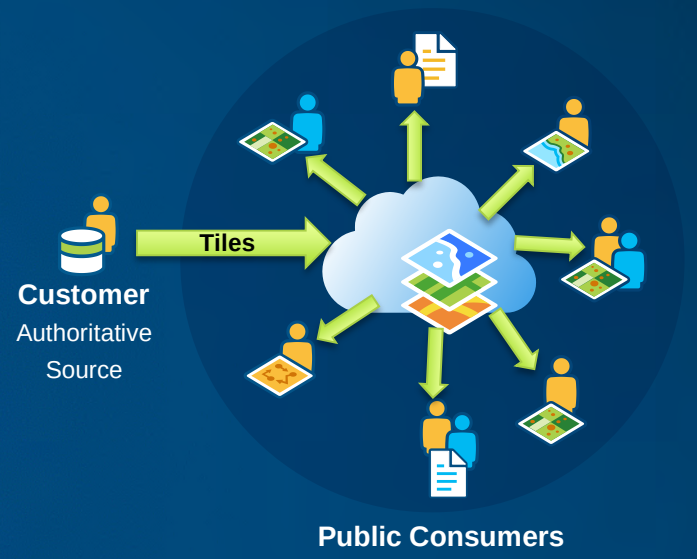
Real Permutations



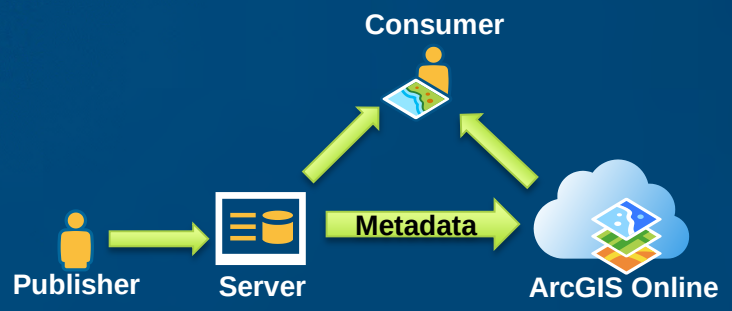
Deployment Strategy

ArcGIS Online Accreditation Use Cases

- **Use Case 1 – Public Dissemination**
  - Publish tiles for fast, scalable visualizations
  - Share information with the public
  - Can be used for mashing up services with external sites



- **Use Case 2 – USG Internal Operations**
  - Hybrid deployment of ArcGIS Server and ArcGIS Online
  - Share operational data within or between organizations
  - Sensitive data maintained on customer premises or other accredited environment
  - ArcGIS Online operates as a discovery portal
  - Utilize Enterprise Logins

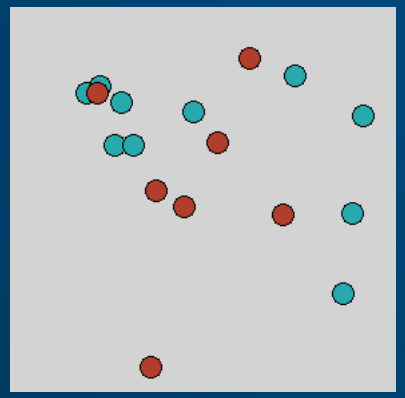


Deployment Strategy

Hybrid – How does it work?

- **Where are internal and cloud datasets combined?**
  - At the browser
  - The browser makes separate requests for information to multiple sources and does a “mash-up”
  - Token security with HTTPS (TLS) or even a VPN connection could be used between the device browser and on-premises system

On-Premises Operational Layer Service

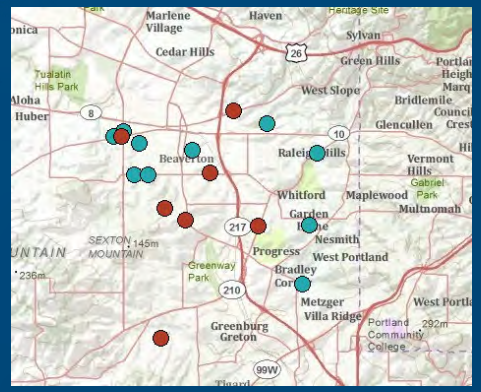


https://YourServer.com/arcgis/rest...

Cloud Basemap Service ArcGIS Online

https://services.arcgisonline.com...

Browser Combines Layers



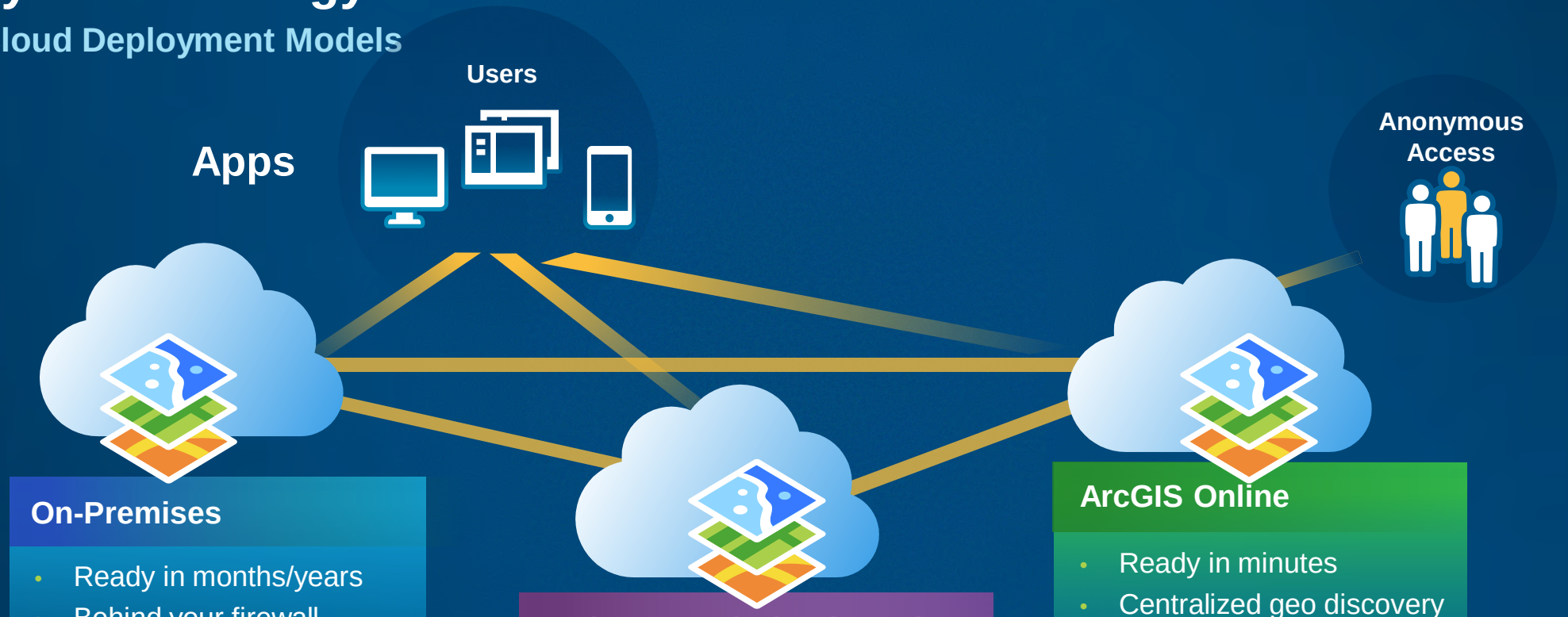
Deployment Strategy

Hybrid Deployments

- Common for large enterprises
- Data Segmentation
- Meet more stringent security and compliance requirements such as CJIS by storing sensitive datasets on-premises
- ArcGIS Online or EMCS can operate as discovery portal in the cloud

