



Secure Cloud Business Applications (SCuBA)  
Technical Reference Architecture (TRA)



# Secure Cloud Business Applications (SCuBA) Technical Reference Architecture (TRA)

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## Secure Cloud Business Applications (SCuBA) Technical Reference Architecture (TRA)

## 1 Introduction

### 2 1.1 Background

3 The Cybersecurity and Infrastructure Security Agency (CISA) leads the national effort to understand, manage,  
4 and reduce cyber risks, including by serving as the operational lead for Federal Civilian Executive Branch (FCEB)  
5 cybersecurity by providing cybersecurity tools, incident response services, and assessment capabilities. Recent  
6 cyberattacks provide ample evidence that the FCEB information technology (IT) enterprise requires continued  
7 focused efforts to protect against sophisticated attacks by nation-state actors.

8 CISA established the Secure Cloud Business Applications (SCuBA) project per its authorities granted in the  
9 American Rescue Plan Act of 2021 and the FY21 National Defense Authorization Act, P.L. 116-283. [1] [2]  
10 Under the SCuBA project, CISA will establish and configure environments for Microsoft 365 (M365) and Google  
11 Workspace (GWS). CISA will design cybersecurity architectures for M365 and GWS services by leveraging vendor  
12 native capacities as well as third-party solutions as necessary. Establishing the visibility of cloud service  
13 offerings and standing up test environments to enable selection, configuration, and testing of security  
14 capabilities affords CISA the opportunity to: (a) expand its cloud security expertise to benefit both government  
15 and critical infrastructure partners; (b) expand utilization of available cloud security related data across existing  
16 and planned security programs; (c) improve program requirements and services; (d) share the knowledge gained  
17 and lessons learned with FCEB agencies; and (e) help secure cloud business application environments across  
18 the federal enterprise.

19 The SCuBA project will address cybersecurity and visibility gaps in business applications hosted in the cloud and  
20 provide guidance to secure FCEB implementations. These gaps impact each agency's ability to manage cyber  
21 risk for its IT enterprise and CISA's ability to adequately understand and manage cyber risk for the federal  
22 enterprise. The SCuBA project will provide architecture and security configurations that offer fundamental  
23 protections for cloud business applications and give FCEB agencies and CISA the visibility necessary to identify  
24 and detect adversarial activity in their cloud environments.

### 25 1.2 Purpose

26 The purpose of the SCuBA Technical Reference Architecture (TRA) is to provide context, standard views, and  
27 terminology that incorporate and align all SCuBA efforts. The SCuBA TRA is product and vendor agnostic and is  
28 consistent with other federal, DHS, and CISA reference architectures (RAs). The SCuBA TRA is based upon the  
29 Cloud Security TRA published by CISA, the United States Digital Service, and the Federal Risk and Authorization  
30 Management Program (FedRAMP). [3] Development of the SCuBA TRA will require interagency coordination and  
31 consultation with the major Cloud Service Providers (CSPs). The SCuBA TRA should be used to inform product-  
32 specific RAs, implementation architectures, and configuration guidelines that will be developed by other SCuBA  
33 efforts.

34 A secure cloud-based business application (e.g., M365 or GWS) deployment requires a combination of  
35 application configuration, security services (provided natively with the application or by a third party), integration  
36 with existing enterprise systems, and robust operational practices. When fully developed, the SCuBA TRA will  
37 provide threat-based guidance to create a secure implementation architecture.

38 CISA will engage with FCEB agencies to facilitate data acquisition of cloud logs and telemetry for analysis and—  
39 when needed—facilitate incident response and threat-hunting activities. Simultaneously, CISA will consult with  
40 cloud vendors to identify opportunities to develop and improve solutions that provide enhanced security and  
41 support for cloud business applications used by FCEB agencies. Cloud vendors occupy a unique vantage point in  
42 the SCuBA TRA because they can identify trends and threat activities across sectors and service offerings. They  
43 can also respond to threats that may be undetectable to their tenants, and they can update their offerings to  
44 mitigate vulnerabilities and adversarial campaigns. CISA will work with agencies to address risks and maximize  
45 benefits associated with their use of cloud services.

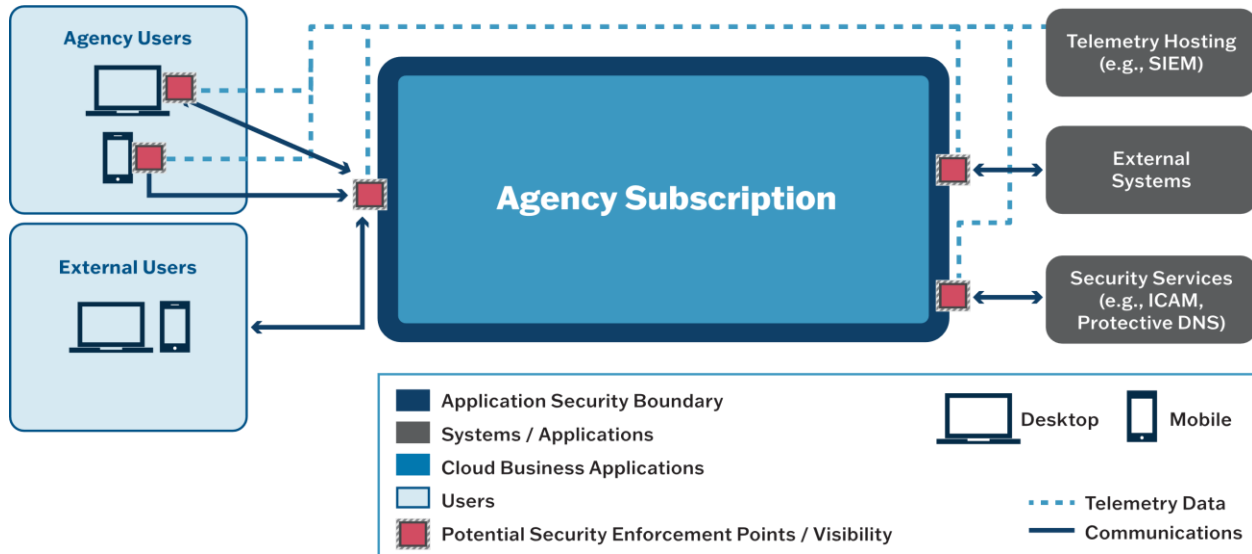
46 For SCuBA to be consistent with Office of Management and Budget (OMB) M-21-31, [4] agencies must work with  
47 CISA to implement comprehensive logging and information-sharing capabilities. This coordination includes  
48 agencies sharing telemetry and logs from their cloud business applications with CISA. Such information is  
49 necessary for CISA to have the visibility and capacity to respond to evolving cloud threats and perform effective  
50 monitoring, threat hunting, and incident response activities. In turn, CISA will share information that will allow

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51 agencies to collect, process, and analyze telemetry to fulfill their own internal security requirements, enhance  
52 their visibility, and meet mission needs.

53 **1.3 Scope**

54 The scope of the SCuBA TRA is cloud business applications, delivered through a Software-as-a-Service (SaaS)  
55 model to users, and the security services used to secure and monitor these applications. Figure 1-1 shows that  
56 agencies are responsible for securely configuring their cloud business applications and collecting the associated  
57 logs and telemetry to meet their security needs.



58  
59

**Figure 1-1. SCuBA System View**

60 **Agency Users:**

- 61 • The scope of the SCuBA TRA includes connections from campus and internet sources. Agency strategies  
62 for adopting Zero Trust (ZT) will define any changes or merging of campus and internet access.
- 63 • Agency user access is through agency endpoints. The management and security of the endpoints are  
64 outside the scope of the SCuBA TRA. Additionally, Bring Your Own Device (BYOD) is not in scope of the  
65 SCuBA TRA.
- 66 • Dedicated telephony devices, such as desktop phones using Voice over Internet Protocol or Time Division  
67 Multiplex signaling, are not in scope of the SCuBA TRA.

68 **External Users:**

- 69 • External users include both trusted business partners and the public, who use the collaboration tools for  
70 voice and video as well as document/content sharing.

71 **Agency Subscribed Cloud Business Applications:**

- 72 • The initial set of cloud business capabilities are scoped to M365 and GWS. These capabilities—which  
73 currently include Productivity, Messaging, Content Management, Collaboration, and Voice—may expand in  
74 the future. See Section 3 for more details on the scope of the cloud business capabilities.

