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JOSE signed Voucher Artifacts for Bootstrapping Protocols

Abstract

This document describes a serialiation of the RFC8366 voucher format to a JSON format is then signed using the JSON Object Signing and Encryption mechanism described in RFC7515.

In addition to explaining how the format is created, MIME types are registered and examples are provided.

Status of This Memo

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1. Introduction

[[RFC8366](#)] describes a voucher artifact used in [[BRSKI](#)] and [[RFC8572](#)] to transfer ownership of a device to from a manufacturer to an owner. That document defines the base YANG module, and also the initial serialization to JSON [[RFC8259](#)], with a signature provided by [[RFC5652](#)].

Other work, [[I-D.ietf-anima-constrained-voucher](#)] provides a mapping of the YANG to CBOR [[RFC8949](#)] with a signature format of COSE [[RFC8812](#)].

This document provides an equivalent mapping of JSON format with the signature format in JOSE format [[RFC7515](#)].

This document does not extend the YANG definition of [[RFC8366](#)] at all, but accepts that other efforts such as [[I-D.richardson-anima-voucher-delegation](#)], [[I-D.friel-anima-brski-cloud](#)], and [[I-D.ietf-anima-brski-async-enroll](#)] do. This document supports signing any of the extended schemas defined in those documents and any new documents that may appear after this one.

2. Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14 [[RFC2119](#)] [[RFC8174](#)] when, and only when, they appear in all capitals, as shown here.

3. JSON Web Signatures

[[RFC7515](#)] defines two serializations: the JWS Compact Serialization and the JWS JSON Serialization. This document restricts itself to the JWS Compact Serialization (JWT) format.

The [[RFC8366](#)] JSON structure consists of a nested map, the outer part of which is:

```
{ "ietf-voucher:voucher" : { ..some items }}
```

this is considered the JSON payload as described in [[RFC7515](#)] section 3.

The JSON Compact Serialization is explained in section 3.1 or section 7.1, and works out to:

```
BASE64URL(UTF8(JWS Protected Header)) || '.' ||  
BASE64URL(JWS Payload) || '.' ||  
BASE64URL(JWS Signature)
```

Note that this results in a long base64 content (with two interspersed dots). The content is transmitted within the HTTPS session in this base64 format, even though HTTP can accommodate binary content. This is done to be most convenient for available JWT libraries, and for humans who are debugging.

There are a number of attributes. They are:

3.1. Unprotected Header

There is no unprotected header in the Compact Serialization format.

3.2. Protected Header

The standard "typ" and "alg" values described in [[RFC7515](#)] are expected in the protected headers.

It is unclear what values, if any, should go into the "typ" header, as in the [[BRSKI](#)] use cases, there are additional HTTP MIME type headers to indicate content types.

The "alg" should contain the algorithm type such as "ES256".

If PKIX [[RFC5280](#)] format certificates are used then the [[RFC7515](#)] section 4.1.6 "x5c" certificate chain SHOULD be used to contain the certificate and chain. Vouchers will often need all certificates in the chain, including what would be considered the trust anchor certificate because intermediate devices (such as the Registrar) may need to audit the artifact, or end systems may need to pin a trust anchor for future operations.

4. Privacy Considerations

The Voucher Request reveals the IDevID of the system that is onboarding.

This request occurs over HTTPS, however the Pledge to Registrar transaction is over a provisional TLS session, and it is subject to disclosure via by a Dolev-Yao attacker (a "malicious messenger") [[onpath](#)]. This is explained in [[BRSKI](#)] section 10.2.

5. Security Considerations

The issues of how [[RFC8366](#)] vouchers are used in a [[BRSKI](#)] system is addressed in

6. IANA Considerations

6.1. Media-Type Registry

This section registers the the 'application/voucher-jwt+json' in the "Media Types" registry.

6.1.1. application/voucher-jose+json

Type name: application

Subtype name: voucher-jwt+json

Required parameters: none

Optional parameters: none

Encoding considerations: JWT+JSON vouchers are JOSE objects signed with one signer.

Security considerations: See Security Considerations, Section

Interoperability considerations: The format is designed to be broadly interoperable.

Published specification: THIS RFC.

Applications that use this media type: ANIMA, 6tisch, and other zero-touch imprinting systems

Additional information:

Magic number(s): None

File extension(s): .vjf

Macintosh file type code(s): none

Person & email address to contact for further information: IETF ANIMA WG

Intended usage: LIMITED

Restrictions on usage: NONE

Author: ANIMA WG

Change controller: IETF

Provisional registration? (standards tree only): NO

7. Acknowledgements

Your name here.

