JS7 JobScheduler Architecture

Security Architecture:

Connections, Access, Operation

Information for Interested Parties

- Secure Connections
  - Network Connections
  - Certificate Preparation
  - Certificate Deployment

- Secure Access
  - Identity and Access Management
  - User Account and Role Management
  - Use of Identity Services
  - Certificate based Authentication
  - FIDO Authentication

- Secure Operation
  - Secure Deployment: Security Level Low
  - Secure Deployment: Security Level Medium
  - Secure Deployment: Security Level High
  - Secure Roll-out

Network Connections

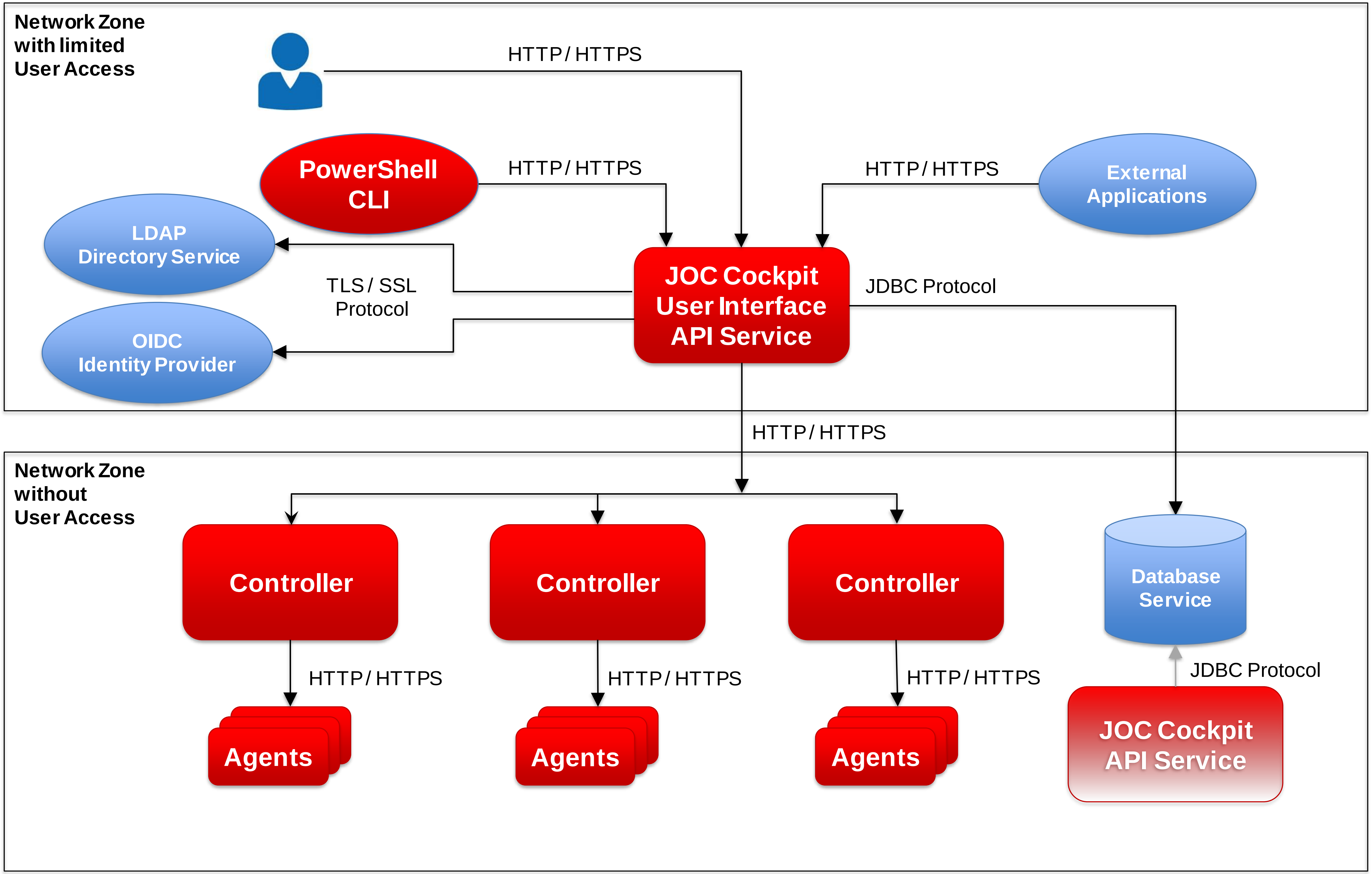
Secure Network Connections

Network Zone with restricted User Access

- Use of HTTPS for any connection to JOC Cockpit
- Access to JOC Cockpit requires authentication
- Access to JOC Cockpit is authenticated by the API Service using TLS/SSL

Network Zone without User Access

- Controller and Agent instances can be operated in a network zone without user access
- Controller instances are accessed exclusively by the JOC Cockpit API Service
- Agent instances are accessed exclusively by Controller instances
- Use of HTTPS for connections with client and server authentication certificates (mutual TLS authentication)



Certificate Management

Certificate Preparation

Server Certificates

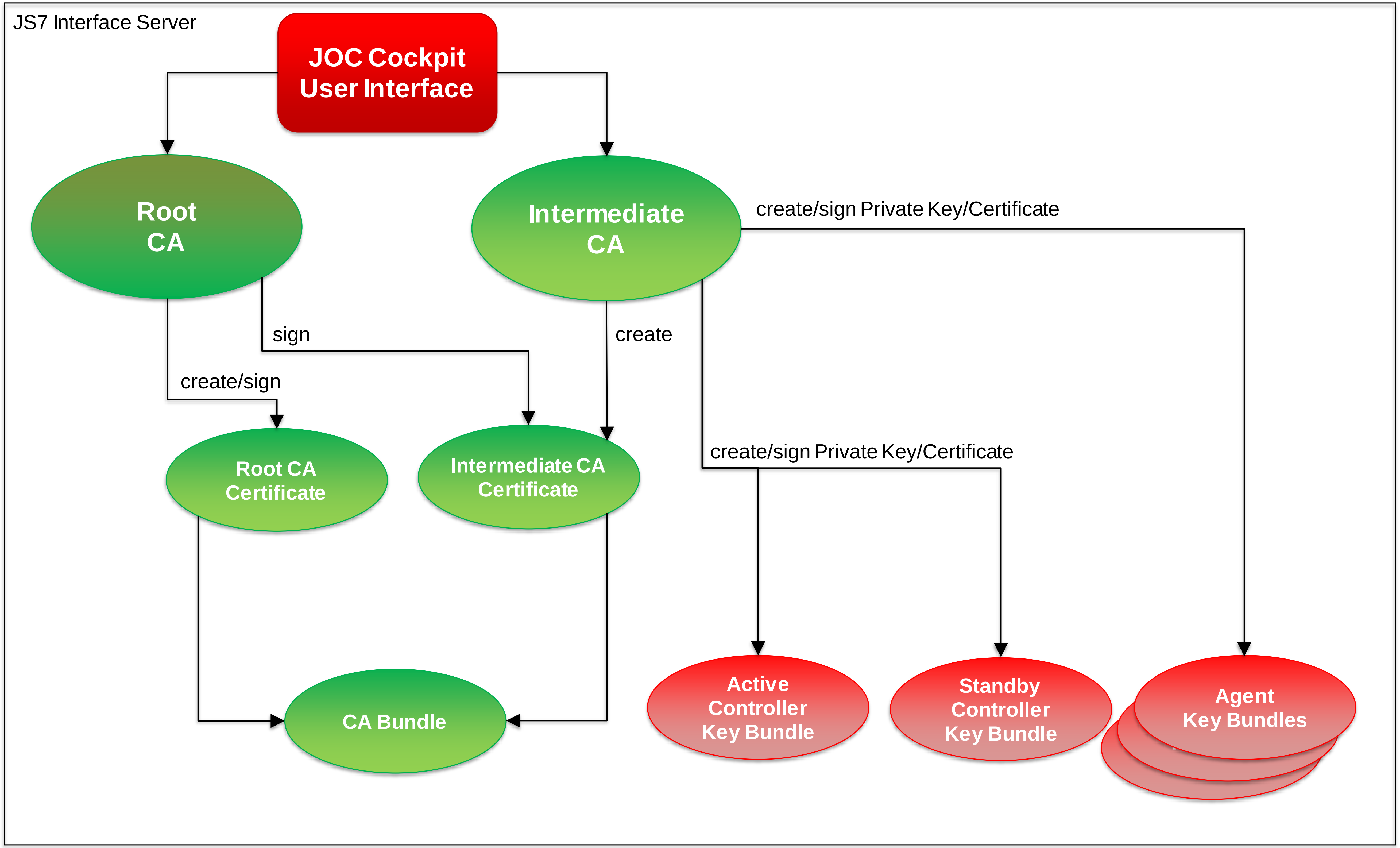
- Server Certificates are required to secure network connection by HTTPS
- Certificates are managed by the user's CA or by the CA provided with JOC Cockpit