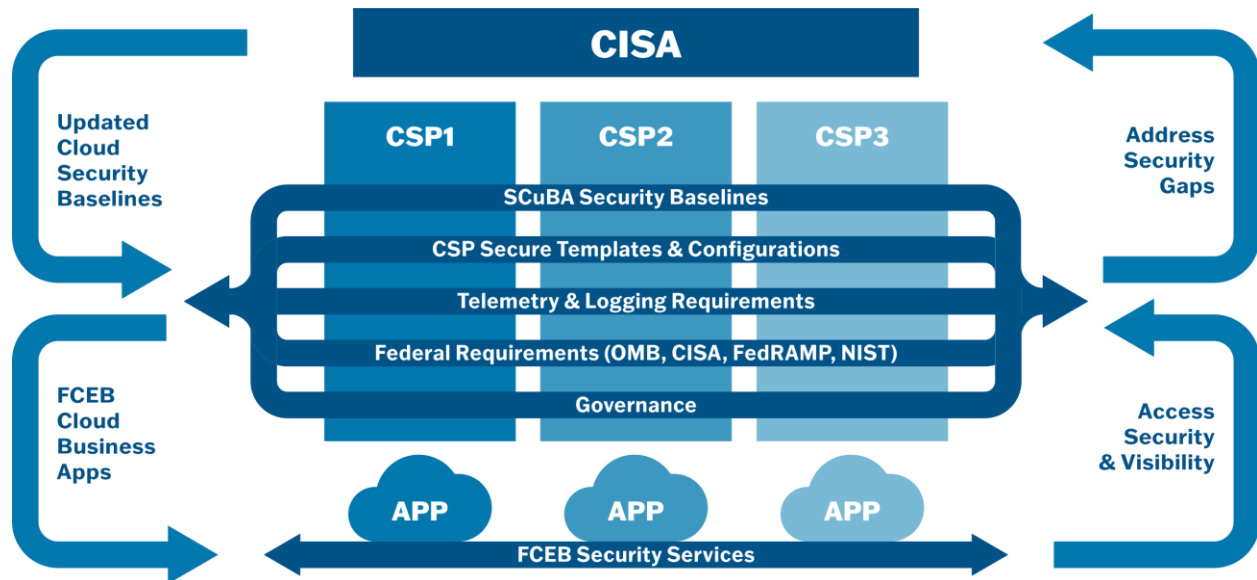
75 **2. Development**

76 Initially, the SCuBA TRA comprises input from across CISA (e.g., National Cybersecurity Protection System  
77 [NCPS], Vulnerability Management, and Continuous Diagnostics and Mitigation [CDM]), analysis and  
78 identification of cloud security guidance, applicable supporting documents (Section 4), identification of  
79 cybersecurity threats (Section 5), and necessary security capabilities to harden cloud business applications  
80 (Section 6).

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81 SCuBA TRA updates will be based on lessons learned from other SCuBA efforts, such as product-specific testing,  
 82 configuration guidance, capabilities, and instance architectures. Updates will also be informed by input from  
 83 FCEB agencies; collaborations with CSPs and commercial organizations with mature cloud implementations;  
 84 and cloud threat assessments, testing, and input from cloud application and infrastructure security Subject  
 85 Matter Experts (SMEs). Figure 2-1 shows the SCuBA iterative approach.

86



87

88

*Figure 2-1. SCuBA Iterative Approach*

89 The SCuBA TRA supports CISA's objective to keep pace with evolving technologies and capabilities. It  
 90 accomplishes this objective through the following iterative approach:

- 91 • **Building on Existing Knowledge:** CISA will build on current knowledge of CSP and SaaS offerings to provide  
 92 guidance based on understanding threats and related efforts. CISA will collaborate with the CSPs to  
 93 improve the SaaS offerings and how these interface with security services.
- 94 • **CISA Cloud Security and SCuBA Baselines:** CISA will first gather and assess feedback and lessons learned  
 95 from implementing within its own divisions, then it will deploy baselines in response to increasingly  
 96 complex mission needs. Applying SCuBA security solutions to a wide range of agencies will require iterating  
 97 on existing technologies and testing new capabilities.
- 98 • **Enabling a Feedback Loop:** As agencies deploy cloud solutions to meet mission needs, threats evolve to  
 99 leverage new tactics, techniques, and procedures (TTPs), and SaaS offerings change to reflect market  
 100 demands. A feedback loop is required to continue refinement of engineering solutions and improved  
 101 guidance on configuring SaaS offerings.

### 102 3. Definition of Cloud Business Applications

103 For the initial version of the SCuBA TRA, cloud business applications are defined as including the business  
 104 capabilities shown in Figure 3-1.

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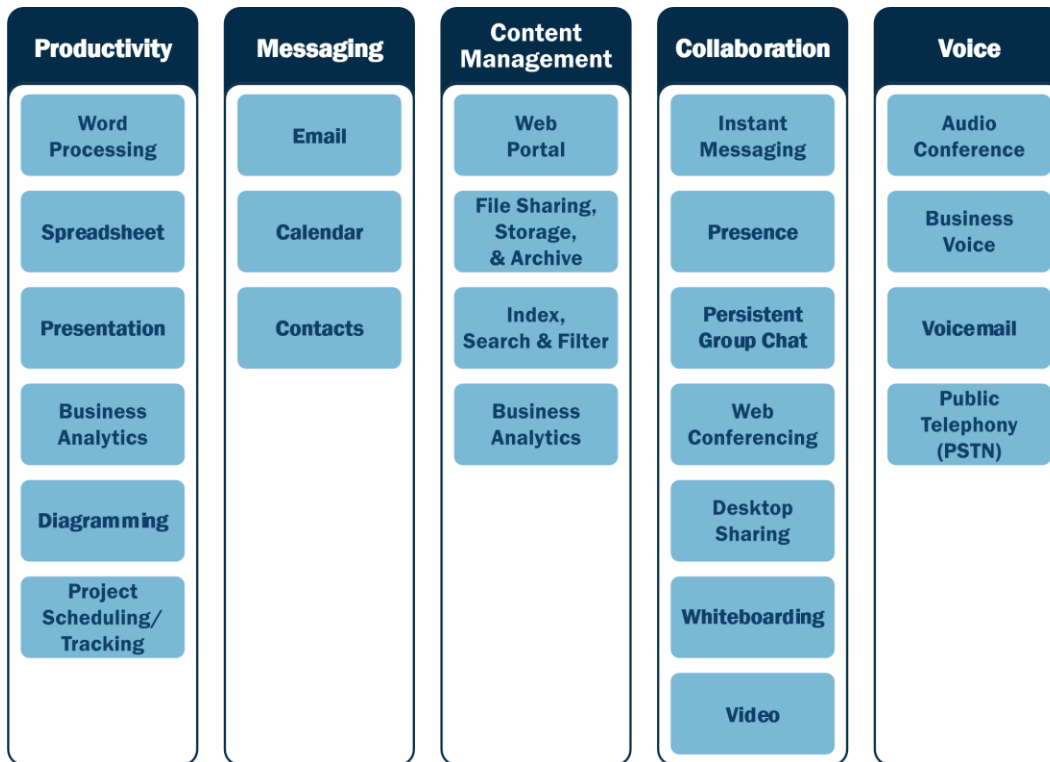


Figure 3-1. Cloud Business Capabilities

105

106

107 Figure 3-1 groups the capabilities into categories using vendor-agnostic terms (Productivity, Messaging, etc.)  
 108 based on their functions. The examples under each category are not exhaustive, but they are representative of  
 109 the scope of the functions. Each category may have similar threats and security controls, and agencies can  
 110 assess the threats and security controls necessary to protect their enterprise and provide CISA the required  
 111 visibility.

112 The categories are:

- 113 • **Productivity:** Capabilities that allow users to perform business analytics and produce documents, graphs,  
 114 spreadsheets, presentations, diagrams, project schedules, and trackers. These capabilities produce  
 115 objects that are human readable and can be shared by Messaging or Content Management capabilities.
- 116 • **Messaging:** Capabilities focused on email, calendaring, and contact management.
- 117 • **Content Management:** Capabilities for website hosting, file storage and sharing, searching, and workflows.
- 118 • **Collaboration:** Capabilities that allow for real-time text, video, and desktop sharing. Productivity capabilities  
 119 can be used as an integrated function of the Collaboration capabilities.
- 120 • **Voice:** Capabilities focused on telephone-based functions, either initiated from a phone (mobile or wired)  
 121 or to connect to the Public Switched Telephone Network (PSTN).

## 122 4. Cloud Security Guidance

123 The following subsections list cloud security guidance documents that informed the development of the SCuBA  
 124 TRA.

### 125 4.1 CISA Cloud Security Guidance

#### 126 CISA Cloud Security Technical Reference Architecture

127 The CISA Cloud Security TRA is a guide for agencies to adopt cloud technology for cloud deployment, adaptable  
 128 solutions, secure architecture, agile development, and ZT. [3] The guide discusses shared services, cloud  
 129 migration, and cloud security posture management. Various sections of the SCuBA TRA correspond to the CISA



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130 Cloud Security TRA including Identity, Credential, and Access Management (ICAM); Logging; Monitoring; and  
131 Shared Services.

### 132 ***CISA NCPS Cloud Interface Reference Architecture Volumes 1 and 2***

133 The NCPS Cloud Interface Reference Architecture is a two-volume set that explains how agencies can create  
134 reporting patterns to describe their process for providing cloud-generated security information to CISA's Cloud  
135 Log Aggregation Warehouse. Volume 1 defines general reporting patterns. [5] Volume 2 is a catalog of reporting  
136 patterns that are typical of how agencies can send telemetry from a single CSP or from multiple providers. [6]  
137 Together these two documents describe multiple options for sharing cloud telemetry with CISA but do not define  
138 specific requirements for what cloud telemetry is shared. The extensible Visibility Reference Framework (eVRF),  
139 described later in this section, will be used as a framework for CISA to define telemetry requirements.

### 140 ***CISA Trusted Internet Connections 3.0 Core Guidance and Use Cases***

141 The Trusted Internet Connections (TIC) 3.0 core guidance comprises the *Program Guidebook*, the *Reference*  
142 *Architecture*, the *Security Capabilities Catalog*, the *Use Case Handbook*, and the *Overlay Handbook*. [7]  
143 Together, these five documents can be used by agencies to develop and deploy modern architectures:

- 144 • The *Program Guidebook* outlines the TIC program and explains its history.
- 145 • The *Reference Architecture* defines the key technical concepts used to define TIC 3.0 architectures.
- 146 • The *Security Capabilities Catalog* is a library of security capabilities that will be used in TIC 3.0 use cases.
- 147 • The *Use Case Handbook* describes how agencies can create and use TIC use cases, in general.
- 148 • The *Overlay Handbook* defines how vendors can map their products and services to the TIC security  
149 capabilities.

