

Security_4_Plugfest – How To

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Introduction

This document assumes that you will (or consider to) participate in the Plugfest during the Nice F2F of the W3C IG WoT and you are developing any of the following components:

- A **resource server** (short: RS) responding to requests via **HTTP** or **CoAP**
- A **client** (short: C) sending requests via **HTTP** or **CoAP**

This document provides a how-to for the security-enabling of these interactions. An overview of the security-enabling is provided in an accompanying slide-deck.

Unprotected Interactions

Adding security is regarded optional for the Nice Plugfest. So your client and/or server should be prepared to accept resp. provide requests via HTTP-plain resp. CoAP-plain without supplying or requiring a security token. This document does not provide further details about unprotected interactions. Do consult other Plugfest documents for that.

Protected Interactions

The following describes the *basic* protection of the interactions during the Nice Plugfest. It is intentional to offer a *low entry*-barrier to encourage many security-enabled Plugfest implementations. For that purpose it is fully intentional to take various shortcuts (e.g. static settings/configurations, 'allow-all'/liberal policies, minimal token contents, optional transport-level security etc.). For production use additional considerations and additional security mechanisms/checks will typically be required: ***the basic protection utilized for Plugfest security shall not be used 1:1 in production setups***

This protection comprises following security services:

- Request authorization and (indirect) caller authentication: this is achieved by means of security tokens. For the Nice Plugfest this is the **primary security goal**. This is detailed in the first part of this HowTo.
- (Optional) message authentication and encryption: this is done by means of TLS (for HTTP) and DTLS (for CoAP). It presents a **subordinate security goal** for the Nice Plugfest. This is detailed in the second part.

Simple Request Authorization and Caller Authentication

The goal is to authorize requests and (implicitly) authenticate callers by means of bearer¹ security tokens (JWT²) with minimal contents.

Communications via HTTP

This section applies to Cs and RSs which support HTTP as a means of their interaction.

RS Developers

Configuration

Configure the RS component with

- RS id: NicePlugfestRS³
- AS issuer name NicePlugfestAS
- AS public signature verification key for ES256⁴. This is following JWK object⁵:

```
{
  "keys": [
    {
      "kty": "EC",
      "use": "sig",
      "crv": "P-256",
      "kid": "PlugFestNice",

```

¹ A shortcut: for the protection of high-value resources, PoP resp. HoK models may be required

² Another shortcut: JWTs are standard (RFC 7519), well-understood among Web developers and well-covered in implementation (see jwt.io). JWTs match RFC 7228 class 2 devices. Equivalent means for class 1 or 0 are not yet available - not yet as standards and also not as (mature) implementations

³ Another shortcut: static/invariant RS identifier values for all RSs

⁴ See appendix for the utilization of alternative JWT token signature schemes

⁵ Another shortcut: this is a plain public key for verifying JWT signature values

Unrestricted

```

        "x": "CQsJZUvJWx5yB5EwuipDXRDye4Ybg0wwqxpGgZtcl3w",
        "y": "qzYskD2N7GrGDSgo6N9pPLXMIwr6jowFGyqsTJGmpz4",
        "alg": "ES256"
    }
  ]
}

```

Registration

Skipped⁶ for RSs that support ES256

Operation

When receiving a HTTP request at a protected endpoint:

1. Check if the request contains an `Authorization` header. Respond with a 401 error if not
2. Check if the request contains an `Authorization: Bearer`-header with non-null/empty contents. Respond with a 401 error if not
3. Check if the value of the `Authorization Bearer`-header is a JWT object. Respond with a 401 error if not
4. Check if the JWT object is signed. Respond with a 401 error if not
5. Check if the signature of the JWT object is valid. This is to be checked with AS public signature verification key (see above). Respond with a 401 error if invalid
6. Check the contents of the JWT object⁷:
 - o Check if the value of “iss” is `NicePlugfestAS`. Respond with a 401 error if not
 - o Check if the value of “aud” is `NicePlugfestRS`. Respond with a 401 error if not
7. Accept the request as well as “sub” as the originator of the request and process it as usual⁸