Root CA / Intermediate CA

- The Certificate Authority (CA) is used to create the Root CA Certificate and Intermediate CA Certificate
- Both certificates are bundled and made available to Controller and Agent instances

Controller/Agent Certificate

- The Intermediate CA creates and signs the certificates for each Controller and Agent
- The CA Bundle and the instance's Key Bundle are deployed to the respective Controller and Agent


JS7 Interface Server
JOC Cockpit User Interface
Root CA
Intermediate CA
create/sign Private Key/Certificate
sign
create
create/sign
Root CA Certificate
Intermediate CA Certificate
create/sign Private Key/Certificate
CA Bundle
Active Controller Key Bundle
Standby Controller Key Bundle
Agent Key Bundles

Certificate Management

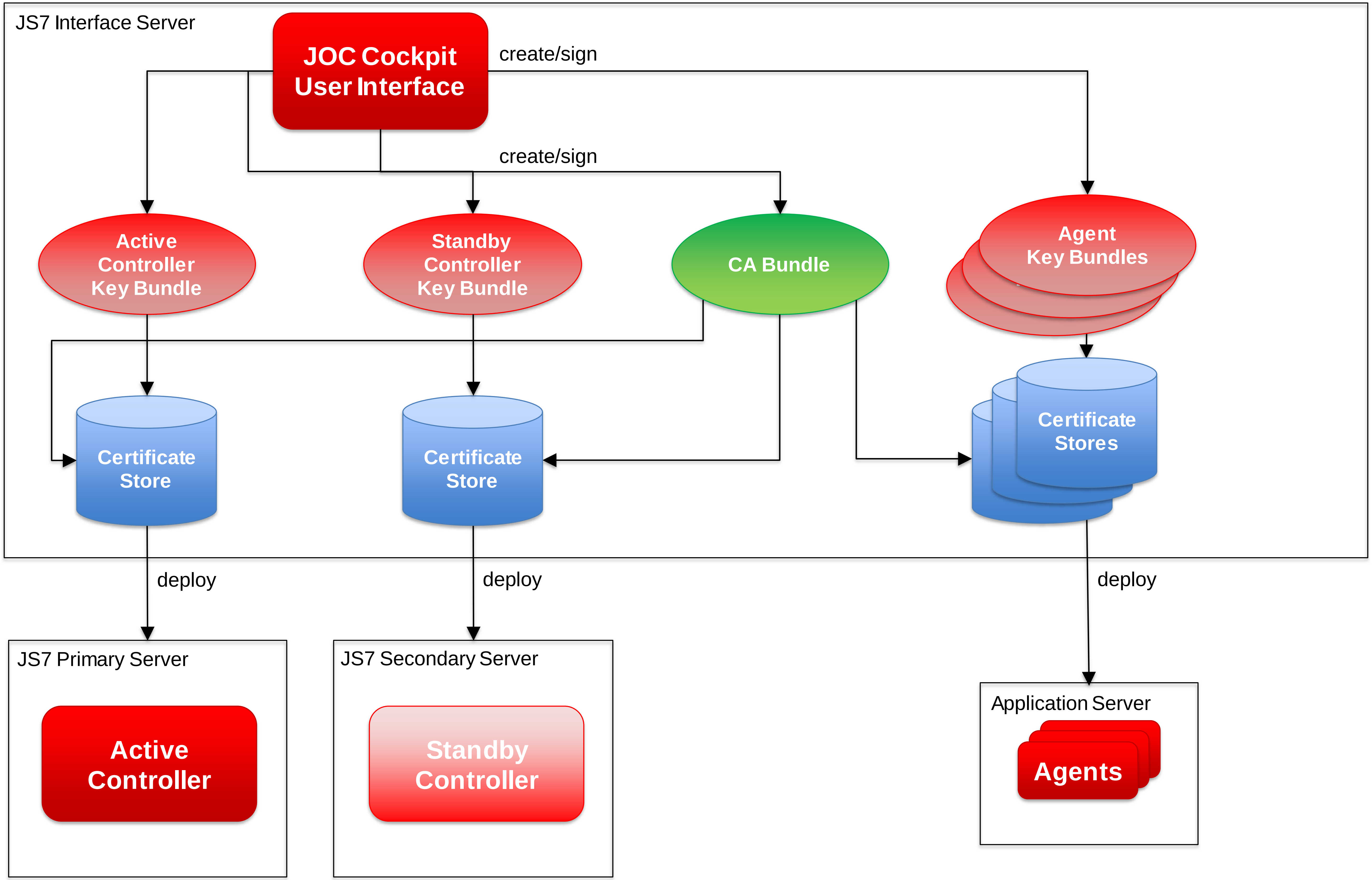
Certificate Deployment

Private Keys / CA Bundle

- The Certificate Authority (CA) adds the Root CA Certificate and Intermediate CA Certificate to a Bundle
- The CA Bundle together with the Private Key is added to a Certificate Store that is managed for each Controller/Agent instance

Deployment

- The Certificate Store is deployed to each Controller/ Agent instance
- The transfer of Certificate Stores to Controller/Agent instances is integrated with the user‘s deployment solution