150 Additionally, TIC 3.0 use cases contain guidance on the secure implementation and/or configuration of specific  
151 platforms, services, and environments. In accordance with OMB M-19-26, CISA has published the following use  
152 cases: (1) Traditional TIC Use Case, (2) Branch Office Use Case, (3) Remote User Use Case, and (4) Cloud Use  
153 Case (Draft). These publications contain specific guidance for agency IaaS, PaaS, SaaS, and EaaS deployments.  
154 Each TIC use case contains a conceptual architecture, risk and deployment considerations, one or more security  
155 pattern options, and security capability implementation guidance for a common agency computing scenario.  
156 Agencies can combine use cases to modernize their enterprise.

### 157 ***Continuous Diagnostics and Mitigation***

158 The SCuBA TRA will draw insight and guidance from the CISA CDM Program to provide a dynamic approach to  
159 fortifying government network and system cybersecurity. [8] The CDM Program will continue to deliver  
160 cybersecurity tools, integration services, and dashboards that help participating agencies improve their security  
161 posture. Additionally, the CDM Program is continuing to develop guidance for agencies focused on the  
162 integration of cloud platforms into CDM dashboards.

### 163 ***CISA Zero Trust Maturity Model***

164 CISA's *Zero Trust Maturity Model* is one of many roadmaps that agencies may reference as they transition  
165 toward a ZT architecture. [9] The maturity model's goal is to assist agencies in developing their ZT strategies and  
166 implementation plans. The model also presents ways in which various CISA cybersecurity programs can support  
167 ZT solutions across agencies.

### 168 ***extensible Visibility Reference Framework Guidebook***

169 The purpose of eVRF is to define the concepts, requirements, and mechanisms for CISA, FCEB agencies, and  
170 other partners to identify, collect, and evaluate cyber visibility to mitigate threats. [10] The *eVRF Guidebook* is an  
171 instruction manual for eVRF; it defines and describes key concepts, roles and responsibilities, and workflows. It  
172 identifies the demand for visibility as a unique characteristic of cybersecurity, with a structure and workflow that  
173 defines visibility for different portions of a digital environment. An eVRF workbook defines specific visibility  
174 surfaces and can be implemented with an Excel spreadsheet or a software application. The implementation of  
175 eVRF workbooks will continue to evolve over time.



## 176 4.2 Federal Cloud Security Guidance

### 177 **Federal Risk and Authorization Management Program**

178 FedRAMP provides a standardized approach to security authorizations for cloud service offerings. [11] This  
179 program provides cloud service offerings to the federal government, adopts innovative cloud services to meet  
180 agency mission needs, and acts as a third party to perform initial and periodic security assessments. The cloud  
181 business application will follow the FedRAMP authorization process to properly authorize the cloud service  
182 offering.

### 183 **OMB Memorandum: Moving the U.S. Government Toward Zero Trust** 184 **Cybersecurity Principles**

185 The OMB Zero Trust Architecture (ZTA) strategy memorandum (M-22-09) sets forth specific cybersecurity  
186 standards and objectives for agencies to fulfill as part of their adoption of ZT architectures. [12] The SCuBA TRA  
187 aligns with these objectives and standards. Agencies should consider the actions specified in the memo and  
188 their own ZT strategies when designing and implementing security for their cloud business applications to  
189 ensure they meet ZT goals.

### 190 **OMB Memorandum: Improving the Federal Government's Investigative** 191 **and Remediation Capabilities Related to Cybersecurity Incidents**

192 The OMB memorandum (M-21-31) establishes logging, log retention, and log management requirements for  
193 agencies. [4] Although its requirements are broader than cloud environments, they do apply to cloud; thus,  
194 agencies will need to ensure they continue to fulfill these requirements in deploying and maintaining their cloud  
195 business applications.

### 196 **Federal ICAM Architecture Introduction**

197 The Federal Identity, Credential, and Access Management (FICAM) Architecture Introduction describes the  
198 basics of ICAM, the FICAM architecture, and how to use the information to facilitate enterprise ICAM practices at  
199 an agency. [13] See Section 6.1 for additional information.

## 200 5. Threats to Cloud Business Applications

201 As the threat landscape constantly evolves, an authoritative source for tracking, documenting, and mitigating  
202 threats is imperative. Multiple sources for characterizing threats can be used to inform an architecture to secure  
203 cloud business applications. Threat identification sources for cloud applications are either open-source or closed  
204 source (proprietary/classified). The [MITRE ATT&CK® framework](#) will be the primary open-source taxonomy for  
205 characterizing threat sources and TTPs for SCuBA.

206 The MITRE ATT&CK matrix for SaaS and relevant vendor-specific matrices will be used to outline security  
207 threats. The MITRE ATT&CK framework is a knowledge base and authoritative source for cyber adversary  
208 behavior. The framework outlines various phases of a cyberattack lifecycle and the targets malicious cyber  
209 actors are known to exploit. ATT&CK includes only adversarial tactics and techniques based on real-world  
210 observations as of the date of the posted matrix, reducing its ability to characterize novel or emerging  
211 adversarial activities. eVRF accounts for these emerging threats by characterizing the visibility available for  
212 cloud business applications, regardless of whether specific attacker actions have been cataloged in ATT&CK.  
213 eVRF further permits mapping of those observables to the ATT&CK techniques applicable to the business  
214 applications domain. In this way, eVRF visibility surface definitions and coverage maps can identify visibility that  
215 should be available and characterize the visibility that is available within a given system, respectively. See  
216 Section 0 for additional details.

## 217 6. Securing Cloud Business Applications

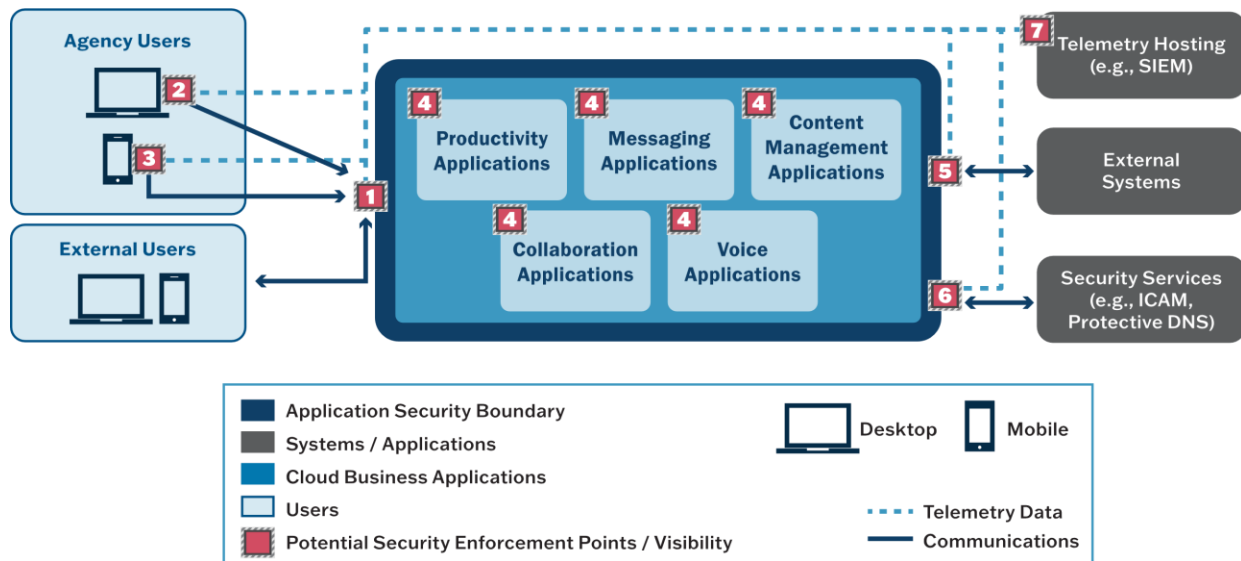
218 This section describes the essential components of security services and capabilities to secure and harden  
219 cloud business applications. These security services and capabilities prevent and mitigate vulnerabilities and  
220 threats from affecting the cloud business applications during implementation, configuration, and administration.

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221 In addition, once in place, these security services and capabilities harden the system to improve the security of  
 222 the cloud business applications and the platform where the applications are hosted.

223 The set of configurations and security services is based on the previously identified business capabilities,  
 224 threats to those capabilities, and related CISA efforts. Agency-specific implementations of these services should  
 225 adhere to their specific risk profiles and tolerances. Also, these security configurations, when monitored in real  
 226 time, serve as a proactive security approach to identify potential cybersecurity threats and help safeguard the  
 227 environment.

228 Figure 6-1 illustrates the security and visibility points for SCuBA. Each of the points maps to one or more  
 229 sections of the SCuBA TRA, as shown in Table 6-1. Additionally, from a ZT perspective, while the security of these  
 230 applications intersects with each of the pillars described in the ZT Maturity Model, the application security  
 231 boundary most closely aligns with the application workload pillar.