8. Changelog

9. References

9.1. Normative References

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9.2. Informative References

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www.ietf.org/internet-drafts/draft-friel-anima-brski-cloud-03.txt>.

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[I-D.richardson-anima-voucher-delegation]

Richardson, M. and J. Yang, "Delegated Authority for Bootstrap Voucher Artifacts", Work in Progress, Internet-Draft, draft-richardson-anima-voucher-delegation-02, 18 September 2020, <<http://www.ietf.org/internet-drafts/draft-richardson-anima-voucher-delegation-02.txt>>.

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Appendix A. Examples

These examples are folded according to [RFC8792] Single Backslash rule.

A.1. Example Voucher Request (from Pledge to Registrar)

The following is an example request sent from a Pledge to the Registrar. This example is from the Siemens reference Registrar system.

<CODE BEGINS> file "voucher_request_01.b64"

```
eyJhbGciOiAiRVMyNTYiLCIAieDVjIjogWyJNSU1CMmpDQ0FZQ2dBd0lCQWd\
R0FXZWdkY1NMTUFvR0NDcUdTTTQ5QkFNQ01EMHhDekFKQmd0VkJBWVRBa0Z\
TVJvd0V3WURWUUVFLREF4S2FXNW5TbWx1WjB0dmNuQXhGekFWQmd0VkJBTU1\
a3BwYm1kS2FXNW5WR1Z6ZEV0Qk1DQVhEVEU0TVRJeE1qQXpNamcxTVZvWUR\
azVPVGt4TWpNeE1qTTFPVFU1V2pCU01Rc3dDUVlEVlFRR0V3SkJVEVWTUJ\
R0ExVUVDZ3dNU21sdVowcHBibWREYjNKd01STXdFUVlEVlFRRkV3b3dNVE\
TkRVMk56ZzVNUmN3RlFZRFZRUUREQTVLYVc1b1NtbnVhMFJsZG1sa1pUQ1p\
Qk1HQnlxR1NNNDlBZ0VHQ0NzR1NNNDlBd0VIQTBJQUJNVkdH0Fo1cGpmNWp\
bnlyVXJYeVoxa1BncUJlM05YdTFkVEFEZStyL3Y2SnPJSjGwzNTVJZ2NIQzN\
eHBpYnFKTS9iV1JhRXlqcWNSmo0akprb3dDdWpWVEJUTUN3R0NTc0dBUVF\
Z3U1U0FnUWZEQjF0VWh0aExYUmxjM1F1YzJsbGJXVnVjeTFpZEM1dVpYUTZ\
VFewTXpBEJnTlZiU1VFRFRBS0JnZ3JCZ0VGQlFjREFqQU9CZ05WSFE4QkF\
0EVCQU1DQjRBd0NnWUllb1pJemowRUF3SURTQUF3U1FJZ1d0UHpJSVhZMml\
UlhKdEV4S0VoaFpkYTRYK0VwbFpvbUVJMNpBMGRzam9DSVFDM0pwUW1SWE1\
bi9wNEJ1OWl6aWk5MmVjbFR4NC9PNHJsbTdNeUxxa2hkQT09Il19.eyJpZX\
mLXZvdWNoZXItcmVxdWVzdDp2b3VjaGVyIjogeyJjcmVhdGVkLW9uIjogIj\
wMjAtMTAtMjJUMDI6Mzc6MzkuMDAwWiIsICJub25jZSI6ICJlRHMmKy9GdU\
IR1VuUnh0M0UxNENRPT0iLCIAic2VyawFsLW51bWJlciI6ICIwMTIzNDU2Nz\
5In19.Vj9pyo43KDEqe5tokwHpNhVM0uUkLCatwNQxfsCKH8GRQ2iTT2fq\
39k40M-7S-vheDHHuBHFSWb502EPwkdA
<CODE ENDS>
```

It contains the following three parts:

Header:

<CODE BEGINS> file "voucher_request_01-header.b64"

```
{
  "alg": "ES256",
  "x5c": [
    "MIIB2jCCAYCgAwIBAgIGAWeGdcSLMAoGCCqGSM49BAMCMD0xCzAJBg\
    VBAYTAKFRMRUwEwYDVQQKDAxKaW5nSmluZ0NvcnAxZzAVBgNVBAMMDkppbm\
    KaW5nVGVzdENBMCAXDTE4MTIxMjAzMjg1MVoYDzK50TkxMjMxMjM10TU5Wj\
    SMQswCQYDVQQGEwJBUTEVMBMGA1UECgwMSmluZ0ppbmdb3JwMRMwEQYDVQ\
    FEwowMTIzNDU2Nzg5MRCwFQYDVQQDDA5KaW5nSmluZ0RldmJjZTBZMBMGBY\
    GSM49AgEGCCqGSM49AwEHA0IABMVGG8Z5pjf5jXnyrUrXyZ1kPgqBe3NXu1\
    TADe+r/v6JzIHL355IgcHC3axpibqJM/bWRaEyjqcCJj4jJkowCujVTBTMC\
    GCSsGAQQBgu5SAgQfDB1tYXNhLXRlc3Quc2llbWVucy1idC5uZXQ60TQ0Mz\
    TBgNVHSUEDDAKBggrBgEFBQcDAjA0BgNVHQ8BAf8EBAMCB4AwCgYIKoZIZj\
    EAwIDSAARQIgwTzPzIIXY2ixRXJtExKEhhZda4X+EplZomEI2zA0dsjoCIQ\
    3JpQmRXMGn/p4Bu9izii92ecLTx4/04rlm7MyLqkhdA=="
  ]
}
```

<CODE ENDS>

Payload:

<CODE BEGINS> file "voucher_request_01-payload.b64"

```
{
  "ietf-voucher-request:voucher": {
    "created-on": "2020-10-22T02:37:39.000Z",
    "nonce": "eDs++/FuDHGUnRxN3E14CQ==",
    "serial-number": "0123456789"
  }
}
```

<CODE ENDS>

Signature:

<CODE BEGINS> file "voucher_request_01-signature.b64"

```
Vj9pyo43KDEq0e5tokwHpNhVM0uUkLCatwNQxfSCKH8GRQ2iTT2fqD39k40\
-7S-vheDHHuBHFSWb502EPwkDA
```

<CODE ENDS>

A.2. Example Parboiled Voucher Request (from Registrar to MASA)

The following is an example request sent from the Registrar to the MASA. This example is from the Siemens reference Registrar system. Note that the previous voucher request can be seen in the payload as "prior-signed-voucher-request".

<CODE BEGINS> file "parboiled_voucher_request_01.b64"