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Identity and Access Management

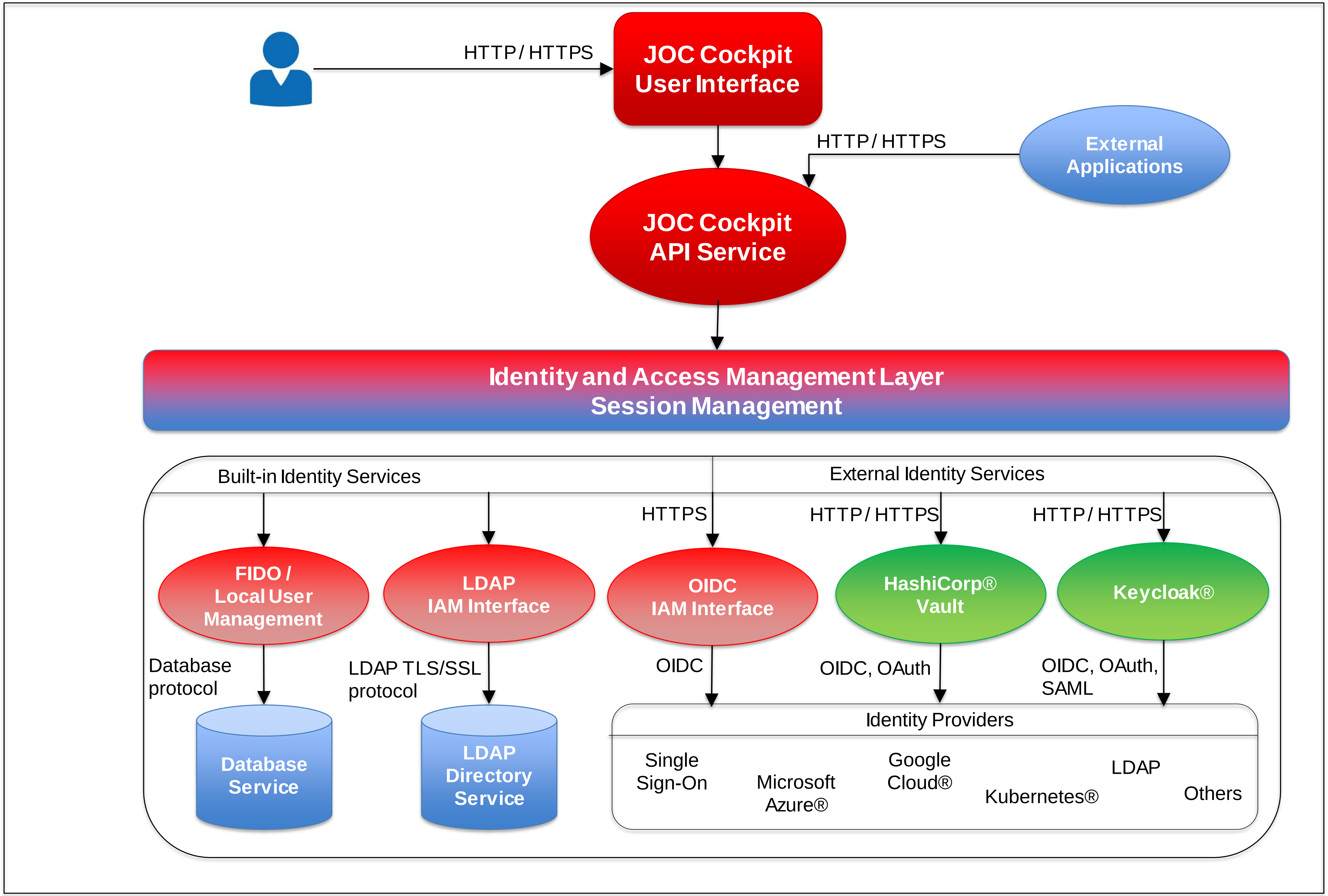
Secure Access

Built-in Identity Services

- JOC Cockpit offers built-in user management with its Database Service
- JOC Cockpit integrates with LDAP Directory Services such as Microsoft Active Directory® and OpenLDAP.®
- LDAP connections can be configured for TLS and SSL
- JOC Cockpit allows authentication with OIDC based Identity Providers, e.g. Azure
- JOC Cockpit offers FIDO authentication with FIDO2, FIDO U2F and Passkeys

External Identity Services

- HashiCorp® Vault and Keycloak® are integrated by their respective REST API
- JOC Cockpit can manage users and roles locally and by use of an Identity Service
- JOC Cockpit requests and renews access tokens with the Identity Service
- Identity Services manage access to the respective Identity Providers