232 **Figure 6-1. SCuBA Security and Visibility View**

233 Table 6-1 maps the numbered security and visibility points to the sections below that cover them .

234 **Table 6-1. Security and Visibility Mapping to Sections**

235

Security Enforcement Point/Visibility	Relevant Sections
1	Section 6.2 Secure Cloud Access from Any Location
2	Section 6.5.1 Desktop Endpoint Security
3	Section 6.5.2 Mobile Endpoint Security
4	Section 6.6 Application Security Configuration
5	Section 6.3 External Email Protections Section 6.6.1 Data Sharing and Exfiltration Protection
6	Section 6.1 Identity, Credential, and Access Management Section 6.4 Protective Domain Name System
7	Section 6.7 Cyber Visibility and the eVRF Analytical Framework Section 6.8 Telemetry Generation and Processing
All	Section 6.7 Cyber Visibility and the eVRF Analytical Framework Section 6.8 Telemetry Generation and Processing Section 6.9 Shared Responsibility Model

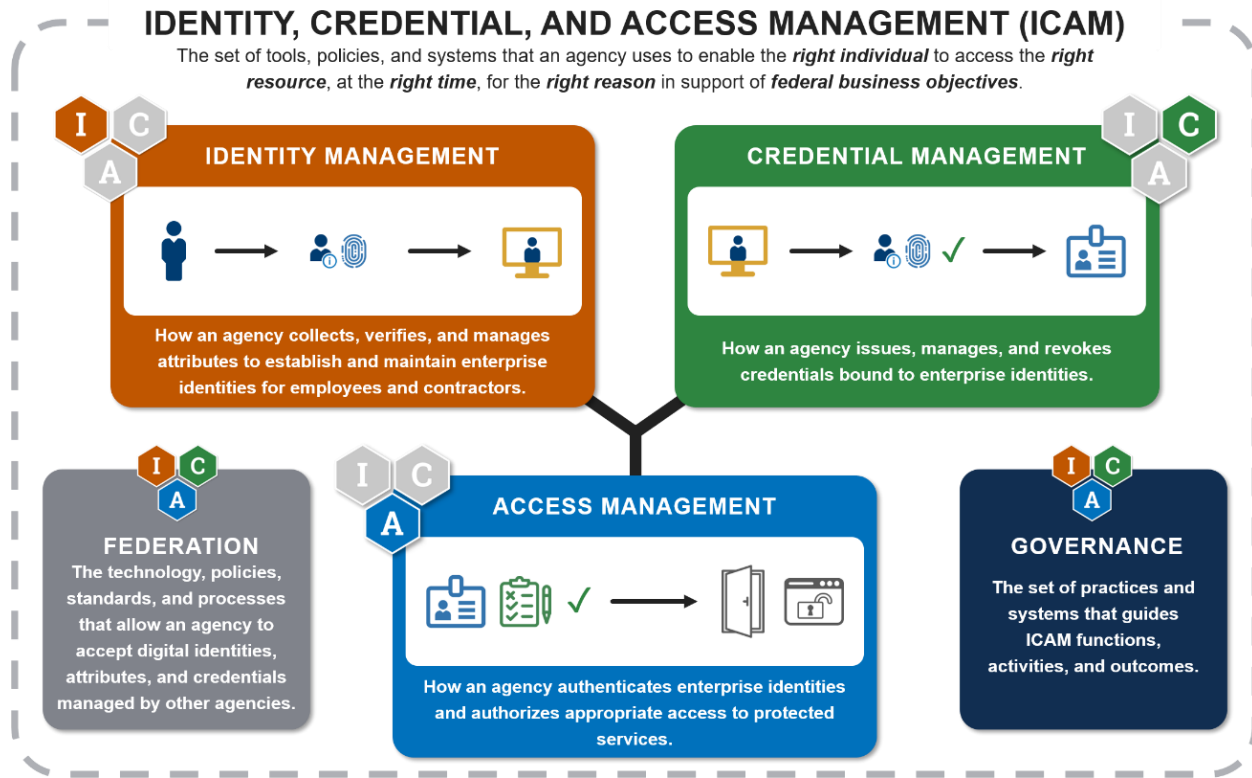
236 **6.1 Identity, Credential, and Access Management**

237 ICAM is a core tenet of ZT, and it facilitates cybersecurity risk management decisions. ICAM is the set of tools,  
 238 policies, and systems that an agency uses to enable the right individual to access the right resource, at the right

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239 time, and for the right reason, in support of federal business objectives. Government Services Administration  
 240 (GSA) provides guidance on establishing an ICAM program through the implementation of FICAM architecture  
 241 and the National Institute of Standards and Technology (NIST) Special Publication 800-63-3, *Digital Identity*  
 242 *Guidelines*. The FICAM architecture provides the overarching architecture for establishing requirements and  
 243 guidelines for an ICAM program. NIST's Special Publication 800-63-3 provides the mandatory guidelines to be  
 244 used to determine various levels of identity proofing, registration, authenticators, authentication protocols, and  
 245 federation for agencies implementing digital identity services. [14]

246 Typically, agencies have a pre-existing ICAM program such as the one shown in Figure 6-2. This infrastructure  
 247 provides central management of identities, issues logical credentials (typically personal identity verification [PIV]  
 248 cards or derived PIV credentials), and, in some advanced cases, provides central management of roles or  
 249 entitlements.



250  
 251 **Figure 6-2. ICAM Practice Areas and Supporting Elements [13]**

252 A common deployment of business applications is to federate the pre-existing ICAM infrastructure (e.g., through  
 253 Microsoft Active Directory Federated Services) with the business applications. (Various configurations are  
 254 possible, but the details are out of scope of this document.) However, because such a deployment reuses pre-  
 255 existing infrastructure, certain cybersecurity compromises of on-premises infrastructure could also pose risks to  
 256 the cloud. The FICAM architecture provides guidance to the Federal Government to design, plan, and execute  
 257 common ICAM processes. [13] FICAM recommends that only end-user accounts should be federated, and OMB  
 258 ZTA strategy (M-22-09) states administrative accounts should be authenticated using phishing-resistant  
 259 multifactor authentication.

260 An alternative architecture that is becoming more prevalent for agencies leverages a cloud-based Identity as a  
 261 Service (IDaaS) provider for authentication directly in the cloud (e.g., using a PIV-based credential). Such an  
 262 architecture adopts a shared responsibility model in which the IDaaS provider assumes responsibility for  
 263 security of key components of the platform (e.g., cryptographic material required for federation protocols) while  
 264 the agency remains responsible for secure configuration. Some responsibilities, such as monitoring for threats,  
 265 are shared between the agency, the vendor, and CISA in this model.

266 CISA recommends that agencies explore, in detail, the tradeoffs between these two models as relevant to their  
 267 existing environment and mission goals.

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268 ICAM is critical to securing a cloud application. Many parts of ICAM should be managed enterprise-wide (identity  
269 lifecycle, issuance of root credentials, and privilege role assignment, etc.). However, some parts of access  
270 management are configured specifically within the cloud business applications. This is especially true with  
271 respect to managing end-user access. One important aspect is strong administrative controls and least privilege.  
272 Policies—such as Conditional Access in M365 or Context Aware Access in GWS—enable limiting access only to  
273 authorized and up-to-date devices. Such policies should be enabled to tie together the Secure Cloud Access  
274 (SCA) and endpoint protection technologies. These policies “close the loop” by ensuring that agency data is only  
275 accessible by devices that follow the agency’s desired security posture. CISA is developing secure configuration  
276 baselines specific to cloud-native identity and access management services for M365 [10] and GWS to support  
277 these identity- and access-focused considerations.

## 278 **6.2 Secure Cloud Access from Any Location**

279 With the growth of mobile, telework, and cloud applications, traditional approaches to secure cloud access no  
280 longer meet the needs of the FCEB. The TIC program recognizes this and articulates a new model for securing  
281 access to cloud applications. The SCuBA TRA uses the TIC 3.0 guidance as the foundation for securing user  
282 access to business applications; this capability is called, "secure cloud access" or "SCA." SCA solutions should be  
283 part of agencies’ cloud business application deployment. In the broader cloud market, vendors use terms such  
284 as Zero Trust Network Access, Cloud Access Security Broker (CASB), Secure Email Gateway (SEG), Secure  
285 Access Service Edge, and others to refer to products and services that target different aspects of SCA. The  
286 broader market is rapidly evolving as these discrete solutions converge.

287 SCA solutions give users the ability to securely access the agency’s business applications that reside on a CSP.  
288 These business application users may be on the enterprise network, in a branch office, on a remote device, or  
289 on a mobile device. A non-person entity<sup>1</sup> (NPE) may also be a user of agency business applications. The SCA  
290 solution, along with the security services embedded in the destination CSP and the source workstation or device  
291 (e.g., endpoint detection and response [EDR]) follow the TIC guidance. Different use cases and security patterns  
292 may require other technical solutions. SCA security functions may be the same as, or complement, the source  
293 workstation or device and CSP security functions. For example, SCA functions may be provided by the CSP, the  
294 source workstation or device, a third-party vendor, or all of these. See Figure 6-3 for an overview graphic of a  
295 SCA concept.

296 The SCuBA TRA provides only an introduction to the SCA topic. TIC 3.0 guidance documents can provide  
297 additional information on design alternatives for different SCA use cases.

---

<sup>1</sup> NPE: An entity with a digital identity that acts in cyberspace but is not a human actor. This can include organizations, hardware devices, software applications, and information artifacts. Source(s): [CNSSI 4009-2015](#) from [DHS OIG 11-121](#).