Deployment Strategy

Hybrid Cloud Deployment Models



On-Premises

- Ready in months/years
- Behind your firewall
- Your security infrastructure
- You manage & certify

Esri Managed Cloud Services

- Ready in days/weeks
- All ArcGIS capabilities at your disposal in the cloud
- Dedicated services
- FedRAMP Moderate

ArcGIS Online

- Ready in minutes
- Centralized geo discovery
- Segment anonymous access from your systems
- FISMA Low

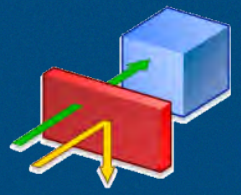
. . . All models can be combined or separate

Deployment Strategy

Key security areas to address

Authentication

Authorization



Filters

Encryption

Logging/Auditing

Deployment Strategy

Security Best Practices

- **Authentication – 2 Factor Authentication (2FA)**
  - ArcGIS Online: SAML 2.0 or built-in accounts
  - ArcGIS for Server: Web-tier Authentication
  - Portal for ArcGIS: Web-Authentication or SAML 2.0

- **Authorization – Principle of Least Privilege**
  - Role Based Access Control – Administrator, Publisher, and User
    - Custom Roles in Portal and ArcGIS Online
  - ArcGIS for Server – Service level authorization set by publisher/admin roles
  - ArcGIS Online and Portal – Item level authorization set by item owner
  - Can be extended by third party components
    - Database level: Row or Feature Class Level, SDE Views
    - Web Server level: URL filtering
    - Service level: Layer / Attribute level authorization

Deployment Strategy

Security Best Practices

- **Filters – Security Infrastructure**
  - Web Application Firewall (WAF), Anti-virus, firewalls, reverse proxies, …
  - Intrusion Detection Systems (IDS)
- **Encryption**
  - In-transit – supported across products
    - Use strong protocols (TLS) and ciphers
    - IPSec with corporate VPN
  - At-rest
    - Database level: Transparent Data Encryption (TDE)
    - File based: Operation System Level (such as Bitlocker), Disk-level
- **Logging and Auditing**
  - Logging should be done and reviewed across application, OS, database, firewall, and other layers
  - Consolidate with a SIEM

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STIG Highlights

STIG Implementation Approach

ArcGIS Server STIG

- **+ Windows 2012 R2 Member Server STIG**
- **+ IIS 7.0 STIG *Concepts* (Applied to 8.x)**
- **+ ArcGIS Server 10.3x STIG**

Contact SoftwareSecurity@esri.com for Assistance/Guidance

Inherited Controls

ArcGIS Server STIG

- **Windows Server 2012 / 2012 R2 Member Server STIG**
  - **Enforce DoD Approved Encryption Algorithms (FIPS 140-2)**
  - **Implement Organization Approved Certificates (PKI)**
  - **Integrate with Central Authentication (Active Directory/LDAP)**
  - **Multifactor Authentication (Smartcards)**
- **IIS 7.0 STIG *Concepts* (Applied to IIS 8.5)**
  - **Web Tier Authentication (HTTP/PKI)**

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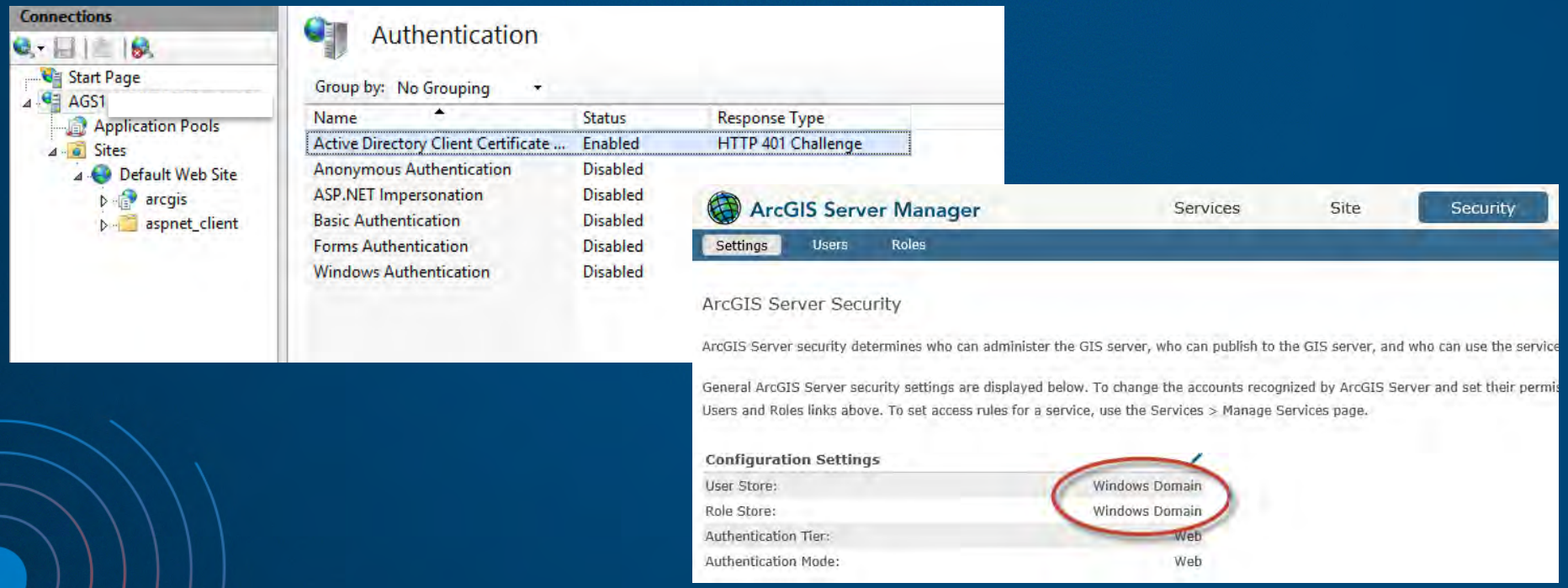
AC (Access Control)