User Account and Role Management

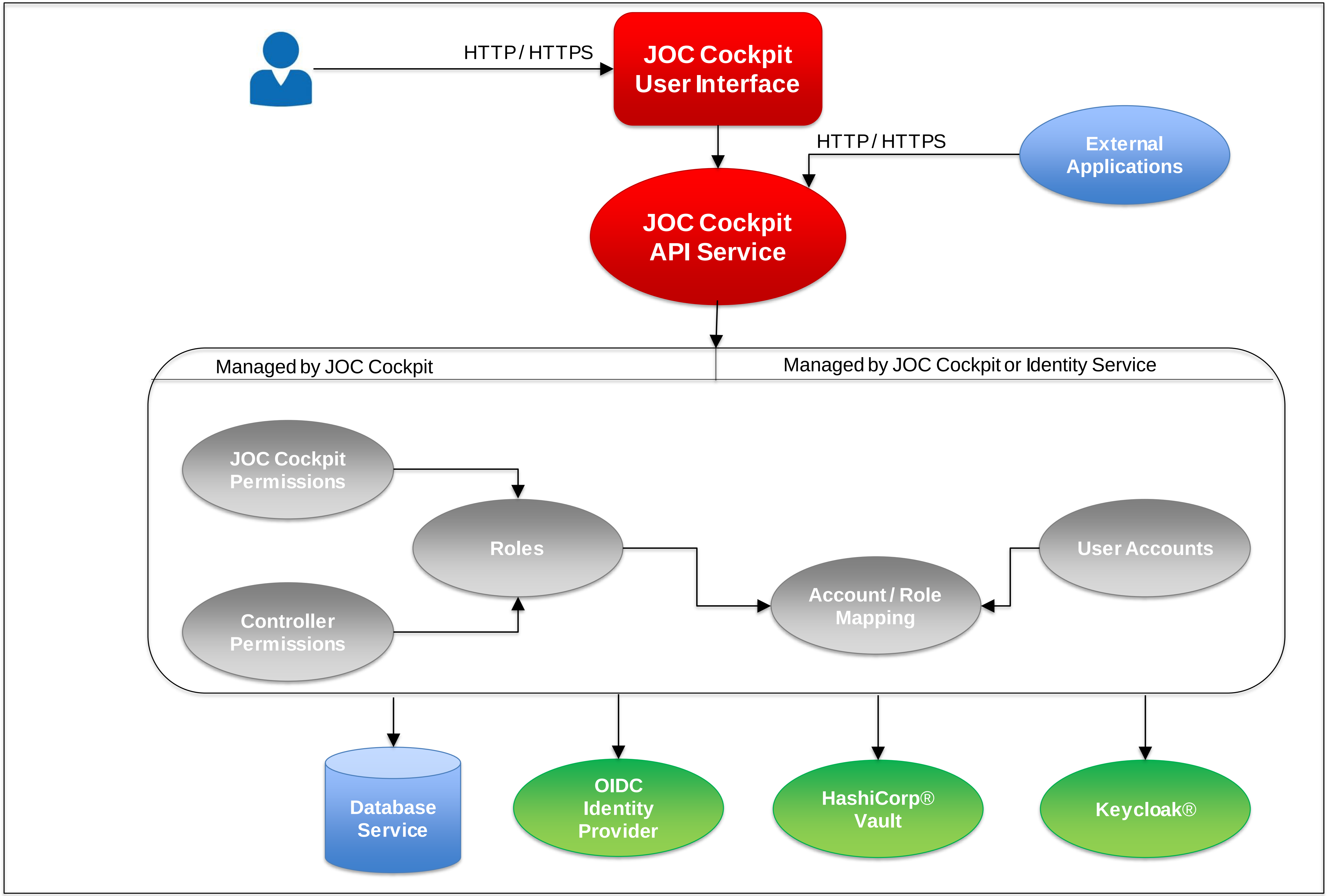
Secure Access

Permissions and Roles

- Permissions for JOC Cockpit and for individual Controllers are managed by the JOC Cockpit API Service
- JOC Cockpit stores permissions and roles with its Database Service

Account and Role Mappings

- User accounts can be managed and stored with the JOC Cockpit database
- Alternatively user accounts can be managed and stored with an Identity Service or OIDC Identity Provider
- JOC Cockpit can be used to populate Identity Services with user accounts and role mappings and it can be used to retrieve role mappings from an Identity Service when a user logs in
- HashiCorp® Vault and Keycloak® are integrated by their respective REST API



Use of Identity Services

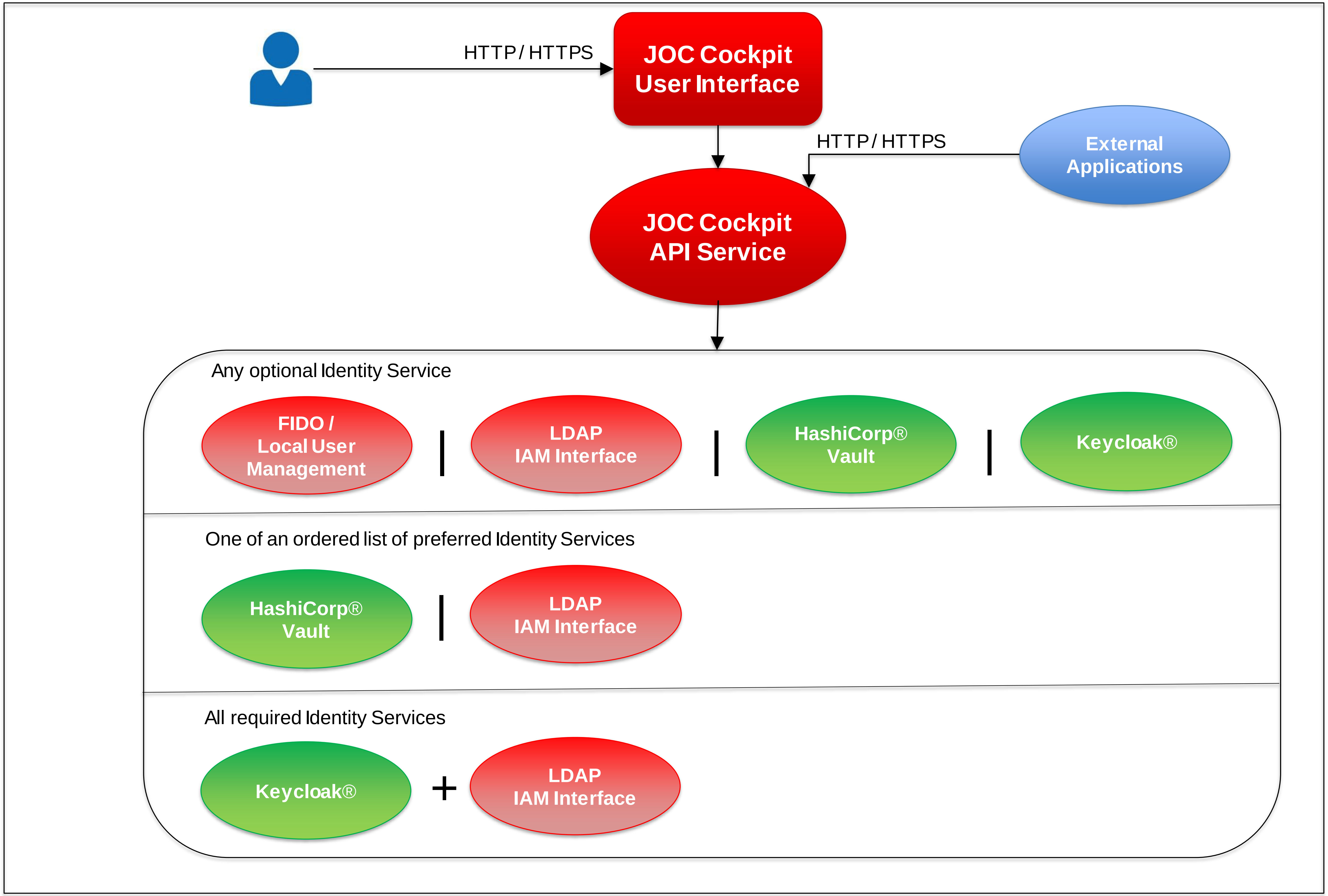
Secure Access

Required Identity Services

- JOC Cockpit offers to specify one or more Identity Services to be required
- This includes to login with all required Identity Services
- A failed login with any required Identity Service results in denial of access to JOC Cockpit
- Role mappings are merged from all required Identity Services

Optional Identity Services

- JOC Cockpit offers to specify any number of optional Identity Services
- With the first successful login to an optional Identity Service the user is logged in and no further Identity Services are consulted
- Identity Services are consulted in the sequence in which they are ordered