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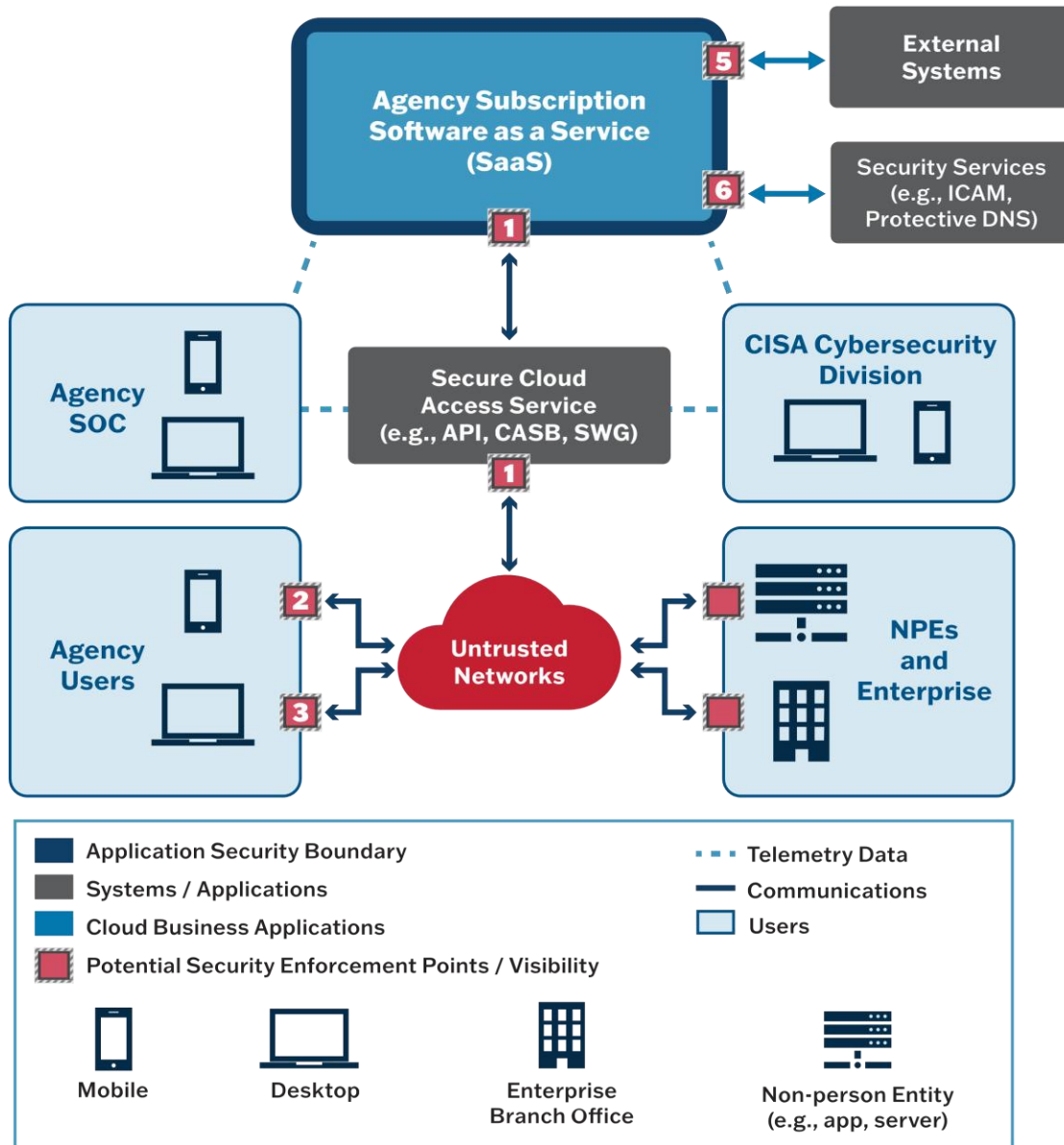


Figure 6-3. SCA Concept

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300 **6.3 External Email Protections**

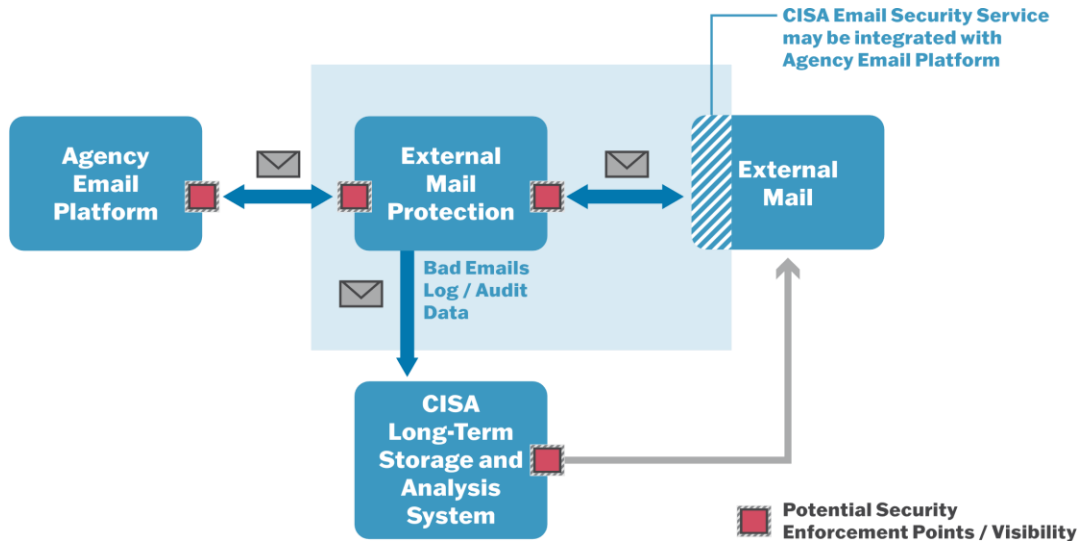
301 Email is often used as an entry point to agency environments, as shown in Figure 6-4. It is used by adversaries  
 302 for delivering both phishing links and malware, as seen in recent high-visibility attacks. Email-related risks are  
 303 typically addressed with a combination of native security capabilities built into the CSP's products as well as  
 304 independent third-party offerings. Historically, these capabilities for federal executive branch agencies were  
 305 provided by EINSTEIN 3 Accelerated (E3A), administered by CISA. Typically, email security solutions (whether  
 306 provided as a native security capability in a CSP offering or as a separate product) include the following:

- 307 • **Filtering and Tagging:** Email filtering of all messages (e.g., ingress, egress, internal) for detecting malware,  
 308 identifying spam, and tagging for agencies. This includes the use of both government (i.e., CISA, agency)  
 309 and commercial indicators and attributes (behavioral and reputational) for malware detection, and spam  
 310 identification and tagging for agencies, including the use of both government (i.e., CISA, agency) and  
 311 commercial indicators and attributes (behavioral and reputational).
- 312 • **Log Visibility:** Visibility into email attributes should be provided to both CISA and agency security operations  
 313 personnel.



## Secure Cloud Business Applications (SCuBA) Technical Reference Architecture (TRA)

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- **Authentication and Integrity:** Modern techniques for ensuring sending and receiving email servers are mutually authenticated and messages are not manipulated in transit. This is accomplished using Domain-based Message Authentication, Reporting, and Conformance, Sender Policy Framework, and Domain Keys Identified Mail.
  - **Additional Features:** Other key features in robust email security protections include automated indicator provisioning, threat intelligence, advanced analytics, reporting, cyber hunt support and incident response, sandboxing, detonation, and the ability to incorporate third-party security services.



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Figure 6-4. External Email Flow

323 CISA is also developing secure configuration baselines (see Section 6.6) that relate to email security. Identity-

324 related configuration requirements and baselines in development also support email security. Agencies should

325 integrate external email protections and implement secure configuration baselines for critical cloud services

326 that affect email security, such as Exchange Online, Azure Active Directory, and Google Cloud Identity.

## 327 6.4 Protective Domain Name System

328 In addition to SCA solutions that apply policy to and collect telemetry from network flows between endpoints and

329 cloud applications, domain name system (DNS) lookup provides a widely used insertion point in internet

330 infrastructure to implement cybersecurity policy and visibility. Secure DNS solutions' key capabilities include:

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- internet protocol (IP) v4 and v6 source address verification;
  - query filtration by IP, domain, subdomain, or record type;
  - auto-blockage of newly created domains, "look-alike" homoglyphs, nonstandard query structures, and known risky domains;
  - self-monitoring heuristics to gauge percentage of correctly permitted (benign) queries, correctly blocked (malign) queries, and anomalous false positives;
  - direct bypass, for use cases where crucial DNS queries must go through;
  - location blocking;
  - DNS over Transport Layer Security (DoT) and DNS over Hypertext Transport Protocol Secure; and
  - telemetry collection for both the agency and CISA (i.e., to discover outbound Command and Control traffic).

341 CISA is developing a new DNS service to replace the legacy E3A domain sinkholing functionality. Agencies

342 should deploy the CISA DNS security solution (when available) or equivalent protective DNS capabilities,

343 including customizable DNS query filtration, such as "allow," "deny" (block), "overwrite" (rewrite) response, or

344 "sinkhole" (suppression), based on domain parameters, encrypted DNS support, DoT support, DNS security

345 extensions support, and compatibility with current Internet Engineering Task Force (IETF) DNS protocol

346 extensions.

## 347 **6.5 Endpoint Security Services**

348 Managing endpoints (both mobile and desktop) is critical to securing cloud business applications and to support  
349 a ZT approach. Although mobile security is not within the scope of the SCuBA project itself, it is expected that  
350 agencies will need to deploy and configure their cloud business applications to enable access from their mobile  
351 and desktop devices.