ArcGIS Server STIG

- Enforce DoD Approved Encryption Algorithms (FIPS 140-2)
- Implement Organization Approved Certificates (PKI)
- Integrate with Central Authentication (Active Directory/LDAP)



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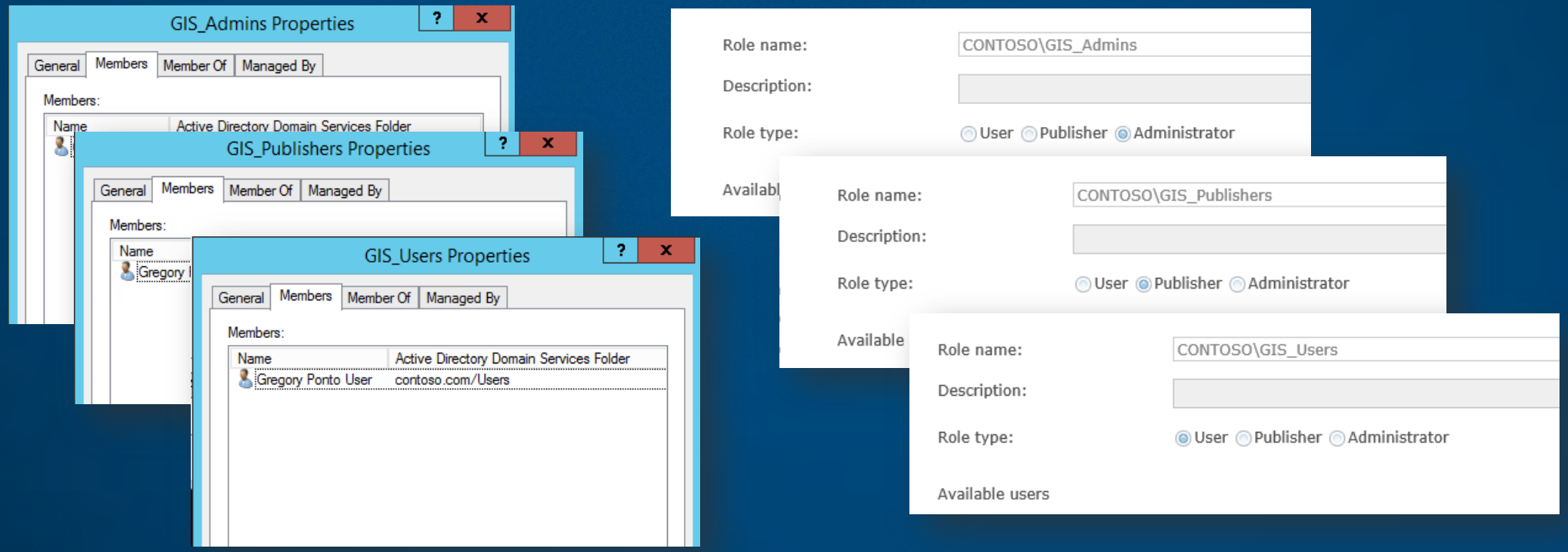
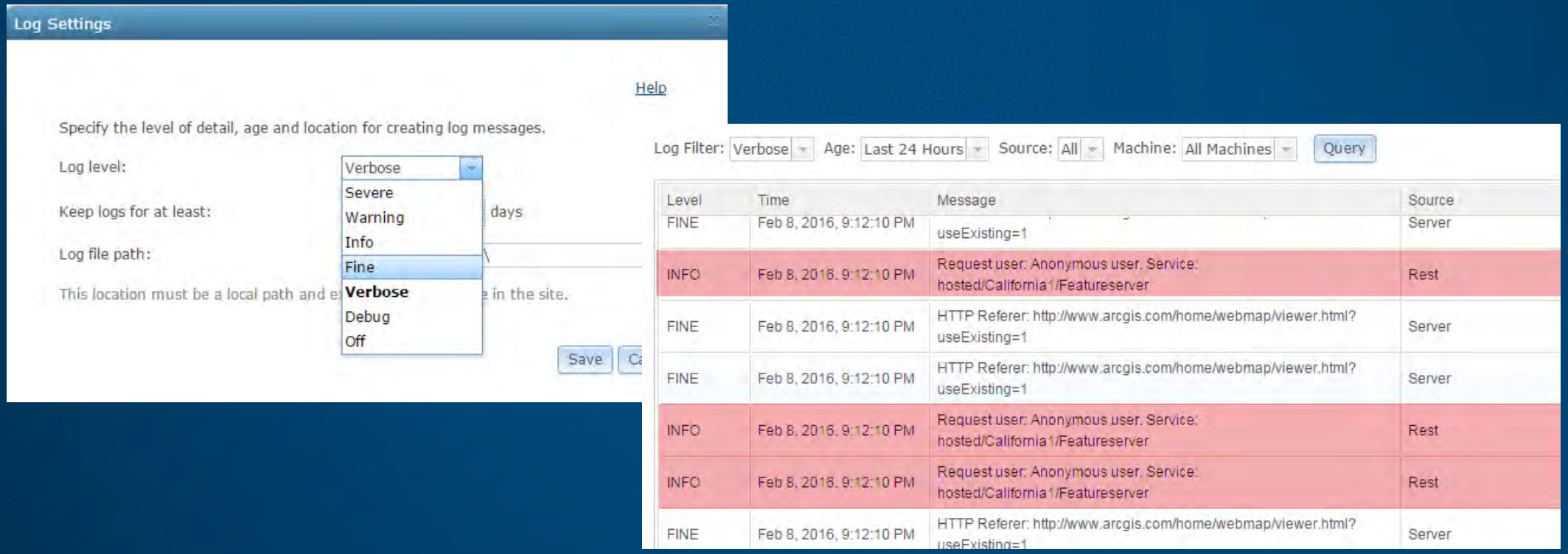


AU (Audit & Accountability)