Certificate Based Authentication

Certificate based Authentication

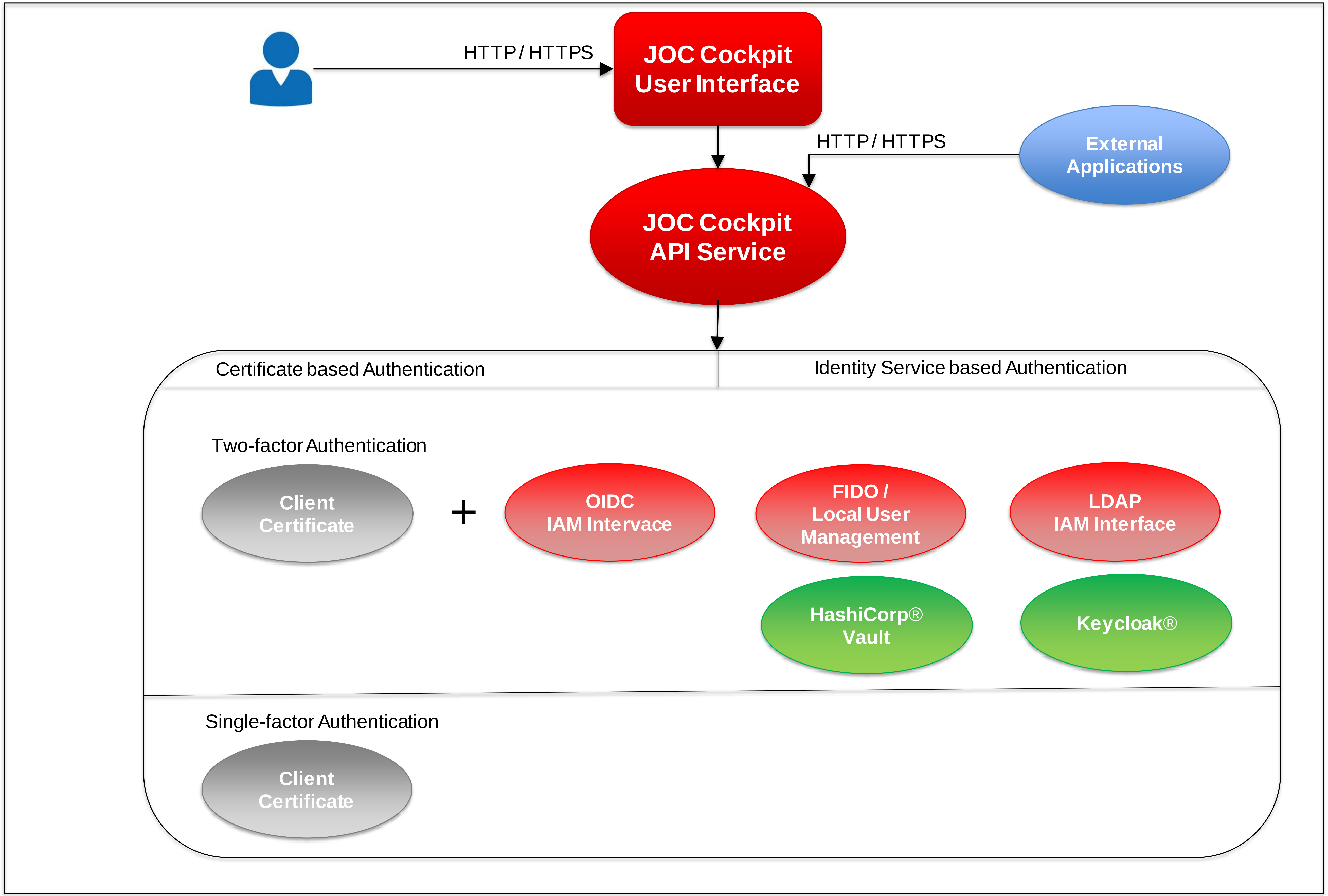
- JOC Cockpit offers use of X.509 Client Authentication Certificates
- Such certificates are used for mutual authentication between JOC Cockpit and Client, e.g. the user browser or external application

Two-factor Authentication

- A certificate is required in addition to credentials that are used with available Identity Services
- If the certificate cannot be validated then the user account is denied access to JOC Cockpit

Single-factor Authentication

- A certificate is accepted as a single factor to authenticate user accounts
- This option is frequently used for automated login by batch processes


HTTP / HTTPS
JOC Cockpit User Interface
HTTP / HTTPS
External Applications
JOC Cockpit API Service
Certificate based Authentication
Identity Service based Authentication
Two-factor Authentication
Client Certificate
+
OIDC IAM Intervace
FIDO / Local User Management
LDAP IAM Interface
HashiCorp® Vault
Keycloak®
Single-factor Authentication
Client Certificate

FIDO Authentication

FIDO2 Authentication

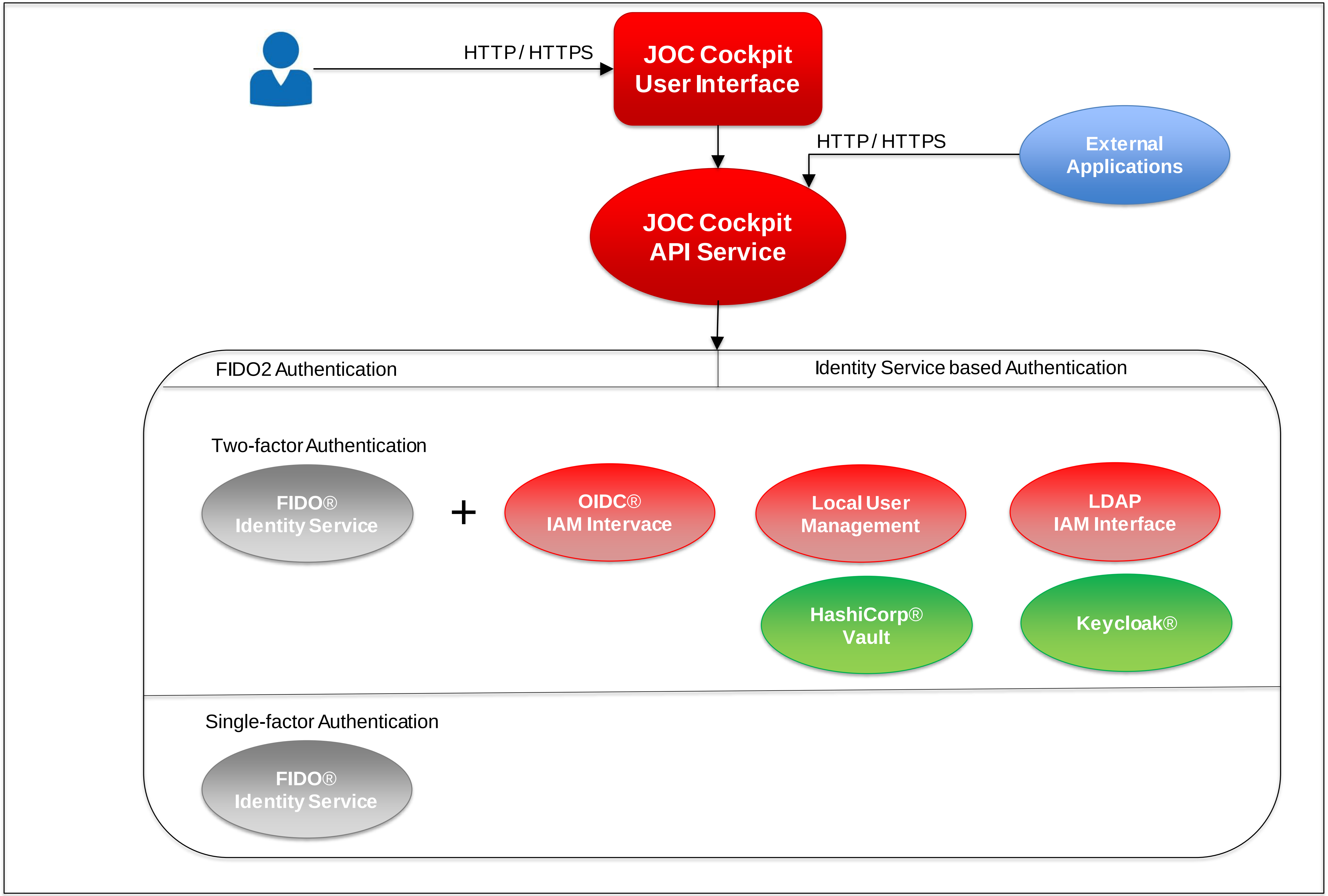
- The JOC Cockpit User Interface implements a FIDO Client for browsers
- The JOC Cockpit API Service implements a FIDO Server (Relying Party)
- Any FIDO compliant Authenticator can be used
- Supported protocols include FIDO2, FIDO U2F, Passkeys