eyJhbGciOiJFUzI1NiIsIng1YyI6WyJNSUlc3pDQ0FVcWdBd0lCQWdJR0F\
MGVMdUlGTUFvR0NDcUdTTTQ5QkFNQ01EVXhFekFSQmd0VkJBb01DazE1UW5\
emFXNWxjM014RFRBTEJnTlZCQWNNQkZ0cGRHVXhEekFOQmd0VkJBTU1CbFJ\
YzNSRFFUQWVGdzB4T1RBNU1URXdNak0zTXpKYUZ3MHlPVEE1TVRFd01qTTN\
ekphTUZReEV6QVJCZ05WQkFvTUNrMTVRblZ6YVc1bGMzTXhEVEFMQmd0VkJ\
Y01CRk5wZEdVeExqQXNCZ05WQkFNTUpWSmxaMmx6ZEhKaGNpQldiM1ZqYUd\
eUlGSmxjWFZsYzNRZ1UybG5ibWx1WnlCTFpYa3dXVEFUQmdjcWhrak9QUU\
QmdncWhrak9QUU1CQnd0Q0FBVDZ4VnZBdnFuejFaVWl1TldoWHBRc2thUHK\
QUhIUUx3WGLKMGlfTHQ2dU5QYW5BTjBRbldNWU8vMENERWpJa0JRb2J30Fl\
cWp0eEpIVlNHVGo5S09veWN3SlRBVEJnTlZIU1VFRERBS0JnZ3JCZ0VGQlF\
REhEQU9CZ05WSFE4QkFm0EVCQU1DQjRBd0NnWUllb1pJemowRUF3SURSd0F\
UkJFJZ1lyMkxmcW9hQ0tERjRSQWNNbUppK05DwnFkU2l1VnVnSVNBN09oS1J\
M1lDSUR4blBNTW5wWefNVHJQSnVQV3ljZUVSMTFQeEhPbiswQ3BTSGkycWd\
VlgiLCJNSUlcCERDQ0FvBd0lCQWdJR0FXMGVMdUgrTUFvR0NDcUdTTTQ\
QkFNQ01EVXhFekFSQmd0VkJBb01DazE1UW5WemFXNWxjM014RFRBTEJnTlZ\
QWNNQkZ0cGRHVXhEekFOQmd0VkJBTU1CbFJsYzNSRFFUQWVGdzB4T1RBNU1\
RXdNak0zTXpKYUZ3MHlPVEE1TVRFd01qTTNnekphTURVeEV6QVJCZ05WQkF\
TUNrMTVRblZ6YVc1bGMzTXhEVEFMQmd0VkJBY01CRk5wZEdVeER6QU5CZ05\
QkFNTUJsUmxjM1JEUVRCWk1CTUdCeXFHU0000UFnRUdDQ3FHU0000UF3RUh\
MElBQk9rdmtUSHU4UwXUM0ZISjFVYUk3K1dzSE9iMFVTM1NBTHRHNXd1S1F\
amlleDA2L1NjWTVQSmldmdIVEIrrRi9RVGpnZWxIR3kxWUtwd2N0TWNzU3l\
alJUQkRNQklHQTFVZEV3RUlvd1FJTUFZQkFm0ENBUUV3RGdZRFZSMFBBUg\
QkFRREFnSUVNqjBHQTfVZERnUVdCQlRvWklNelFkc0Qvai8rZ1gvN2NCSnV\
SC9YbWpBS0JnZ3Foa2pPUFFRREFnTkpbREJHQWlFQXR4UTMrSUxHQLBJdFN\
NGI5V1hoWE51aHFTUDZIK2IvTEMvZlZZRGpRNm9DSVFERzJ1UkNIbFZxM3l\
Qju4VFhNVWJ6SDgrT2xoV1V2T2xSRDNWRXFEZGNRdz09Il19.eyJpZXRMlX\
vdWNoZXItcmVxdWVzdDp2b3VjaGVyIjpw7InNlcmlhbC1udW1iZXIiOiIwMT\
zNDU2Nzg5Iiwibm9uY2UiOiJlRHMmKy9GdURIR1VuUnh0M0UxNENRPT0iLC\
wcmVlcilzaWduZWQtdm91Y2hlcilzXFl1ZXN0IjoiaXZlKaGJHY2lPaUFpU\
NeU5UWwLMQ0FpZURWaklqb2dXeUp0U1VsQ01tcERRMEZaUTJkQmQwbENRV2\
KUjBGWFpXZGtZMU5NVFVGdlIwTkrjVWRUVFRRNVFrRk5RMDFFTUhoRGVrRk\
RbWRPvmtKQldWUkJhMFpTVFZKvMqWvjNXVVJXVVZGTFJFRjRTMkZYTlclVG\
XeDFXakJPZG10dVFYaEdla0ZXUW1kT1ZrSkJUVTFFYTNCd1ltMwtTMkZYTl\
1V1IxWjZarVZPUWsXRFFWaEVWRVUwVFZSSmVFMXFRWHB0YW1jeFRWwNzXVV\
2YXpWUFZHdDRUV3B0ZUUXcVRURlBWRLUxVjJwQ1UwMVJjM2REVZsRVZsRL\
SMFYzU2tKVlZfVldUVUp0UjBFeFZVvKRam2R0VTIxc2RWb3djSEJpYldSRV\
qTktkMDFTVfhkRlVwBEVWbEZSUmTWm2IzZE5WRWw2VGtSVk1rNTZaelZ0VW\
OM1JsRlpSRlpSVVVSrvFUVkxZVmMxYmx0dGJIVmFNRkpzWkcxc2FscFVRbH\
OUWsXSFFubHhSMU50TKRsQlowVkhRME54UjF0Tk5EbEJkMFZJUVRCSlFVSk\
Wa2RIT0ZvMWNHcG10V3BZYm5seVZYSlllVm94YTFcBmNVSmxNMDVZZFRGa1\
FRkVaU3R5TDNZNlNucEpTR3d6TlRWSloyTk1Rek5oZUhCcFluRktUuzlpVj\
KaFJYbHFjV05EU21vMGFrchJiM2REZFdwV1ZFSlVUVU4zUjB0VGMwZEJVVk\
DwjNVMVUwRm5V1pFUWpGMFdwE9hRXhZVW14ak0xRjFZekpzYkdKWFZuVm\
lVEZwWkVNMWRwcFlVVFpQVkJZFd1RYcEJWRUpuVGxaSVUxVkJZSRVJCUzBKbl\
zSkNaMFZHUWxGa1JFRnFRVTldWjA1V1NGRTRRa0ZtT0VWQ1FVMURRa1JCZD\
ObldVbExiMxBKZW1vd1JVRjNTVVJUUVVGM1VsRkpaMWQwVUhwSlNWaFpNbW\
0VWxoS2RFVjRTMFZvYUzwa1lUu1llLMFZ3YkZwdmJVVkpNbnBCTUdSemFtOU\
TVkZETTBwd1VXMVNXRTFIYmk5d05FSjFPV2w2YVdrNU1tVmpiRlI0TkM5UE\
ISnNiVGR0ZV4eGEyaGtRVDA5SWwx0S5leUpwWlhSbUxYWnZkV05vWlhJdG\
tVnhkV1Z6ZERwMmIzVmPhR1Z5SWpvZ2V5SmpjbVZoZEdWa0xX0XVJam9nSW