### 352 **6.5.1 Desktop Endpoint Security**

353 SCuBA relies upon endpoint security technologies for both policy and visibility. The cloud business application  
354 access policies should be configured to limit access to agency data based on host posture assessment (see  
355 Section 6.6). In other words, the policies should enforce that all sensitive data requests come from agency-  
356 managed devices that comply with agency endpoint security policies, such as operating system version and  
357 patch level (or devices explicitly authorized by risk-based policy decisions supporting mission needs). EDR  
358 products can be used to collect the signals necessary for these policy decisions to be made and to provide  
359 critical visibility into the endpoints that enable cybersecurity response.

360 Agencies should leverage the CDM Program to obtain and deploy EDR technologies in their environment.  
361 Additionally, the cloud business application should be configured to leverage signals from the EDR products to  
362 govern access to private agency data.

363 Endpoints not managed by the agency, such as those of guests, collaborators, partners, customers, or even  
364 agency users' personal devices, will have limited opportunities for agency policy enforcement or evaluation. The  
365 breadth of access to agency data should reflect this limited insight by reducing or even prohibiting access to  
366 sensitive information.

### 367 **6.5.2 Mobile Endpoint Security**

368 Similar access policies should also be configured for agency-managed mobile endpoints. To protect and manage  
369 mobile devices and applications, the CDM Program helps agencies deploy Enterprise Mobility Management  
370 (EMM) capabilities. [15] EMM solutions enable agencies to manage device configuration and device  
371 compliance; monitor and track devices; manage allowed mobile apps; detect and address malicious mobile  
372 apps via mobile threat defense and mobile application vetting; discover and respond to network-based attacks  
373 and vulnerable configurations; and support the issuance and life cycle management of credentials provisioned  
374 on mobile devices. Agencies' cloud business applications should be configured to leverage signals from EMM  
375 solutions in access decisions.

376 CISA also published Capacity Enhancement Guides to help enterprises and consumers improve cybersecurity of  
377 their mobile devices. [16] To support agencies as they develop their ZT plans and roadmaps, CISA developed a  
378 whitepaper titled "Applying Zero Trust Principles to Enterprise Mobility." [17] The paper describes mobile  
379 security technologies, explains how they support ZT principles, and identifies areas requiring additional work.

## 380 **6.6 Application Security Configuration**

381 As the federal government continues to move critical services to the cloud, it is imperative to ensure consistent,  
382 effective, modern, and manageable security configurations to protect all information assets in and connections  
383 to cloud services. The objective of this initiative is to move federal cybersecurity forward by helping agencies  
384 keep pace with sophisticated and determined cyber threats. At the time of this writing, the SCuBA project is  
385 developing and testing minimum viable security baselines that can be easily and quickly adopted across the  
386 federal civilian landscape. A "Security Baseline" defines a set of basic security objectives that must be met by  
387 any given service or system. (See Figure 2-1 for a visual representation of where these artifacts sit within the  
388 iterative approach to the SCuBA TRA development.)

389 A key benefit of this work is that agencies using M365 and GWS can adopt these recommended cybersecurity  
390 configurations. Maintaining and updating this guidance is essential to ensuring an acceptable and consistent  
391 security posture. These efforts are led by CISA with input and support from interested federal agencies. The  
392 baselines are also developed with an eye towards automation rather than manual repetitive tasks where  
393 possible, improving consistency in application and reducing time to deployment.

394 The baselines cover the full scope of the security architecture for SCuBA, including ICAM, collaboration, cloud  
395 access security broker capabilities, threat intelligence, detection, mitigation, cloud storage, cloud-native email



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396 service security, and cloud-native business applications. Additional baselines may be selected as CISA continues  
397 maturing SCuBA.

### 398 6.6.1 Data Sharing and Exfiltration Protection

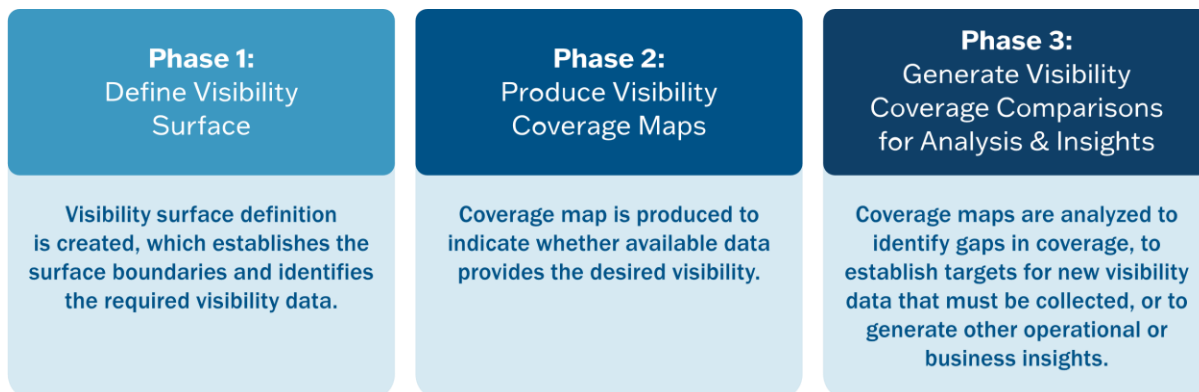
399 Another SCuBA security concern is data sharing and data exfiltration risk. Agencies must balance the need to  
400 collaborate with other stakeholders outside the agency (and thus share content, calendars, etc.) with the need  
401 to protect agency data.. At a minimum, agencies should use cloud business applications' built in rules systems  
402 to detect cross-tenant data sharing. These rules can be used to discover exfiltration of important agency data. In  
403 some cases, agencies may also choose to block cross-tenant sharing of certain types of data (e.g., share  
404 busy/free status but not documents), depending on mission requirements.

## 405 6.7 Cyber Visibility and the eVRF Analytical Framework

406 Agencies will need to collect and apply cyber visibility, both operational and technical (e.g., insights into assets,  
407 users, systems, data, events, logs), to detect potentially malicious activities associated with the use of cloud  
408 business applications. These activities include the application of key eVRF concepts. The fundamental purpose  
409 of the *eVRF Guidebook* is to define the concepts, requirements, and mechanisms for CISA, FCEB agencies, and  
410 other partners to collect and apply cyber visibility to mitigate threats. In the context of SCuBA, an applicable  
411 eVRF concept is that of the visibility surface, which is defined as "a digital environment for which cyber-  
412 observable data exists or should exist." [10] The application logs, endpoint access logs, proxy logs, service logs,  
413 reports, and alerts generated with the monitoring, auditing, and alerting services are essential parts of this  
414 digital environment and will provide evidence of malicious and benign activity. Section 6.1 identifies sources for  
415 such telemetry. Analysts from agencies, CISA, and vendors each have a unique role and associated visibility  
416 demands for telemetry from these sources that are stored in the Telemetry Hosting solution. These visibility  
417 demands will need to be accommodated when deploying and configuring services to ensure coverage. Use of  
418 the eVRF workflow can assist in characterizing visibility completeness.

419 The *eVRF Guidebook* identifies three phases of the workflow for accomplishing cyber visibility: (1) define visibility  
420 surface, (2) produce visibility coverage maps, and (3) generate coverage comparisons for analysis and insights.  
421 Figure 6-5 describes these process phases and includes a detailed description for each. The execution steps are  
422 provided in the referenced document. [10]

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**Figure 6-5. eVRF Workflow**

426 The *eVRF Guidebook* identifies roles and responsibilities for CISA, organizations (agencies), and vendors/service  
427 providers. [10] In summary, CISA has the responsibility for developing an eVRF visibility surface definition and  
428 requirements coverage map in an eVRF workbook. Agencies are to use this eVRF workbook to guide their  
429 internal policies and align with CISA's cyber visibility requirements, and vendors/service providers can work to  
430 reduce or eliminate visibility gaps in their offerings.

431 An eVRF workbook can be implemented as a purpose-built software application, using a spreadsheet or tables.  
432 Ultimately, a purpose-built software application would offer the most flexible way to create and edit a visibility  
433 surface definition and coverage maps.

434 **6.8 Telemetry Generation and Processing**

435 The quality and completeness of the visibility offered to cyber analysis is dependent upon the observation points  
 436 and telemetry-generating system components. The following subsections outline what services agencies will  
 437 need to use to ensure effective security visibility and management of cloud business applications. In  
 438 implementing these services, agencies should comply with the logging requirements issued by OMB M-21-31 [4]  
 439 and consult NIST Special Publication 800-92 [18] for additional guidance on security log management.<sup>2</sup> This will  
 440 enable agencies to collect the logs they need for their own security operations and to provide additional visibility  
 441 to CISA.

442 **6.8.1 Logging**

443 Agencies will need to configure their cloud services to generate logs for their applications to enable various  
 444 cybersecurity outcomes: improved visibility, asset management, incident response, and more. They are also  
 445 essential to fulfill many compliance requirements. By leveraging the eVRF workbook for SCuBA, agencies can  
 446 determine the necessary log data that must be collected to enable these outcomes and detect different TTPs as  
 447 well as what logs must be shared with CISA.

448 To ensure appropriate levels of visibility, logs from multiple observation points must be collected. Figure 6-6  
 449 presents an alternate SCuBA security and visibility view that emphasizes the collection of telemetry and logs.