Two-factor Authentication

- FIDO authentication can be used in addition to any other Identity Service
- If FIDO authentication is not successful then the user account is denied access to JOC Cockpit

Single-factor Authentication

- FIDO2 and Passkeys are accepted as a single factor to authenticate user accounts



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Secure Operation

Secure Deployment: Security Level Low

JOC Cockpit Signing

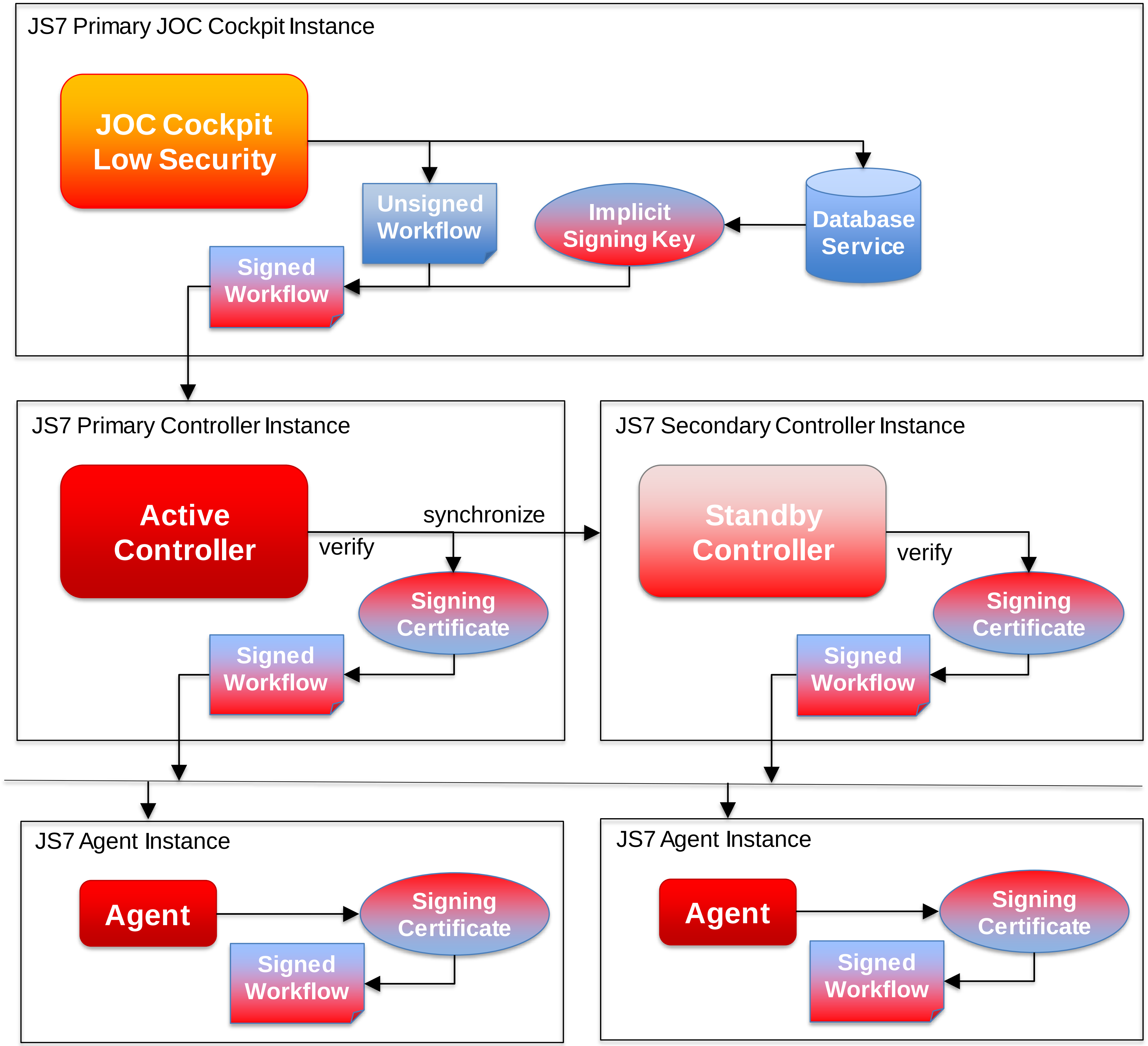
- Workflows are signed for deployment using a Signing Key from the database.
- The signature is deployed with the workflow.

Controller Signature Check

- Workflows are checked if they match the signature provided with certificates available to the Controller and otherwise are denied.
- Similar check is performed by the Standby Controller that requires availability of the same certificates.

Agent Signature Check

- Workflows are checked if they match the signature provided with certificates available to the Agent.
- Workflows are not accepted in case of failed signature checks.



Implicit Signing

- Workflows are implicitly signed for deployment
- Deployments by any user make use of the same Signing Key
- Deployment is a single click operation in the user interface

Security Level Low

- JOC Cockpit offers built-in signing operations for workflows
- Signed workflows are not associated with individual users
- The Signing Key might be copied or compromised as it is accessible from the database

