Iotivity
OCF Guide

Iotivity User Guide (DRAFT)

The content of this UG is drawn from the Iotivity Documentation and Wiki pages.

summary

Contents

Iotivity User Guide Abstract

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summary

Notice

Notice

Topics:

Here's a shortdesc...

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Preface

Preface

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About this Document

The content of this UG is drawn from the Iotivity Documentation and Wiki pages.

Revision: 0.1

Acknowledgements

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Part I

Overview

This is the overview of Part I ...

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Part II

Data Model

OCF formally defines a sophisticated resource-based data model.

Part III

Security

Topics:

OCF defines a sophisticated security model...

Chapter 1

Security Overview

OCF security is built on two orthogonal pillars: data integrity and confidentiality, and access control.

The integrity and confidentiality of in-flight data is handled by transport-level encryption (DTLS/TLS). The integrity of data at rest is the responsibility of the implementation; OCF provides some recommendations but no mandatory features.

Access control is composed of authentication and authorization. Authentication is based on cryptographic credentials; authorization is based on Access Control Lists.

Encryption and access control are orthogonal. All access to resources is governed by access control, whether communications are encrypted or not. It follows that every resource must have an ACL.

Provisioning of security-related resources (identity, credentials, ACLs) is an important aspect of OCF security.

- Security Services
- Security Management Service
- Security Resources
- Security Protocols
- etc...

Chapter 2

Configuration and Provisioning

Topics:

In this document we make a distinction between security provisioning and configuration.

Concepts:

- Device Identity
- Device Credential
- Device Ownership
- Device Onboarding
- Ownership Transfer
- Security Provisioning
- Security Configuration

Security states:

- *RESET*
- *Ready For Ownership Transfer Method (RFOTM)*
- *Ready For Provisioning (RFPRO)*
- *Ready For Normal Operation (RFNOP)*
- *Soft Reset*

Dynamic Security Configuration and Provisioning

Dynamic security provisioning and configuration...

Static Configuration and Provisioning

For development and testing purposes, static provisioning configuration may be more convenient that dynamic configuration.

```
{
   "acl": {
       "aclist2": [
           {
               "aceid": 1,
               "subject": { "conntype": "anon-clear" },
               "resources": [
                   { "href": "/oic/res" },
                   { "href": "/oic/d" },
                   { "href": "/oic/p" },
                   { "href": "/oic/sec/doxm" }
               ],
               "permission": 2
           },
           {
               "aceid": 2,
               "subject": { "conntype": "auth-crypt" },
               "resources": [
                   { "href": "/oic/res" },
                   { "href": "/oic/d" },
                   { "href": "/oic/p" },
                   { "href": "/oic/sec/doxm" }
               ],
               "permission": 2
           },
           {
               "aceid": 3,
               "subject": { "uuid":
"32323232-3232-3232-3232-323232323232" },
               "resources": [{ "wc": "*" }],
               "permission": 7
           },
           {
               "aceid": 4,
               "subject": { "uuid":
"31393139-3139-3139-3139-313931393139" },
               "resources": [{ "href": "/a/led" }],
               "permission": 7
           },
           {
               "aceid": 5,
               "subject": { "uuid":
"37373737-3737-3737-3737-373737373737" },
               "resources": [{ "href": "/a/led" }],
               "permission": 6
           }
       ],
       "rowneruuid" : "31313131-3131-3131-3131-313131313131"
   },
   "pstat": {
        "dos": {"s": 3, "p": false},
        "isop": true,
        "rowneruuid": "31313131-3131-3131-3131-313131313131",
        "cm": 0,
        "tm": 0,
        "om": 4,
        "sm": 4
        },
    "doxm": {
        "oxms": [0],
        "oxmsel": 0,
        "sct": 9,
        "owned": true,
        "deviceuuid": "31313131-3131-3131-3131-313131313131",
        "devowneruuid": "32323232-3232-3232-3232-323232323232",
        "rowneruuid": "31313131-3131-3131-3131-313131313131"
    },
    "cred": {
        "creds": [
            {
                "credid": 1,
                "subjectuuid": "32323232-3232-3232-3232-323232323232",
                "credtype": 1,
                "period": "20150630T060000/20990920T220000",
                "privatedata": {
                    "data": "AAAAAAAAAAAAAAAA",
                    "encoding": "oic.sec.encoding.raw"
                }
            },
            {
                "credid": 2,
                "subjectuuid": "31393139-3139-3139-3139-313931393139",
                "credtype": 1,
                "period": "20150630T060000/20990920T220000",
                "privatedata": {
                    "data": "BBBBBBBBBBBBBBBB",
                    "encoding": "oic.sec.encoding.raw"
                }
            }
        ],
        "rowneruuid": "32323232-3232-3232-3232-323232323232"
    }
}
```