For more background see RFC 6750 (HTTP Bearer tokens) and RFC 7519 (JWT), RFC 7517 (JWK). For JWT libraries in various programming languages see <http://jwt.io/> section “*Libraries for Token Signing/Verification*”. For JSON libraries see <http://json.org/>. Depending on the chosen strategy (JSON vs. JWT library) and instance, the steps 4-6 will be done by a 3rd party library

C Developers

Configuration

Not required

Registration

Registration may be done programmatically (default) or manually⁹ (fallback). Programmatic registration is done according RFC 7591 and described in the following:

⁶ Another shortcut

⁷ Another shortcut: further checks would apply in production environments including an “aud” check which depends on RS registration (that was skipped for simplicity)

⁸ Another shortcut that implements a naive and very coarse access control: presenters of a valid security token (no detailing anything about the resource) may access any available resource with any method. One would not do this in production systems at least not without careful consideration.

Unrestricted

Create a HTTP request¹⁰ with JSON request content as in the following prototype and send it via TLS to the AM¹¹:

Request:

```
POST /iam-services/0.1/oidc/am/register HTTP/1.1
```

Request headers:

```
Host: ec2-54-154-59-218.eu-west-1.compute.amazonaws.com
Content-Type: application/json
Accept: application/json
```

Request body¹²:

```
{
  "client_name": "yourClientName",
  "grant_types": ["client_credentials"]
}
```

Security: note that the registration endpoint is unprotected for the purpose of the Plugfest¹³. To comply with its TLS profile, configure the client-side TLS engine as follows:

- **Protocol version:** TLSv1.2, 1.1 or 1.0 (note that the usage of SSLv3.0 is deprecated by the IETF)
- **Cipher suite:** any ECDHE_ECDSA cipher suite. Note that ECDSA is used as public key algorithm during server authentication
- **Server authentication:** configure the trusted root CAs to Plugfest root CA certificate

Response:

Check that you get a 201 Created response and extract the value of “client_id” (this value is called <c_id> in the following) and the value of “client_secret” (called <c_secret> in the following) from the JSON response body. A response body prototype¹⁴ is:

```
{
  "client_id": "889d02cf-16dd-4934-9341-a754088faxyz",
  "client_secret": "ahd5MU42J0hIxPXzhUhjJHt2d0Oc5M6B644CtuwU1E9zpSuF14-kXYZ",
}
```

Store <c_id>¹⁵ and <c_secret>¹⁶ for use during the token acquisition.

⁹ For manual registration send a mail with *yourClientName* to the author of this document. You will get <c_id> and <c_secret> values in a response mail.

¹⁰ If the C component is implemented as a browser-based app that wants to utilize XMLHttpRequest for interactions with AM (registration, token request) the CORS rules apply (see <http://www.w3.org/TR/cors/>). Right now the AM does not set HTTP allow-origin headers. This will be needed for Cs calling by means of XMLHttpRequest. Send a mail to the author for further coordination

¹¹ URL: <https://ec2-54-154-59-218.eu-west-1.compute.amazonaws.com/iam-services/0.1/oidc/am/register>

¹² Naming convention: replace all values prefixed “*your*” with your value i.e. use any string of your choice instead “*yourClientName*”

¹³ Another shortcut that one would not do - at least not without careful consideration- in production

¹⁴ The actual response object (JSON) will provide more information. The JSON response members that shall be processed are documented here. Additional information may be ignored.