ArcGIS Server STIG

- **Configure VERBOSE Logging with ArcGIS Server**



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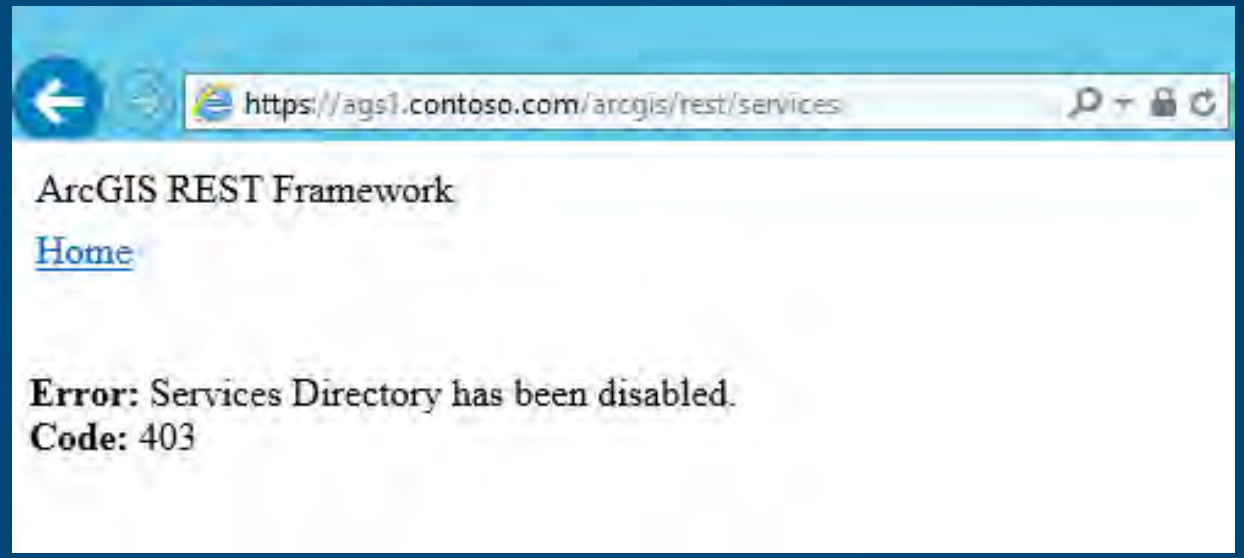
CM (Configuration Management)

ArcGIS Server STIG

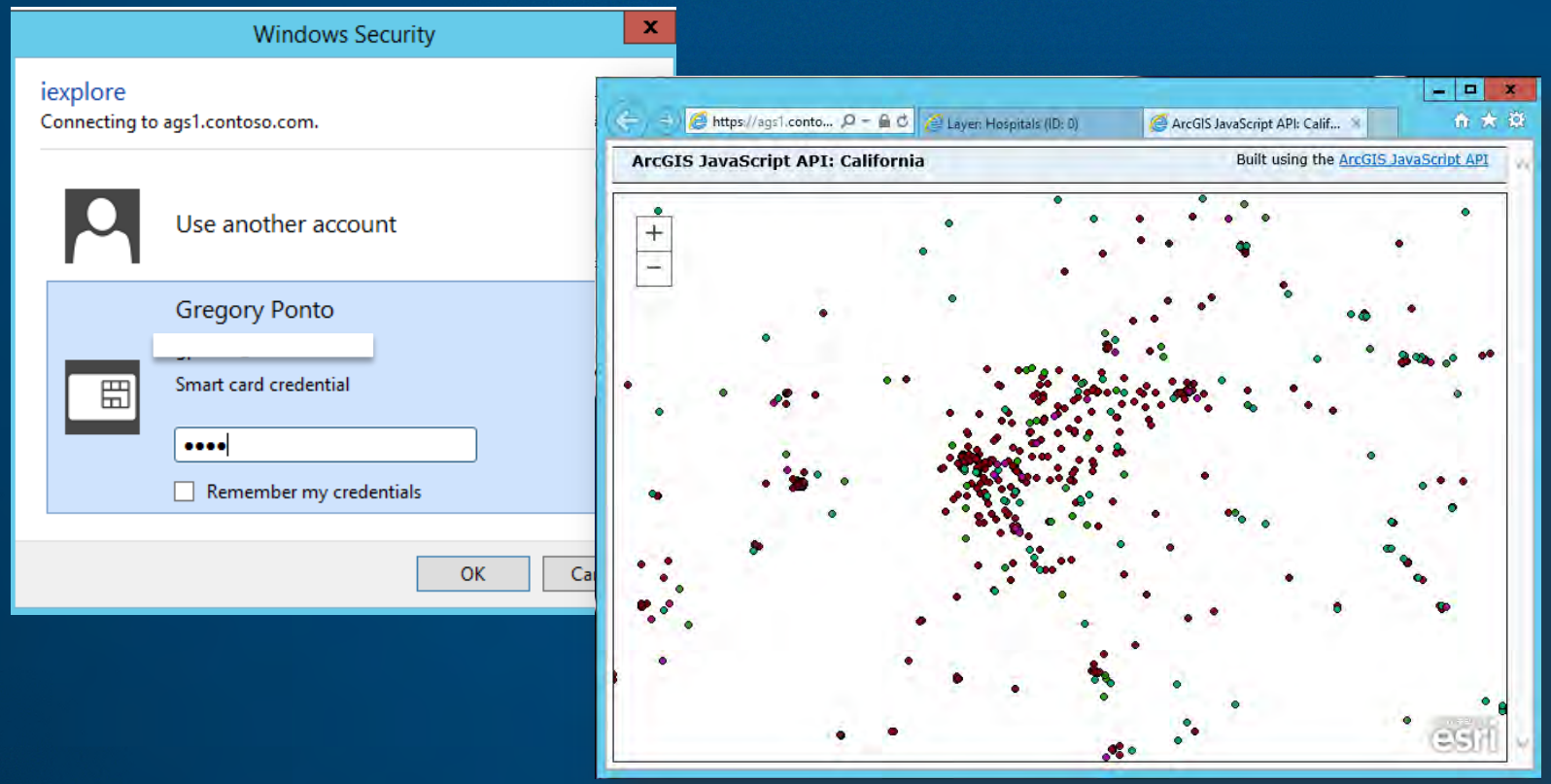
- **Disable HTTP Listener**
- **Disable REST Services Directory**



IA (Information Assurance)

ArcGIS Server STIG

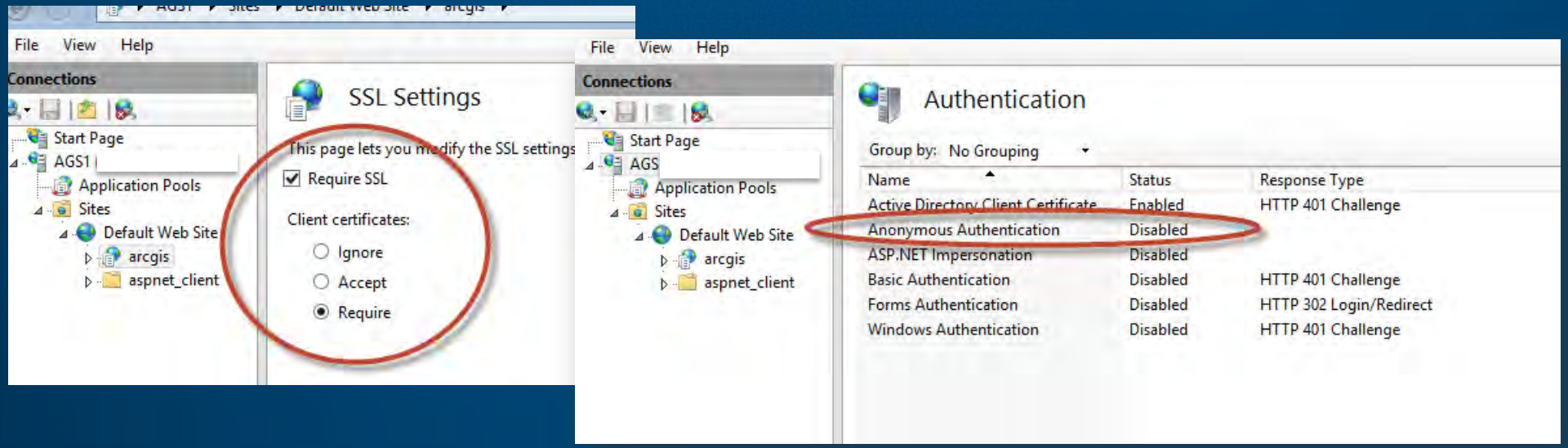
- **Require Certificate Authentication (MFA/Smartcards)**
- **Utilize Centralized Authorization (Active Directory Groups)**