A	intercooler
B	expansion tank

Figure 1: Configuration file for server

An SVR configuration file for a client that owns the server:

```
      {
    "acl": {
        "aclist2": [
            {
                "aceid": 1,
                "subject": { "conntype": "anon-clear" },
                "resources": [
                    { "href": "/oic/res" },
                    { "href": "/oic/d" },
                    { "href": "/oic/p" },
                    { "href": "/oic/sec/doxm" }
                ],
                "permission": 2
            },
            {
                "aceid": 2,
                "subject": { "conntype": "auth-crypt" },
                "resources": [
                    { "href": "/oic/res" },
                    { "href": "/oic/d" },
                    { "href": "/oic/p" },
                    { "href": "/oic/sec/doxm" }
                ],
                "permission": 2
            }
        ],
        "rowneruuid" : "32323232-3232-3232-3232-323232323232"
    },
    "pstat": {
        "dos": {"s": 3, "p": false},
        "isop": true,
        "rowneruuid": "32323232-3232-3232-3232-323232323232",
        "cm": 0,
        "tm": 0,
        "om": 4,
        "sm": 4
        },
    "doxm": {
        "oxms": [0],
        "oxmsel": 0,
        "sct": 9,
        "owned": true,
        "deviceuuid": "32323232-3232-3232-3232-323232323232",
        "devowneruuid": "32323232-3232-3232-3232-323232323232",
        "rowneruuid": "32323232-3232-3232-3232-323232323232"
    },
    "cred": {
        "creds": [
            {
                "credid": 1,
                "subjectuuid": "31313131-3131-3131-3131-313131313131",
                "credtype": 1,
                "privatedata": {
                    "data": "AAAAAAAAAAAAAAAA",
                    "encoding": "oic.sec.encoding.raw"
                }
            }
        ],
        "rowneruuid": "32323232-3232-3232-3232-323232323232"
    }
}
```

Chapter

3

Encryption

Topics:

Data integrity and confidentiality are ensured via transport layer encryption. OCF requires support for DTLS for UDP and TLS for TCP communications.

Establishment of a secure communication channel using (D)TLS requires two things: and agreed-upon cipher suite, and cryptographic credentials. The latter are used for mutual authentication: servers authenticate clients, and vice-versa.

It follows that OCF devices must be configured with the credentials and the cipher suites necessary for secured communication. Static configuration provisions the necessary information at build time or during runtime initialization (e.g. by reading a fixed configuration file). Devices may also be configured dynamically, over the network. OCF defines a detailed model of dynamic provisioning (described in Provisioning Services on page 32).

Related information

The TLS Handshaking Protocols (IETF RFC 5246)

Intro to DTLS

An overview of the SSL or TLS handshake

(D)TLS Configuration

OCF devices must be properly configure to use (D)TLS security.

(D)TLS requires that communicating parties negotiate a *Cipher Suite* and exchange the information necessary for mutual authentication.

If Symmetric Key credentials are being used, each party must be provisioned with the ID and credential of the other. See

(D)TLS Cipher Suites

Establishing a (D)TLS session requires negotiation of a *Cipher Suite*.

OCF supports the following cipher suites:

- TLS_ECDH_ANON_WITH_AES_128_CBC_SHA256
- TLS_ECDH_ANON_WITH_AES_256_CBC_SHA256
- TLS_ECDHE_PSK_WITH_AES_128_CBC_SHA256
- TLS_ECDHE_PSK_WITH_AES_256_CBC_SHA256
- TLS_ECDHE_ECDSA_WITH_AES_128_CCM_8
- TLS_ECDHE_ECDSA_WITH_AES_256_CCM_8
- TLS_ECDHE_ECDSA_WITH_AES_128_CCM
- TLS_ECDHE_ECDSA_WITH_AES_256_CCM
- TLS_ECDHE_PSK_WITH_AES_128_CBC_SHA256
- TLS_ECDHE_PSK_WITH_AES_256_CBC_SHA256
- TLS_PSK_WITH_AES_128_CCM_8 (* 8 OCTET Authentication tag *)
- TLS_PSK_WITH_AES_256_CCM_8
- TLS_PSK_WITH_AES_128_CCM (* 16 OCTET Authentication tag *)
- TLS_PSK_WITH_AES_256_CCM
- TLS_ECDHE_ECDSA_WITH_AES_128_CCM_8
- TLS_ECDHE_ECDSA_WITH_AES_256_CCM_8
- TLS_ECDHE_ECDSA_WITH_AES_128_CCM
- TLS_ECDHE_ECDSA_WITH_AES_256_CCM
- ...etc...