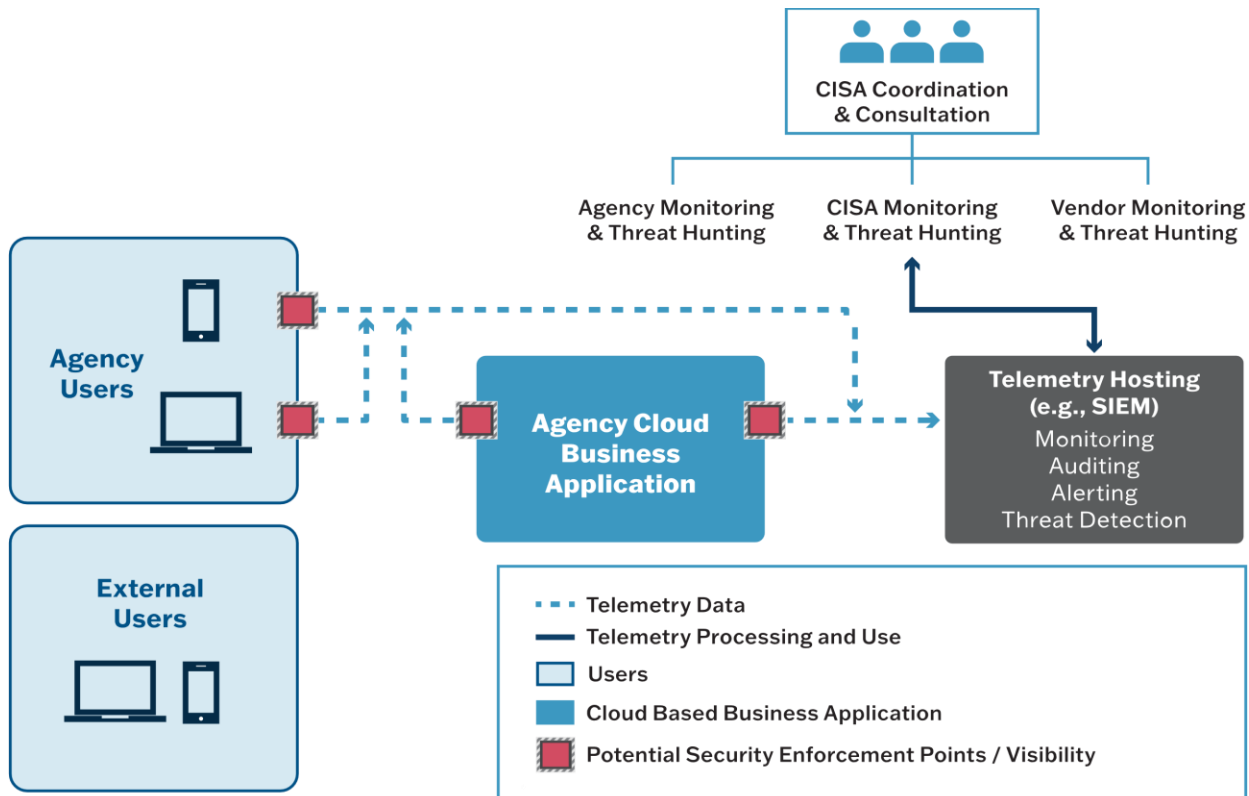


Figure 6-6. SCuBA Telemetry

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<sup>2</sup> NIST is in the process of revising the NIST Special Publication 800-92 (<https://csrc.nist.gov/Projects/log-management>).

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453 In cloud business applications, logs should be collected from each of the key building blocks previously  
454 identified:

- 455 • The SCA solution
- 456 • The endpoint solutions
- 457 • The SCuBA application platform (M365/GWS)
- 458 • The security services, such as the ICAM solution (whether on-premises or cloud-based) and the secure  
459 DNS solution

460 As shown in Figure 6-6, the telemetry and logs can be aggregated via the Telemetry Hosting solution to facilitate  
461 analysts' needs and internal agency monitoring, auditing, alerting, and threat detection activities. An eVRF  
462 visibility surface definition and OMB M-21-31 [4] logs should capture both key business events (e.g.,  
463 send/receive email, document sharing outside of tenant) as well as configuration changes (e.g., new user  
464 creation, policy updates) as both can be indicative of cybersecurity events. Logs should be generated in an  
465 automated fashion. They can be configured to capture numerous pieces of contextual information about cloud  
466 activities, accesses, and resource states; this often includes fields or attributes such as associated user ID,  
467 resource ID, Application Programming Interface (API) name, timestamp, IP addresses, etc. Specific metadata are  
468 identified in more detail in the eVRF visibility surface definition. Agencies will need to manage issues associated  
469 with scaling, retention, access, privacy, provenance, exportability, and timeliness—among other issues—of their  
470 logs as well as ensure that the logs that must be shared with CISA in real time are properly delivered as per the  
471 NCPS Cloud Interface Reference Architecture. [5], [6]

## 472 6.8.2 Monitoring

473 While some logs may be stored for record keeping and compliance purposes, others will be monitored, audited,  
474 and analyzed as part of broader agency security posture management. Agencies should therefore incorporate  
475 logs from their cloud business applications into their monitoring services to update tracking metrics, conduct  
476 resource mapping, and generate security reports, which will in turn facilitate auditing, alerting, and threat  
477 detection. The same applies for new security services deployed as part of SCuBA adoption.

## 478 6.8.3 Auditing

479 Agencies should conduct further analysis of their application logs and security reports through security auditing.  
480 This can address various contextual questions for a potential event, such as which users, processes, services, or  
481 applications were involved; what was done; where it took place; when it occurred and over what time period;  
482 how it occurred; and the impacts. Auditing services allow agencies to better understand what is happening  
483 within (and to) their cloud environments and ensure they are operating as desired. This is a more labor-intensive  
484 process than automated monitoring and report generation, as it typically involves a human policy decision point  
485 (as opposed to a technology policy decision point). Periodic audits can further seek to discern not only whether  
486 given transactions *can* occur, but whether they *should* occur in normal operating conditions and states. The  
487 additional review of organizational visibility (i.e., the awareness of business functions, priorities, risks, and  
488 collaboration agreements) enhances auditor precision and can provide further insights to an agency.

## 489 6.8.4 Alerting

490 Agencies should create alerts for their business applications that automatically generate based on their  
491 monitoring and auditing data. Alerts will enable agencies to quickly identify various issues with business  
492 applications, such as misconfigurations, unauthorized access, and privilege changes, as well as other  
493 anomalous activities for review and remediation. Such alerts will represent the result of defects or heuristically  
494 derived detections and should be given preferential treatment in analysis tools and dashboards (with respect to  
495 the raw data used to generate the alerts). Agencies should integrate these alerts into their existing Security  
496 Operations Center (SOC) procedures and leverage their existing Security Information and Event Management  
497 (SIEM) and Security Automation, Orchestration, and Response (SOAR) tooling to respond to security alerts.

## 498 6.8.5 Threat Detection

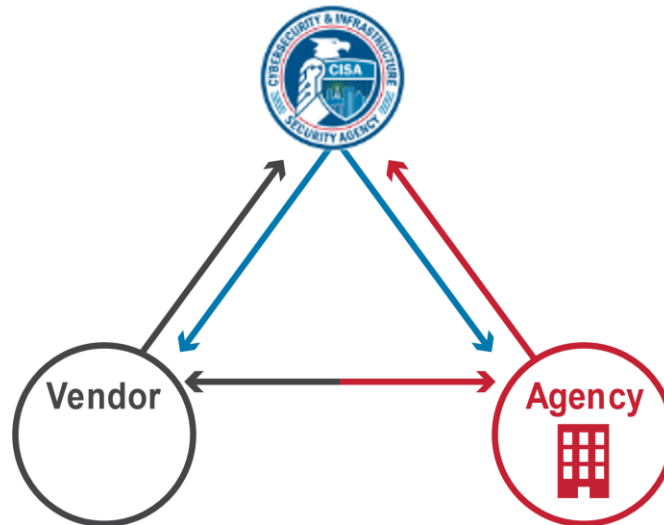
499 Agencies can leverage a variety of tools and services to detect and mitigate potentially malicious activity taking  
500 place within or against their cloud environments through business applications. These can include threats such  
501 as denial of service, data exfiltration, malware injection, unauthorized privilege escalation and account creation,  
502 etc. Threats may be detected using automated means or manual discovery. Data visualization tools and

## Secure Cloud Business Applications (SCuBA) Technical Reference Architecture (TRA)

503 dashboards can assist agency analysts in detecting threats against agency cloud business applications.  
 504 Agencies should review threat-detection services offered natively by their service provider as well as stand-alone  
 505 and third-party offerings to incorporate anomaly detection, machine learning, threat intelligence, etc., within  
 506 their threat detection capabilities for their cloud business applications. Agencies should test these services to  
 507 benchmark fidelity in the alerts generated and latencies in detection. Agencies should also update their logging,  
 508 monitoring, auditing, and alerting policies and procedures based on lessons learned from their threat detection  
 509 capabilities (i.e., to incorporate analytics for newly discovered threats, reduce false positives, and expand  
 510 visibility coverage to mitigate gaps).

## 511 6.9 Shared Responsibility Model

512 The SCuBA TRA relies on a shared responsibility model, as shown in Figure 6-7 and described in the following  
 513 subsections, between the agency, CISA, and the selected vendors. Each plays a critical role in ensuring a robust  
 514 security posture and achieving the desired security outcomes. This is true both with respect to protective  
 515 security controls as well as visibility, detection, and response.