IA (Information Assurance)

ArcGIS Server STIG

- Require Certificate Authentication (MFA/Smartcards)
- Utilize Centralized Authorization (Active Directory Groups)
- **Require Encrypted Web Access**
- **Disable Anonymous Web Access**



SC (System & Communication Protection)

ArcGIS Server STIG

- **Disable "Primary Site Administrator"**

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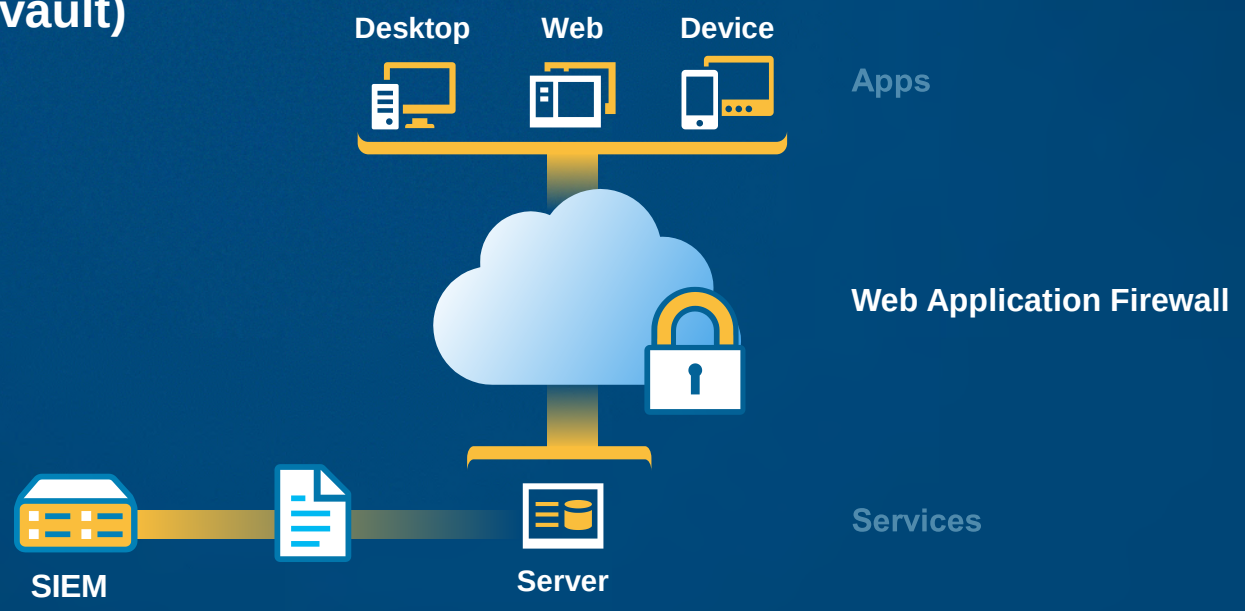
Mitigating Controls

ArcGIS Server STIG

- Access Control (AC): Endpoint Protection
  - Web Application Firewalls (eg. Barracuda, Sonicwall)
- Audit & Accountability (AU): Log Aggregation & Correlation
  - 3rd Party SIEM (eg. Splunk, Alienvault)



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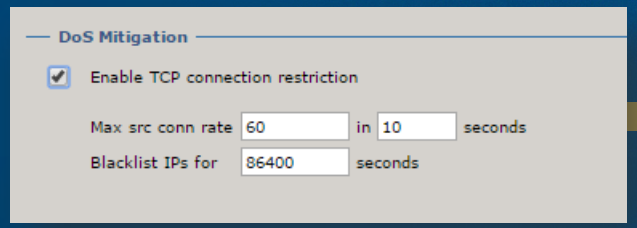
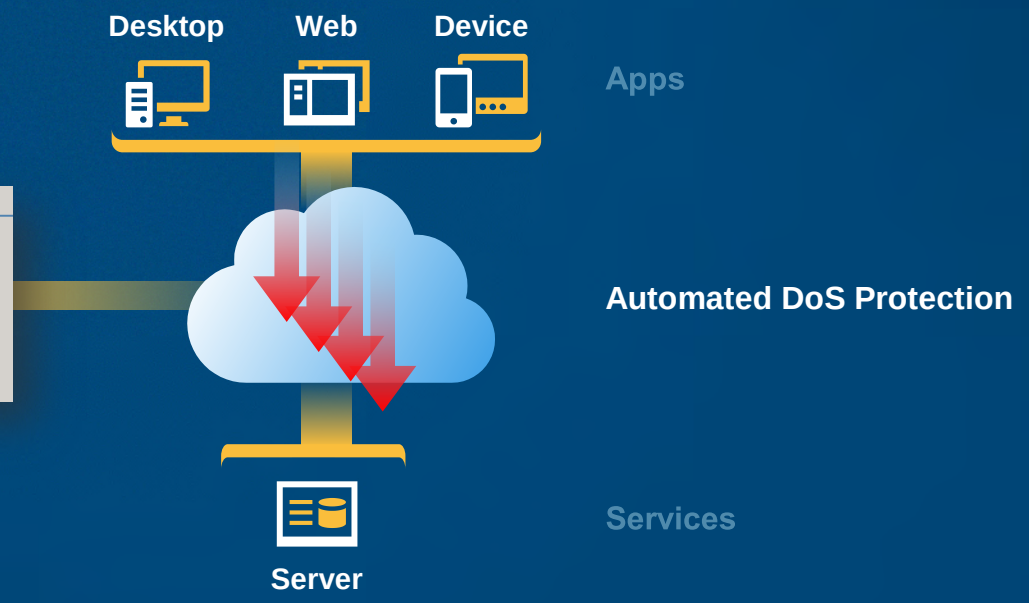
Mitigating Controls