See section 11.2 of the OCF Security Specification, version 1.3.0

Related information

RFC 4279: Pre-Shared Key Ciphersuites for Transport Layer Security (TLS)

RFC 4492: Elliptic Curve Cryptography (ECC) Cipher Suites for Transport Layer Security (TLS)

RFC 5489: ECDHE_PSK Cipher Suites for Transport Layer Security (TLS)

RFC 6655: AES-CCM Cipher Suites for Transport Layer Security (TLS)

RFC 7251: AES-CCM Elliptic Curve Cryptography (ECC) Cipher Suites for TLS

(D)TLS Authentication

(D)TLS requires mutual authentication using cryptographic credentials

(D)TLS requires mutual authentication

Chapter 4

Credentials

OCF uses *Cryptographic Credential* to authenticate requests...

Chapter 5

Access Control

Topics:

OCF access control is provided through authentication and authorization services.

blah

Authentication Services

Authentication is the process of verifying the identity of a participant in a transaction, such as the sender of a request message. OCF authentication is based on cryptographic credentials.

There are two basic types of cryptography used for credential authentication, symmetric and asymmetric.

Symmetric cryptography uses the same (secret) cryptographic key for both encryption and decryption. The key is often called a "Pre-Shared Key" (PSK), since both parties to the transaction must be provisioned with it.

Asymmetric cryptography uses a pair of keys, one a private (secret) key and the other a public key. The private key is never shared. Senders use their private key to "sign" their messages, and receivers use the public key of the sender to verify the signature. Asymmetric cryptography is often referred to as "Public-Key Cryptography".

Closely related to asymmetric cryptography is the use of "certificate authorities" to certify ownership of key pairs. Using a public key to verify the signature of a message ensures that the sender is in possession of the private key that signed the message; it does not, however, authenticate the *identity* of the sender. A certificate authority (CA) is an entity that issues digital certificates that certify ownership of a public key by the entity named in the certificate.

OCF authentication services support the following credential types:

- Symmetric Pairwise Key (Pre-Shared Key or PSK)
- Symmetric Group Key
- Asymmetric Signing Key
- Asymmetric Signing Key with Certificates
- PIN or Password
- Assymetric Encryption Key

OCF engines maintain a Credentials Database that stores credentials and associated device IDs. The database is accessible as a resource (/oic/sec/cred). Provisioning of the database is described in Provisioning Services on page 32.

When symmetric keys are used, OCF authentication services attach to outgoing messages the device id and credential (PSK) of the sending device, and, on the receiving end, extract the device ID and credential from the incoming message and look them up in the Credentials DB. If found, the messages is marked as authenticated and processing continues; otherwise, the message is rejected with an UNAUTHENTICATED response.

When asymmetric credentials are used, OCF authentication services use the sender's private key to sign outgoing messages, and on the receiving end use the sender's public key to verify the signature. ... etc. ...

Related information

Authentication (Wikipedia)

Certificate Authority (Wikipedia)

Public-key Certificate (Wikipedia)

Symmetric-key Algorithm (Wikipedia)

Public-key Cryptography

Authorization Services

OCF authorization services grant or deny access requests.

blah

Chapter 6

Security Virtual Resources

Topics:

A *Security Virtual Resource (SVR)* is an OCF-defined resource that controls some aspect of security. OCF defines six SVRs:

- /oic/sec/doxm - Device Ownership Transfer Management
- /oic/sec/pstat - Provisioning Status
- /oic/sec/cred - Credentials
- /oic/sec/acl2 - Access Control Lists
- /oic/sec/amacl - Access Management Service ACLs
- /oic/sec/sacl - Secure ACLs

DOXM (Device Ownership Transfer Management)

The *Device Ownership Transfer Management* resource controls device ownership transfer.

URL: `/oic/doxm`

Properties:

PSTAT (Provisioning Status)

The *Provisioning Status (PSTAT)* resource controls provisioning.

URL: `/oic/pstat`

Properties:

CRED (Credentials)

The *Credential (CRED)* resource controls credentials.

URL: `/oic/cred`

Properties:

ACL2 (Access Control List)

The *Provisioning Status (ACL2)* resource controls resource access.

URL: `/oic/acl2`

Properties:

Note: Earlier versions of OCF (and its predecessor, OIC) defined an ACL resource (`/oic/acl`). This is obsolete as of OCF version 1.3.0.

AMACL (Access Manager ACL) resource

The *Access Manager ACL (AMACL)* resource supports remote ACL management.

URL: `/oic/amacl`

Properties:

SACL (Signed ACL)

The *Signed ACL (SACL)* resource supports cryptographically signed ACLs.

URL: `/oic/sacl`

Properties:

Chapter 7

Security Management

Topics:

Security management overview...