Token Acquisition

Create a HTTP request as in the following prototype and send it via TLS to the AM¹⁷:

Request:

```
POST /iam-services/0.1/oidc/am/token HTTP/1.1
```

Request headers:

```
Host: ec2-54-154-59-218.eu-west-1.compute.amazonaws.com
Content-Type: application/x-www-form-urlencoded
Accept: application/json
Authorization: Basic Base64(<c_id>:<c_secret>)
```

Request body:

```
grant_type=client_credentials
```

Security: same as in registration

Response:

Check that you get a 200 OK response and extract the value of the `access_token` member from the JSON response body. A response body prototype is:

```
{
  "access_token": "eyJhbGciOiJIUzI1NiJ9.eyJhdWQiOiJhYjliN2NiNy02YzQwLTQ3ZjU0OTBiOC0xNTlmMzQ0MDIxOTYiLCJzdzIiOiJhYjliN2NiNy02YzQwLTQ3ZjU0OTBiOC0xNTlmMzQ0MDIxOTYiLCJpc3MiOiJodHRwczpcL1wvYW0uY29tcGFueS1zLmNvbTo4NDQzXC9pYW0tc2VydmljZXNcLzAuMVwvb2lkY1wvYW0uYkdjaU9pSkZvekkxTmlKOS5leUpoZFdRaU9pSk9hV05sVUd4MVoyWmxjM1JTVXlJc0luTjFZaUk2SW1GaU9XSTNZMkkzTFRaak5EQXRORGRtTlMwNU1HSTRMVEUxTldZek5EUXdNakU1TmlJc0ltbHpjeUk2SWs1cFkyVlFiSFZuWm1WemRFRlRJaXdpZEhsc01qb2liM0puT25jek9uZHZkRHBxZDNRN1lYTTZiV2x1SW13aWFnUnBJam9pWTJZeU5UTm1PV1l0WXpVME5pMDBBZbVF4TFRoa1ptUXROamcyTURabE16UmhOalEwSW4wLmZlcVZFZF9JdXk1Q2FpNDhhb0RuWUhfOTlPX1ZlYncxMDdLdXpSc1Rpc1RBeHZkY1JaWjZaS3RPVWZkOUNlclYzaG1rQWF0LUNXUElCckxMOUZXTFhRIiwianRpIjo1N2MyMjFmMWItZjNkNC00ZTc4LWE4ZkZlOTQ0RmOWUxNGNjMWM5In0.Le_Y90zs092MyDgbKxUCr3eUNU8Z7-QKc0u0RSr26MHN1za2EUQ1wOoJhLDXR2dFo9geFf7mBbiM77EP6h01dA",
  "token_type": "bearer",
  "expires_in": 3600
}
```

Decode the value of the `access_token` value. This provides a JWT structure. Optionally validate it (see above for JWT validation hints). Extract the value of the `as_token` member in the JWT payload. This value is called `<as_token>` in the following.

Operation

Attach an `Authorization: Bearer <as_token>` header to HTTP requests to RS.

¹⁵ In the prototype `<c_id>=889d02cf-16dd-4934-9341-a754088facdb`

¹⁶ In the prototype `<c_secret>= ahd5MU42J0hIxPXzhUhjJHt2d0Oc5M6B644CtuwUIE9zpSuF14-kF8Q`

¹⁷ URL: <https://ec2-54-154-59-218.eu-west-1.compute.amazonaws.com/iam-services/0.1/oidc/am/token>

On an optional basis: supply C functionality that allows requesting a resource from a protected endpoint without a security token or an invalid security token (change some bytes to break the signature). This allows showing the effect of RS endpoint protection.

Communications via CoAP

This section applies to Cs and RSs which support CoAP as a means of their interaction.