ArcGIS Server STIG

- System & Communication Protection (SC): Mobile Code Execution
  - Client Browser Management (“Trusted Sites”)
- System & Communication Protection (SC): DoS Protection
  - DoS Protection (Automated IP Blacklist)





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Mitigating Controls

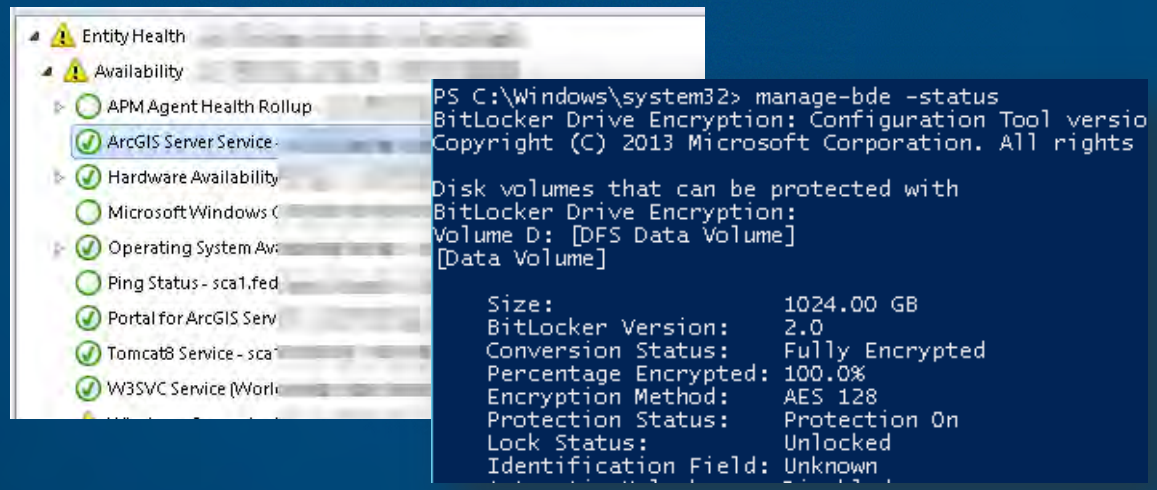
DoS/DDoS

Containment Strategy	Volumetric (Effectiveness)	Protocol (Effectiveness)	Application (Effectiveness)
Network firewalls, subnets, segmentation	High	High	Low
Scaling	Moderate	Moderate	Moderate
Report to your ISP	Varies	Varies	Low
Throttling	Moderate	Moderate	Low
Secure endpoints	Low	Low	High
Filtering (WAF)	Low	Low	Moderate-High

Mitigating Controls

ArcGIS Server STIG

- System & Communication Protection (SC): Data Protection at Rest
  - Whole Disk Encryption on Data Drives (Bitlocker, checkpoint, …)
- SI (System & Information Integrity): Automated Response to Anomalies
  - System Center Operations Manager (SCOM, Solarwinds, …)



Microsoft Bit Locker: https://technet.microsoft.com/en-us/library/ff829849.aspx
System Center Operations Manager: https://technet.microsoft.com/en-us/library/hh509025.aspx

Summary

ArcGIS Server STIG

- Inherited Controls
  - Windows 2012 / 2012 R2 STIG
  - IIS 7.x STIG Concepts
- Configurable Controls (ArcGIS Server)
  - Integrated Security (Active Directory & PKI)
  - Disable HTTP
  - Disable Services Directory
  - Enable Verbose Logging
  - Disable Primary Site Administrator
- Mitigating Controls
  - Whole Disk Encryption
  - Mobile Code Execution Management
  - Automated DoS Protection
  - Log Management (SIEM)
  - Automated Monitoring (SCOM)

Contact SoftwareSecurity@esri.com for Assistance/Guidance

Real World Deployments

Lessons Learned

- Distributed File Services
  - High Availability File Services
  - ArcGIS Server Config Store
  - ArcGIS Server Directories
  - File Data
- Group Managed Service Accounts
  - ArcGIS Server Service Account
  - Automated Password Management
- Encryption at Rest (Easy Win)
  - Whole Disk Encryption
  - Transparent Data Encryption
- Web Application Firewalls
  - High Effort / Maintenance
  - Automated Learning / Scoping

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4

Esri Managed Cloud Services Advanced Plus

Esri Managed Cloud Services Advanced Plus

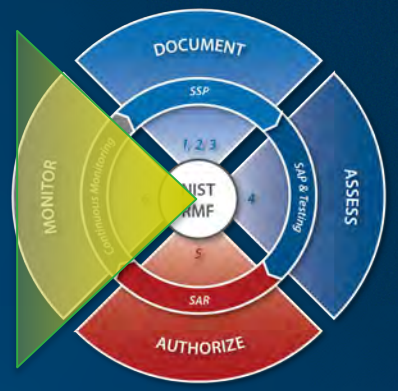
What is Esri Managed Cloud Services?

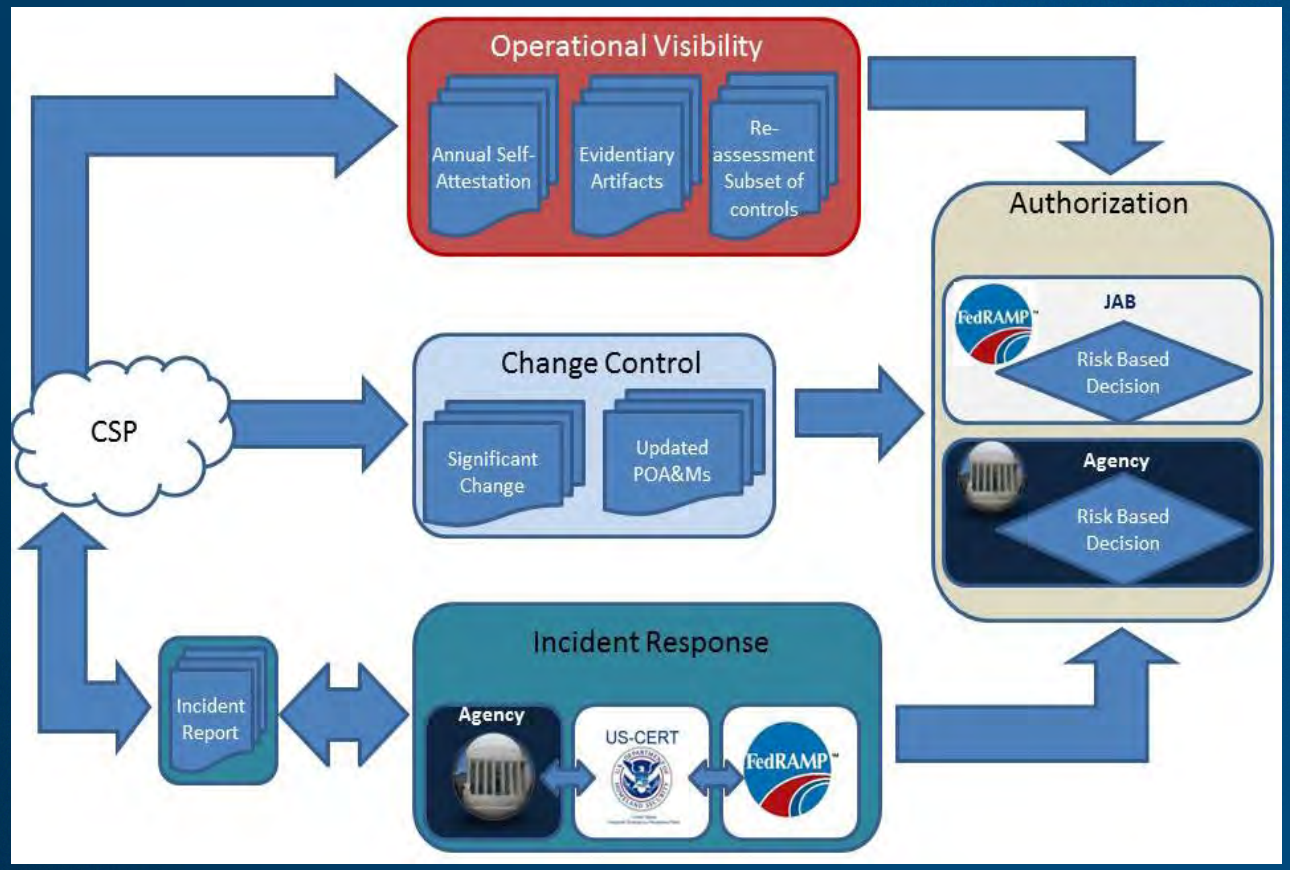
- **Cloud-based GIS infrastructure support, including:**
  - Enterprise system design
  - Infrastructure management
  - Software (Esri & 3rd Party) installation, updates, and patching
  - Application deployment
  - Database management
  - 24/7 support and monitoring