Secure Operation

Secure Deployment: Security Level Medium

JOC Cockpit Signing

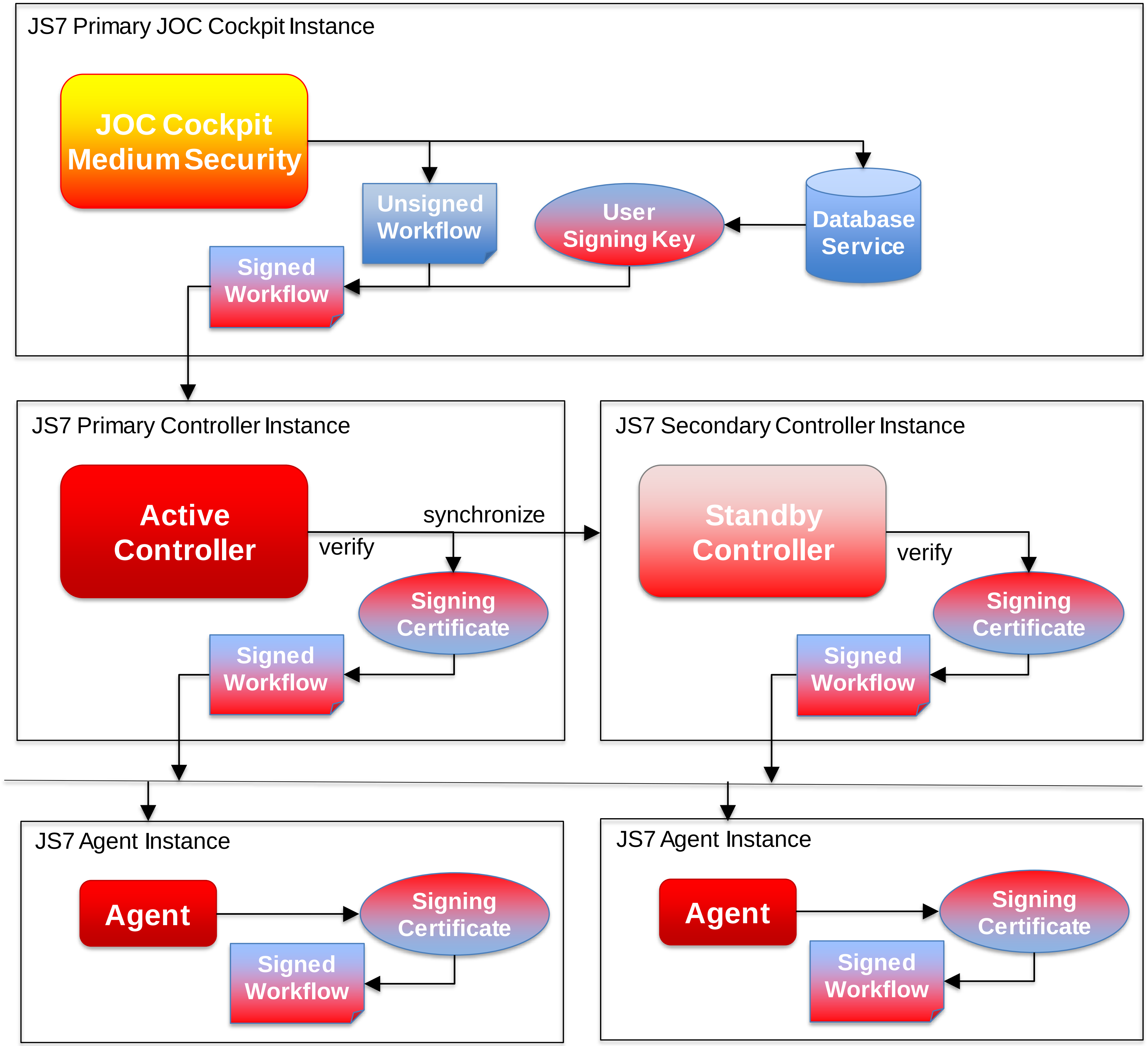
- Workflows are signed for deployment using a Signing Key from the database
- The signature is deployed with the workflow

Controller Signature Check

- Workflows are checked if they match the signature provided with certificates available to the Controller and otherwise are denied
- Similar check is performed by the Standby Controller that requires availability of the same certificates

Agent Signature Check

- Workflows are checked if they match the signature provided with certificates available to the Agent
- Workflows are not accepted in case of failed signature checks



User based Signing

- Workflows are signed individually per user for deployment with an individual Signing Key
- Deployment is a single click operation in the user interface

Security Level Medium

- JOC Cockpit offers built-in signing operations for workflows
- Each signed workflow is associated with a user
- The Signing Key might be copied or compromised as it is accessible from the database

Secure Operation

Secure Deployment: Security Level High

External Signing

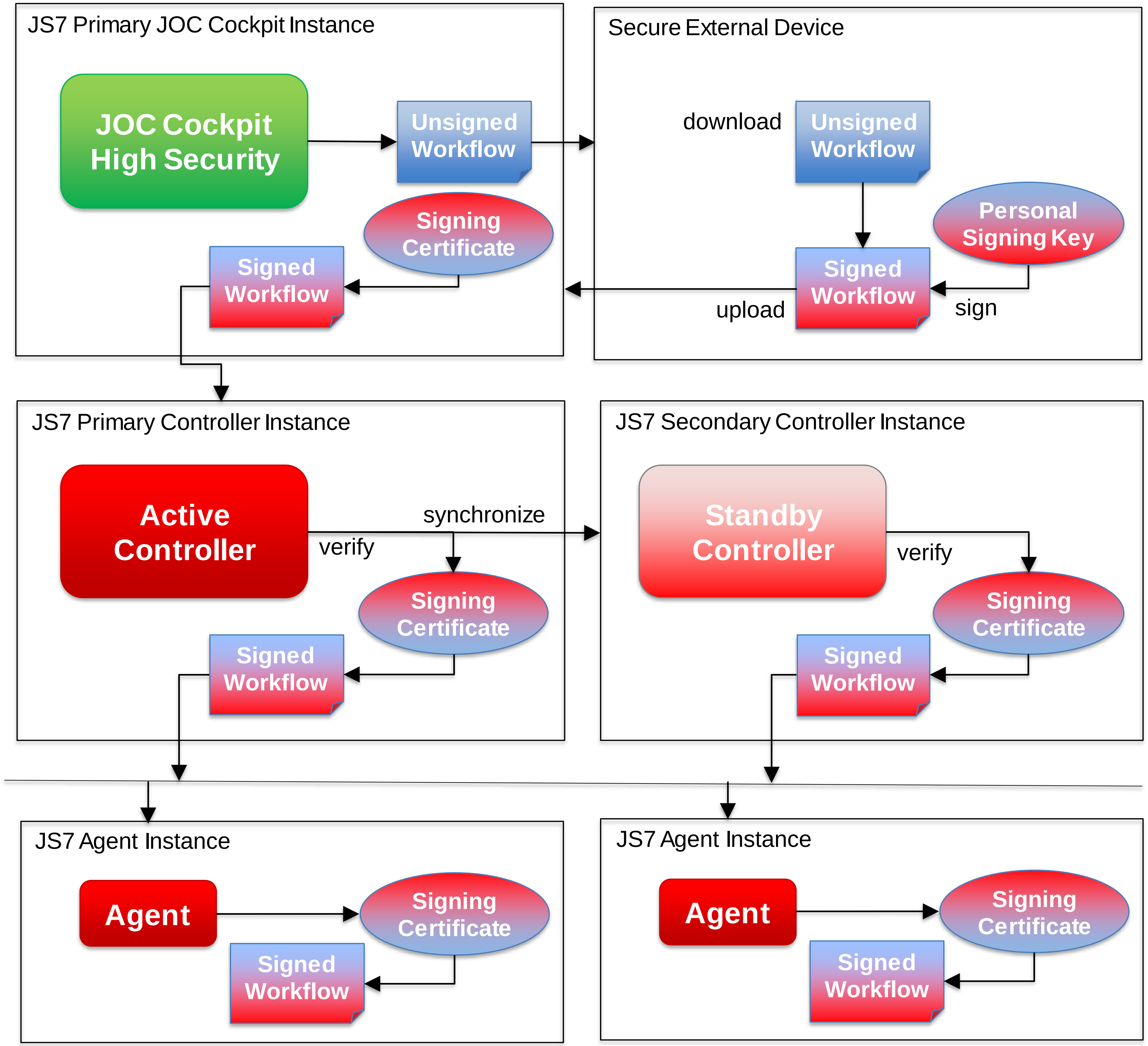
- Workflows are signed for deployment performing the signing from a secure external device.
- The signature is deployed with the workflow