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Identity Provisioning and Management

Every operational device on an OCF network must be provisioned with a unique *device identifier*.

blah

Ownership (Registration) Management

Every device on an OCF network must be registered to the network. OCF expresses this in terms of **device ownership**.

An OCF *Device Ownership Transfer Service* provides device registration (ownership transfer) services.

Here is another use of the *DOXS* term.

Provisioning Services

Once a device has been provisioned with an identifier and registered with the network, it must be provisioned with security resources: credentials and access control lists (ACLs).

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Phasellus nisl felis, faucibus non arcu eget, ultricies lobortis ipsum. Nulla nulla purus, sagittis et cursus at, porttitor a felis. Nulla ut dolor enim. Vivamus imperdiet nunc sit amet lacus laoreet tincidunt. Mauris velit quam, faucibus eu consectetur vel, hendrerit et felis. Sed mattis dapibus auctor. Vivamus posuere eget magna in congue. Proin nisl massa, venenatis sit amet tempus eget, lobortis non nisi. Cras rhoncus posuere lectus vel tincidunt.

Etiam posuere mi purus, vel elementum nisl efficitur pretium. Maecenas vehicula pellentesque mauris a tincidunt. Nullam gravida neque vel ex porttitor eleifend. Integer semper neque quis arcu aliquet luctus. Fusce tortor ligula, ornare at facilisis id, dictum eu ante. Suspendisse pulvinar ex quis ullamcorper bibendum. Curabitur non ipsum dolor.

Related information

Key Management for Updating Crypto-keys over AIR (PDF)

Credential Provisioning and Management

OCF Credential Management Services ....

blah

ACL Provisioning and Management

OCF Access Control List management services ...

blah

Part IV

Add-ons

Topics:

- Cloud Programming

Iotivity implements some add-ons...

Chapter 8

Cloud Programming

Topics:

Iotivity Cloud overview (wiki)

There are three servers and a sample client in IoTivity Cloud project. This page will guide you how to install and run cloud servers. The sample client will let you to test server and how to make clients for cloud.

Related information

Iotivity Cloud - Programming Guide (Iotivity Wiki)

Cloud Server

Cloud Client

Appendix A

User Guide Appendix

This appendix describes things that you rarely need to know.

You can consult this section when you need detailed information about a specific component.

Glossary

ACL2
: **A**ccess **C**ontrol **L**ist (version **2**). An *SVR* whose state controls resource access. See ACL2 (Access Control List) on page 30 for details.

AMACL
: **A**ccess **M**anager **ACL** resource. An *SVR* whose state supports management of non-local ACLs. See AMACL (Access Manager ACL) resource on page 30 for details.

AMS
: ACL **M**anagement **S**ervice(s)

Authentication
: Authentication verifies the identity of ...

Authorization
: Authorization refers to the process of granting or denying a request to access a resource.

Cipher Suite
: A cipher suite is ...

CMS
: **C**redential **M**anagement **S**ervice(s)

CRED
: **CRED**ential SVR. An *SVR* whose state controls security credentials. See CRED (Credentials) on page 30 for details.

Cryptographic Credential
: A cryptographic credential is ...

DOXM
: **D**evice **O**wnership **T**ransfer **M**anagement. An *SVR* whose state controls device ownership transfer. See DOXM (Device Ownership Transfer Management) on page 30 for details.

DOXS
: **D**evice **O**wnership **T**ransfer **S**ervice. An OCF DOXS provides device registration (ownership transfer) services.

Provisioning
: Provisioning refers to the distribution of the *SVR* data necessary to correctly configure an OCF device. See Security Virtual Resources on page 29.

PSTAT
: **P**rovisioning **STAT**us. An *SVR* whose state controls security provisioning. See PSTAT (Provisioning Status) on page 30 for details.

RESET
: **RESET**. A security state indicating the device is in the (manufacturer-defined) default security state.

RFNOP
: **R**eady **F**or **N**ormal **O**peration. A security state indicating the device is properly provisioned and configured for normal operations.

RFOTM
: **R**eady **F**or **O**wnership **T**ranser **M**ethod. A security state indicating the device is properly provisioned and configured for ownership transfer.

RFPRO
: **R**eady **F**or **PRO**visioning. A security state indicating the device is properly provisioned and configured for security resource provisioning.

SACL
: **S**igned **A**ccess **C**ontrol **L**list resource. An *SVR* whose state supports management of cryptographically signed ACLs. See SACL (Signed ACL) on page 30 for details.

Soft Reset
: Soft **RESET**. A security state indicating the device is not operational but is owned (registered with the network).

SVR
: **S**ecurity **V**irtual **R**esource. An OCF-defined resource whose state governs some aspect of security. See Security Virtual Resources on page 29.

TBS
: **T**o **B**e **S**igned. Refers to certificates and certificate lists.

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