- **Advanced plus offering**
  - FedRAMP Moderate ATO by US Census Bureau
  - Security infrastructure & 24x7 SOC
  - Security controls and processes that align with FedRAMP moderate level
  - Initial offering based in AWS, looking at expanding into Azure based on demand

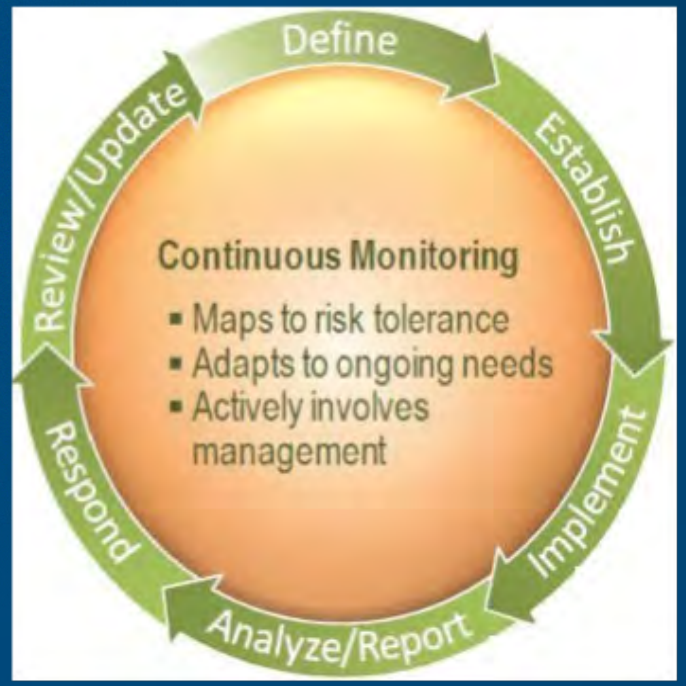
Esri Managed Cloud Services Advanced Plus

Continuous Monitoring





FedRAMP Reporting Workflow

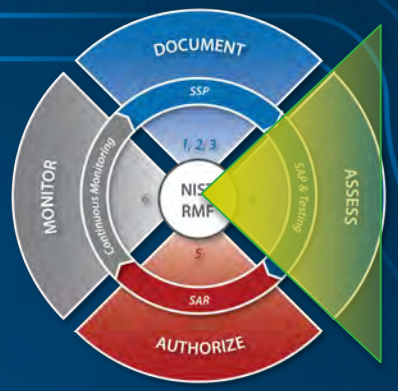


Monitoring Workflow

Ensures maintenance of acceptable risk posture

Esri Managed Cloud Services Advanced Plus

Rigorous Third Party Security Assessment



- Must occur annually
- Third Party Assessment Organization (3PAO) accredited by FedRAMP
- Documentation
  - A security review of all FedRAMP controls and implementation details
- Technical Assessment
  - System level scans
  - Web Interface scans
  - Database scans
  - Penetration testing