RS Developers

Configuration

Same as for HTTP communications. See above

Registration

Same as for HTTP communications. See above

Operation

When receiving a CoAP request at a protected endpoint:

- Check if the request contains a CoAP option 65000 with non-null/empty contents. Respond with a 4.01 error if not
- Check if the value of the CoAP option 65000 content is `Bearer <jwt_token>` with a non-null/empty `<jwt_token>`. Respond with a 4.01 error if not
- Check if the JWT object is signed. Respond with a 4.01 error if not
- Check if the signature of the JWT object is valid. This is to be checked with AS public signature verification key (see above). Respond with a 4.01 error if invalid
- Check the contents of the JWT object¹⁸:
 - Check if the value of “iss” is `NicePlugfestAS`. Respond with a 4.01 error if not
 - Check if the value of “aud” is `NicePlugfestRS`. Respond with a 4.01 error if not
- Accept the request as well as “sub” as the originator of the request and process it as usual

C Developers

Registration

Same as for HTTP communications. See above

Token Acquisition

Same as for HTTP communications. See above

Operation

Attach `Bearer <as_token>` as value of the CoAP option `<NN>` to CoAP requests to RS.

¹⁸ Another shortcut: further checks would apply in production environments including an “aud” check which depends on RS registration (that was skipped for simplicity)

On an optional basis: provide C functionality that allows requesting a resource from a protected endpoint without a security token or an invalid security token (change some bytes to break the signature). This allows showing the effect of RS endpoint protection.

Advanced Request Authorization and Caller Authentication

The AM and AS components also support a more advanced way of request authorization that supplies a JWT bearer security token with actual access control information in style of AIF (draft-bormann-core-ace-aif-03). If you want to move to this level: send an email to the author.

Message Authentication and Encryption

Message authentication and encryption is done by means of TLS (for HTTP) and DTLS (for CoAP). Utilizing TLS and DTLS for the interactions between C and RS is an optional part of security-enabling¹⁹.

Communications via HTTP

This section applies to Cs and RSs which support HTTP as a means of interaction between C and RS and which opt-in to utilize message authentication and encryption. The goal is HTTP-over-TLS with server authentication²⁰.

RS Developers

Expose a port at the default port number 443²¹ which accepts HTTP-over-TLS according RFC 2818²². Configure the TLS engine as follows:

- **Protocol version:** all supported TLS versions (note that the usage of SSLv3.0 is deprecated by the IETF, see RFC 7568)
- **Cipher suite:** all available ECDHE_ECDSA cipher suites. Note that ECDSA is used as default public key algorithm during server authentication
- **Server authentication:** public/private key pair for ECDSA where the public key is certified by the Plugfest Root CA. To obtain a server certificate that is signed by the Plugfest Root CA send a PKCS#10 request to the author. This shall contain:

```
-----BEGIN CERTIFICATE REQUEST-----  
  
Base64(PKCS#10(serverName, serverPublicKey))  
  
-----END CERTIFICATE REQUEST-----
```

Note that common tools such as the Java KeyTool or OpenSSL can be used for ECDSA key pair as well as PKCS#10 certification request generation

¹⁹ Rationale: i. to allow the inclusion of esp. RSs without native support for TLS or DTLS resp. ii. to allow participants to focus on authorizing actions and authenticating actors

²⁰ This is a shortcut for telling the RS what to do while telling the C to accept all. Okay for a Plugfest, should not be done in any production setup.

²¹ <http://www.iana.org/assignments/service-names-port-numbers/service-names-port-numbers.txt>

²² Java containers esp. Servlet engines contain such implementations.

C Developers

When encountering a resource access at a https-URL send the HTTP request over a TLS-protected channel according RFC 2818. Configure the TLS engine to run:

- **Protocol version:** any supported TLS version (note that the usage of SSLv3.0 is deprecated by the IETF)
- **Cipher suite:** any ECDHE_ECDSA cipher suite (default: TLS_ECDHE_ECDSA_WITH_AES_128_CBC_SHA256)
- **Server authentication:** configure the trusted root CAs to contain the Plugfest Root CA

Communications via CoAP

This section applies to Cs and RSs which support CoAP as a means of interaction between C and RS and which opt-in to utilize message authentication and encryption. The goal is CoAP-over-DTLS with server authentication²³.