Controller Signature Check

- Workflows are checked if they match the signature provided with certificates available to the Controller and otherwise are denied
- Similar check is performed by the Standby Controller that requires availability of the same certificates

Agent Signature Check

- Workflows are checked if they match the signature provided with certificates available to the Agent
- Workflows are not accepted in case of failed signature checks



JS7 Primary JOC Cockpit Instance

JOC Cockpit High Security

Unsigned Workflow

Signing Certificate

Signed Workflow

Secure External Device

download

Unsigned Workflow

Personal Signing Key

Signed Workflow

upload

sign

JS7 Primary Controller Instance

Active Controller

synchronize

verify

Signing Certificate

Signed Workflow

JS7 Secondary Controller Instance

Standby Controller

verify

Signing Certificate

Signed Workflow

JS7 Agent Instance

Agent

Signing Certificate

Signed Workflow

JS7 Agent Instance

Agent

Signing Certificate

Signed Workflow

External Signing

- Workflows are downloaded to a secure external computer, the user's Signing Key might be provided by portable media
- Signing is performed with any tool accepted by company standards, e.g. OpenSSL
- The workflows and resulting signature files are added to an archive file and are uploaded

Security Level High

- JOC Cockpit offers no built-in signing operations for workflows
- Workflows have to be signed externally to be deployable
- The Signing Key is used outside of JOC Cockpit
- A signed workflow is associated with a user (non-repudiability)

Secure Operation

Secure Roll-out

External Signing

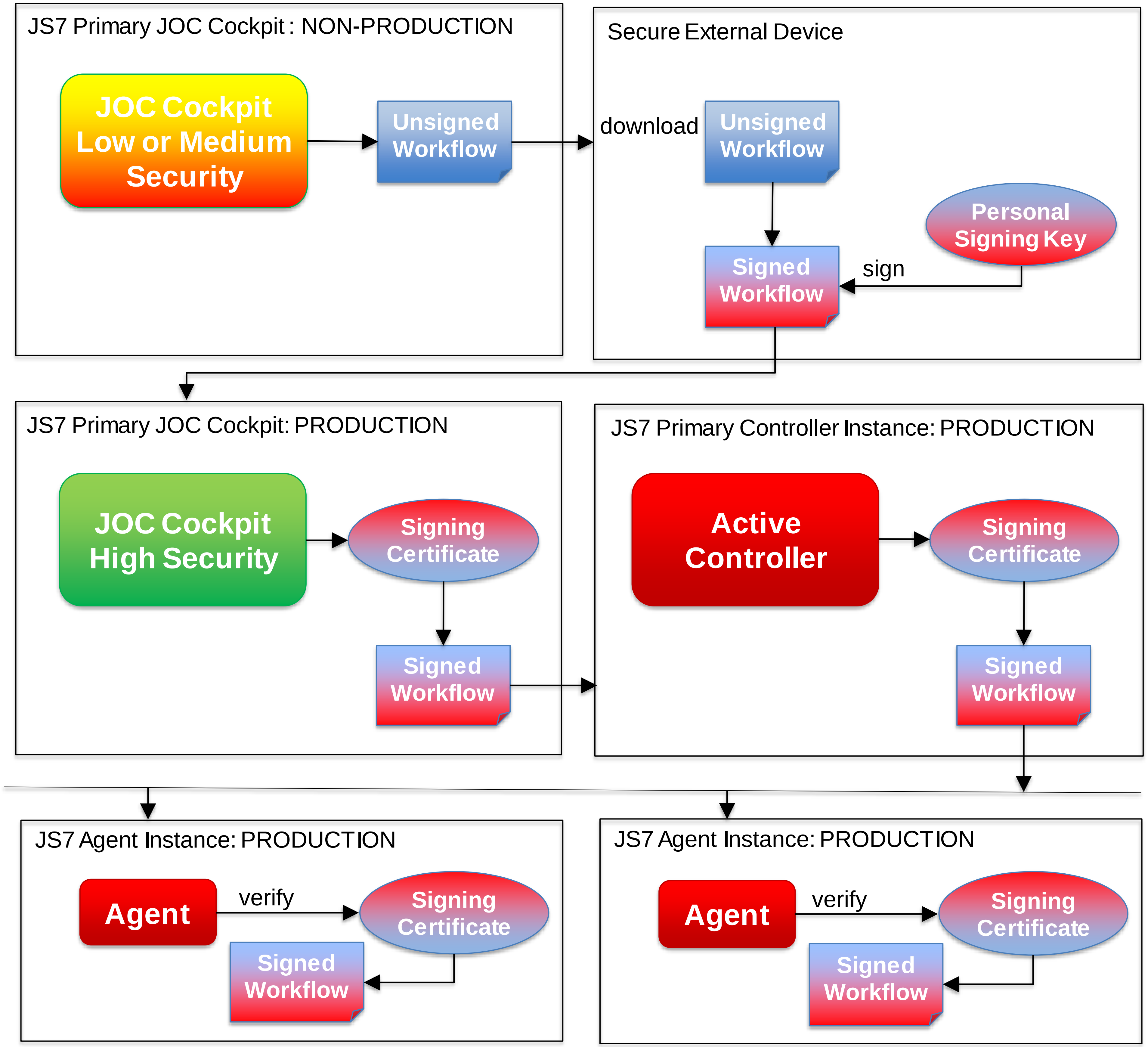
- Workflows are signed for deployment performing the signing from a secure, external device
- The signature is deployed with the workflow

Controller Signature Check

- Workflows are checked if they match the signature provided with certificates available to the Controller and otherwise are denied
- Similar check is performed by the Standby Controller that requires availability of the same certificates

Agent Signature Check

- Workflows are checked if they match the signature provided with certificates available to the Agent
- Workflows are not accepted in case of failed signature checks



External Signing

- Workflows are downloaded to a secure external computer, the user's Signing Key might be provided by portable media
- Signing is performed with any tool accepted by company standards, e.g. OpenSSL
- The workflows and resulting signature files are added to an archive file and are uploaded to a secure JOC Cockpit instance

Secure Roll-out

- A secure JOC Cockpit instance accepts signed workflows only
- There is no possibility to sign a workflow within a secure JOC Cockpit instance
- A secure JOC Cockpit instance will accept workflows only if their signatures match the signing certificate

Questions?

Comments?

Feedback?

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