Great advisors and skilled assessors keep the effort focused

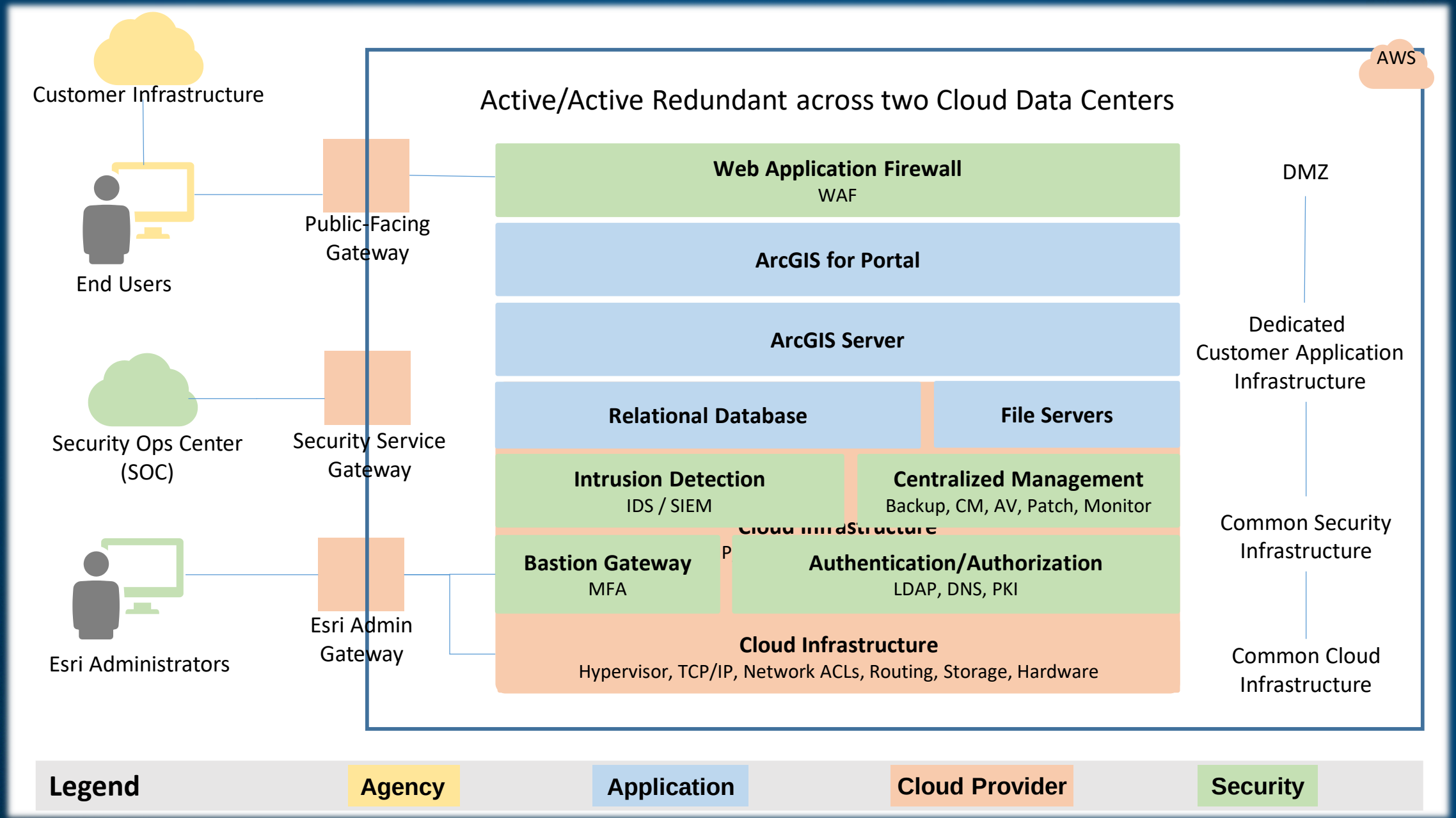
Esri Managed Cloud Services Advanced Plus

Design goals

- **Most government systems**
  - Require moderate security baseline controls
- **Most geospatial information sets**
  - Only require low baseline controls
  - ArcGIS Online FedRAMP Tailored Low is adequate for many customer use cases
- **EMCS FedRAMP Infrastructure Design Goals**
  - Consumable by the widest range of customers
    - Amazon East-West Regions – Not limited to GovCloud
  - Drive down customer expenses for secure, compliant geospatial services
    - Customer's can choose level of multi-tenancy vs dedicated services they are comfortable with
  - Meet and exceed current rigorous FedRAMP requirements for cloud services
    - First geospatial platform to be compliant with FedRAMP Rev 4 requirements

A balance of robust security and business requirements drove infrastructure choices

EMCS Security Infrastructure



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Summary

Summary

Resources Available for Agency Review

- Cloud infrastructure provider
  - SSAE16 and ISO 27001
  - Report available from cloud providers under NDA
- FedRAMP Repository
  - ArcGIS Online Compliance Package (See FedRAMP.gov Marketplace)
  - Cloud Service Provider FedRAMP Moderate Packages
- Esri
  - Reports available from Esri under NDA
  - Cloud Security Alliance (CSA) Answers Publically Available
    - ArcGIS Online answers have been updated to newest version

Summary

Solution/Services Accreditation Roadmap

- **ArcGIS Online FedRAMP Tailored Low Authorization**
  - **Agency authorization 2018**

- **Esri Managed Cloud Services (EMCS) FedRAMP Moderate Authorization**
  - **Agency Authorization 2015**
  - **Establishes validated secure clouds deployment patterns**

- **Documentation and assessment materials enable FISMA or FedRAMP authorization**

Summary

- Esri is working with security leaders to create standardized security hardened deployment guidance for our customers
- ArcGIS Online is FedRAMP Tailored Low authorized and we can work with you to support your Agency's authorization
- Esri Managed Cloud Services FedRAMP moderate compliant option ready for your agency to review and authorize
- Information readily available on Trust.ArcGIS.com

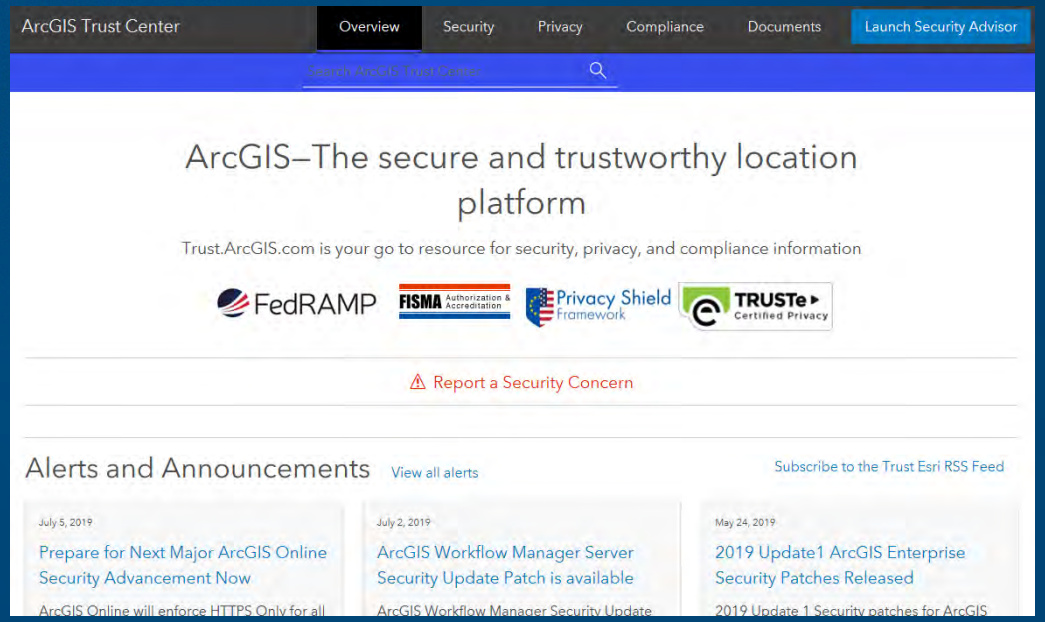
We welcome your feedback concerning any authorization needs or gaps not addressed in this presentation

Summary

We are here for you

- **Esri's Software Security & Privacy Team**
  - Led by Esri's Chief Product Security Officer consisting of Security Engineers and Architects
  - Leads Security Certification efforts across the ArcGIS Platform
  - Created and maintain Trust.ArcGIS.com as a one-stop shop for security and privacy
  - Performs security validation / testing of products and deployments
  - Utilizes all of the above as inputs for providing customer guidance such as this presentation

- **Contact our team at:**
  SoftwareSecurity@Esri.com



Questions?

Contact SoftwareSecurity@esri.com for Assistance/Guidance

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