RS Developers

Expose a port at the default port number 5684²⁴ which accepts CoAP-over-DTLS in style of RFC 2818 (there is no equivalent to RFC 2818 in the CoAP/DTLS ecosystem). Configure the DTLS engine as follows:

- **Protocol version:** all supported DTLS versions²⁵
- **Cipher suite:** all available ECDHE_ECDSA cipher suites²⁶
- **Server authentication:** public/private key pair for ECDSA where the public key is certified by the Plugfest Root CA. To obtain a server certificate that is signed by the Plugfest Root CA send a PKCS#10 request to the author. This shall contain:

```
-----BEGIN CERTIFICATE REQUEST-----  
  
Base64(PKCS#10(serverName, serverPublicKey))  
  
-----END CERTIFICATE REQUEST-----
```

Note that common tools such as the Java KeyTool or OpenSSL can be used for ECDSA key pair as well as PKCS#10 certification request generation

C Developers

When encountering a resource accesses at a coaps-URL send the CoAP request over a DTLS-protected channel in style of RFC 2818. Configure the TLS engine to run:

- **Protocol version:** any supported DTLS version²⁷

²³ This is a shortcut for telling the RS what to do while telling the C to accept all. Okay for a Plugfest, should not be done in any production setup.

²⁴ <http://www.iana.org/assignments/service-names-port-numbers/service-names-port-numbers.txt>

²⁵ For Scandium 1.0.0 this is DTLS v1.2

²⁶ For Scandium 1.0.0 this list is: TLS_ECDHE_ECDSA_WITH_AES_128_CBC_SHA256, TLS_ECDHE_ECDSA_WITH_AES_128_CCM_8

²⁷ For Scandium 1.0.0 this is DTLS v1.2

- **Cipher suite:** any ECDHE_ECDSA cipher suite (default: TLS_ECDHE_ECDSA_WITH_AES_128_CBC_SHA256)
- **Server authentication:** configure the trusted root CAs to contain the Plugfest Root CA

Plugfest Root CA Certificate

Following self-signed root CA certificate is used for signing RS certificates for TLS and DTLS-protected communications:

```
-----BEGIN CERTIFICATE-----
MIIBgjCCASigAwIBAgIEVm6vGDAKBggqhkJOPQQDAjA3MQwwCgYDVQQKDANXM0Mx
DzANBgNVBASMBldvVCBJRzEWMBQGA1UEAwNTmljZSBQbHVnZmVzdDAgFw0xNTEy
MTQxMjAwNDFaGA8yMDY1MTIxNDEyMDA0MVowNzEMMAoGA1UECgwDVzNDMQ8wDQYD
VQQLDAAZXB1QgSUcxFjAUBgNVBAMMDU5pY2UgUGx1Z2Zlc3QwWTATBgqhkJOPQIB
BggqhkJOPQMBBwNCAARi7l1JQPjYpJCPpHRNC4nTwRj+vEWXunSiawpD9a2rKgJi
4g1+jLDmrxztrJa7e9NI9BkD9vZP2DgU6DfAU2czoYAwHjAPBgNVHRMECDAGAQH/
AgEDMA5GA1UdDwQEAwICBDAKBggqhkJOPQQDAgNIADBFAiBbYQOvT7yjmm+V9L2e
Dg6eFls4uHeorqgSlP51NbGgsgIhAJ59KwTXkFxf1CXV9vafNk02xcV1lOYn7WRW
A7NR3A19
-----END CERTIFICATE-----
```

Appendix: Alternative AS Token Signature Scheme

The default AS token signature scheme is ES256. RSs that can use JWT libraries which support ES256 can proceed as described above.

If ES256 support is not available an alternative signature scheme is needed. In this case HS256 should be considered as a fallback. This has following implications:

- Signaling the use of an alternative JWT signature scheme (to the AS) is performed as part of an RS registration at AS (not needed for ES256)
- Requesting the issuance of a JWT with an alternative signature scheme required to supply the RS identifier in the token request which implies the issuance of a “normal” AS token

If an alternative AS token signature scheme send a mail to the author for further instructions.