516  
517 **Figure 6-7. Shared Responsibility Model**

### 518 6.9.1 Protective Security Controls and Services

- 519 • **Agencies:** Agencies are responsible for properly configuring their chosen cloud business application  
 520 platform in accordance with the SCuBA solution architecture documents. Agencies are also responsible for  
 521 ensuring that their SCuBA deployment leverages appropriate capabilities of their other security services as  
 522 discussed in Sections 6.1 and 6.5.
- 523 • **Vendors:** Vendors are responsible for securing the underlying SaaS platform behind the business  
 524 applications. Vendors should also offer agencies the necessary product capabilities to implement the  
 525 required security controls, including integrations with independent software vendor solutions (e.g., to  
 526 provide email security services or identity services) if necessary.
- 527 • **CISA:** CISA is responsible for defining the baseline security requirements, architectures, and configurations  
 528 necessary to realize the SCuBA vision. CISA is also responsible for developing shared services to  
 529 implement pieces of the TRA.

### 530 6.9.2 Visibility, Detection, and Response

- 531 • **Agencies:** Agencies are responsible for first-line security operations, such as alert triage and response to  
 532 limited-scope incidents. Agencies collect and retain logs per OMB M-21-31 and CISA guidelines (both the  
 533 CISA logging guidance as well as the eVRF CISA visibility requirements). Agencies can leverage CISA-  
 534 provided shared services to enhance their logging and security monitoring operations. Agencies are also  
 535 encouraged to coordinate with their vendors and/or service providers on the application of telemetry  
 536 configuration and visibility coverage map generation, which may include feature requests in future product  
 537 releases.

## Secure Cloud Business Applications (SCuBA) Technical Reference Architecture (TRA)

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- **Vendors:** Cloud business application providers can share vulnerability and breach-related information with CISA and agencies to enhance situational awareness and facilitate response activities. Additionally, vendors can identify trends and threat activities across sectors and service offerings. They can respond to threats that are undetectable to their tenants and update their offerings to mitigate vulnerabilities and adversarial campaigns. Vendors can also share information about updates and changes to their products, share guidance on how to effectively use their offerings as engineered, and provide formal instruction and training opportunities to ensure consistent understanding of product limitations and features.
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- **CISA:** CISA's duties include refining visibility requests, updating baselines, and providing response support. One of CISA's primary responsibilities is to assist agencies in threat discovery and remediation. Thus, CISA will engage with FCEB agencies to facilitate data acquisition of cloud logs and telemetry to ensure delivery aligns with CISA's preferences for timeliness, frequency, format, and other attributes, as described in the *National Cybersecurity Protection System Cloud Interface Reference Architecture Volume Two: Reporting Pattern Catalog*. [6] This telemetry will enable CISA's analysis, incident response, and threat hunting activities. CISA will engage cloud vendors to mitigate security and visibility gaps providing enhanced security for cloud business applications. CISA will also coordinate with cloud vendors to mitigate risks facing FCEB agencies' cloud services through information sharing and the deployment of security services.
- 554

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## Appendix A. Glossary

**Application Programming Interface (API):** A system access point or library function that has a well-defined syntax and is accessible from application programs or user code to provide well-defined functionality.

**Cloud Service Provider (CSP):** An external company that provides a platform, infrastructure, applications, and/or storage services for its clients.

**Continuous Diagnostics and Mitigation (CDM):** A CISA program that provides a dynamic approach to fortifying government networks and systems cybersecurity by delivering cybersecurity tools, integration services, and dashboards that help participating agencies improve their security posture.

**Domain Name System (DNS):** A system that stores information associated with domain names in a distributed database on networks. DNS translates IP addresses into human-understandable names.

**Enterprise Mobility Management (EMM):** A suite of services and technologies that enables an agency to secure the use of mobile devices (e.g., tablets, smartphones, and e-readers) per the agency's policies. Components of an EMM include mobile device management, mobile application management, and mobile identity management.

**extensible Visibility Reference Framework (eVRF):** Defines the concepts, requirements, and mechanisms for CISA, FCEB agencies, and other partners to collect and apply cyber visibility to mitigate threats. eVRF was created in response to Executive Order 14028, "Improving the Nation's Cybersecurity."

**Federal Civilian Executive Branch (FCEB):** A subset of U.S. federal departments and agencies that excludes the Department of Defense and agencies in the intelligence community.

**Identity, Credential, and Access Management (ICAM):** A fundamental and critical cybersecurity capability that ensures the right people and NPEs have the right access to the right resources at the right time.

**Internet Engineering Task Force (IETF):** A large, open, international internet standards body comprised of network designers, operators, vendors, and researchers interested in how the internet architecture evolves and the smooth operation of the internet. The IETF technical work of developing open standards through open processes is done in working groups that are organized by topic into several areas.

**Mobile Application Vetting (MAV):** Performs enterprise-level security analysis of managed apps and their libraries prior to deployment and throughout the lifecycle of the apps. Integration of EMM with MAV provides the ability for the EMM to apply mitigations (e.g., uninstall app or block access to enterprise resources).

**Mobile Threat Defense (MTD):** Helps detect the presence of malicious apps or software, malicious activity, and connections to deny-listed websites or networks. Integration of EMM with MTD provides the ability for MTD to notify the EMM of malicious apps or activity on a mobile device so that the EMM can provide mitigations.

**Multifactor Authentication (MFA):** An authentication system that requires more than one distinct authentication factor for successful authentication. Multifactor authentication can be performed using a multifactor authenticator or a combination of authenticators that provide different factors.

**Secure Cloud Access (SCA):** A subset of remote access solutions that provide the ability for a trusted user on a remote workstation to securely access the agency's business application on a cloud service provider.

**Security Information and Event Management (SIEM):** An application that is used to gather security data from across systems to facilitate monitoring, analysis, triaging, and alerting through a single interface.

**Security Operations Center (SOC):** A centralized operations center for monitoring, analyzing, detecting, and responding to security information and security incidents.

**Security Orchestration, Automation, and Response (SOAR):** A platform or collection of technologies for coordinating, defining, automating, and executing tasks to analyze and respond to security data and security incidents. This often includes threat and vulnerability management technologies, security incident response capabilities, and additional tools that enable automation across security operations.

## Secure Cloud Business Applications (SCuBA) Technical Reference Architecture (TRA)

**Software-as-a-Service (SaaS):** The capability provided to the consumer to use the provider's applications running on cloud infrastructure. The applications are accessible from various client devices through either a thin client interface, such as a web browser (e.g., web-based email) or a program interface. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, storage, or even individual application capabilities, with the possible exception of limited user-specific application configuration settings.

**Technical Reference Architecture (TRA):** A document that illustrates recommended approaches to cloud migration and data protection, as outlined in Section 3(c)(ii) of Executive Order 14028. As the federal government continues to transition to the cloud, the TRA will be a guide for agencies to leverage when migrating to the cloud securely. Additionally, the document explains considerations for shared services, cloud migration, and cloud security posture management.

**Telemetry:** Artifacts derived from security capabilities that provide visibility into security posture.

**Zero Trust (ZT):** Per Executive Order 14028, "the term "Zero Trust Architecture" means a security model, a set of system design principles, and a coordinated cybersecurity and system management strategy based on an acknowledgement that threats exist both inside and outside traditional network boundaries. ... In essence, a Zero Trust Architecture allows users full access but only to the bare minimum they need to perform their jobs. If a device is compromised, zero trust can ensure that the damage is contained. The Zero Trust Architecture security model assumes that a breach is inevitable or has likely already occurred, so it constantly limits access to only what is needed and looks for anomalous or malicious activity."

## Appendix B. Abbreviations

Abbreviation	Definition
API	Application Programming Interface
ATT&CK	[MITRE] Adversarial Tactics, Techniques, and Common Knowledge
BYOD	Bring Your Own Device
CASB	Cloud Access Security Broker
CDM	Continuous Diagnostics and Mitigation
CISA	Cybersecurity and Infrastructure Security Agency
CSP	cloud service provider
DHS	Department of Homeland Security
DNS	domain name system
DoT	DNS over Transport Layer Security
E3A	EINSTEIN 3 Accelerated
EDR	endpoint detection and response
EMM	Enterprise Mobility Management
eVRF	extensible Visibility Reference Framework
FCEB	Federal Civilian Executive Branch
FedRAMP	Federal Risk and Authorization Management Program
FICAM	Federal Identity, Credential, and Access Management
GSA	Government Services Administration
GWS	Google Workspace
ICAM	Identity, Credential, and Access Management
IDaaS	Identity as a Service
IETF	Internet Engineering Task Force
IP	internet protocol
IT	information technology
M365	Microsoft 365
MAV	mobile application vetting
MFA	multi-factor authentication
MTD	Mobile Threat Defense
NCPS	National Cybersecurity Protection System
NIST	National Institute of Standards and Technology
NPE	non-person entity
OMB	Office of Management and Budget
pDNS	protective domain name system
PIV	personal identity verification
PSTN	Public Switched Telephone Network
RA	Reference Architecture
SaaS	Software-as-a-Service
SCA	Secure Cloud Access
SCuBA	Secure Cloud Business Applications

## Secure Cloud Business Applications (SCuBA) Technical Reference Architecture (TRA)

Abbreviation	Definition
<b>SEG</b>	Secure Email Gateway
<b>SIEM</b>	Security Information and Event Management
<b>SME</b>	subject matter experts
<b>SOAR</b>	Security Automation, Orchestration, and Response
<b>SOC</b>	Security Operations Center
<b>TIC</b>	Trusted Internet Connection
<b>TRA</b>	Technical Reference Architecture
<b>TTPs</b>	Tactics, Techniques, and Procedures
<b>ZT</b>	Zero Trust
<b>ZTA</b>	Zero Trust Architecture