Jd01qQXRNVEF0TWpKVU1ESTZNemM2TXprdU1EQXdXaUlzSUNKdWIyNWpaU0\
2SUNKbFJITXJLeTlHZFVSSVixVnVVbmhPTTBVeE5FTlJQVDBpTENBaWMyVn\
hV0ZzTFc1MWJXSmxjaUk2SUNJd01USXp0RFUyTnpnNULuMTkuVmo5cHlvND\
LREVxMGU1dG9rd0hwTmhWTTB1VWtMQ2F0d05ReGZzQ0tI0EdSUTJpVFQyZn\
EMzlrNDBNLtDTLXZoZURISHVCSEZTV2I1MDJFUHDrZEEiLCJjcmVhdGVkLW\
uIjoiMjAyMC0xMC0yMlQwMjozNzoz0S4yMzVaIn19.S3BRYIKHbsqwQEzSB\
J1C0IVAx02NPEc5oo_BnXK_JkQfStTIEHFCALdv5MzYdTU9myJ01muaSFEI\
_NFMSFjA

<CODE ENDS>

It contains the following three parts:

Header:

<CODE BEGINS> file "parboiled_voucher_request_01-header.b64"

```
{
  "alg": "ES256",
  "x5c": [
    "MIIBozCCAUqgAwIBAgIGAW0eLuIFMAoGCCqGSM49BAMCMDUxEzARBg\
VBAoMCK15QnVzaW5lc3MxDTALBgNVBACMBFNpdGUxDzANBgNVBAMMB1Rlc3\
DQTAeFw0xOTA5MTEwMjM3MzJaFw0yOTA5MTEwMjM3MzJaMFQxEzARBgNVBA\
MCK15QnVzaW5lc3MxDTALBgNVBACMBFNpdGUxLjAsBgNVBAMMJVJlZ2lzdH\
hciBwb3VjaGVyIFJlcXVlc3QgU2lnbmLuZyBLZXkwWTATBgqcqhkJOPQIBBg\
qhkJOPQMBBwNCAAT6xVvAvqTz1ZUiuNWhXpQskaPy7AHHQLwXiJ0iELt6uN\
anAN0QnWMY0/0CDEjIkBQobw8YKqjtxJHVSGTj9K0oycwJTATBgNVHSUEDD\
KBggrBgEFBQcDHDAAOBgNVHQ8BAf8EBAMCB4AwCgYIKoZIZj0EAwIDRwAwRA\
gYr2LfqaCKDF4RACMmJi+NCZqdSiuVugISA70hKRq3YCIDxnPMMnpXAMTr\
JuPWyceER11PxH0n+0CpSHi2qgpWX",
    "MIIBpDCCAUmgAwIBAgIGAW0eLuH+MAoGCCqGSM49BAMCMDUxEzARBg\
VBAoMCK15QnVzaW5lc3MxDTALBgNVBACMBFNpdGUxDzANBgNVBAMMB1Rlc3\
DQTAeFw0xOTA5MTEwMjM3MzJaFw0yOTA5MTEwMjM3MzJaMDUxEzARBgNVBA\
MCK15QnVzaW5lc3MxDTALBgNVBACMBFNpdGUxDzANBgNVBAMMB1Rlc3RDQT\
ZMBMGBYqGSM49AgEGCCqGSM49AwEHA0IAB0kvkTHu8QlT3FHJ1UaI7+WsH0\
0US3SALtG5wuKQDjiejx06/ScY5PJibvgHTB+F/QTjgeLHGy1YKpwcNMcsSy\
jRTBDMBIGA1UdEwEB/wQIMAYBAf8CAQEWdgYDVR0PAQH/BAQDAgIEMB0GA1\
dDgQWBBToZIMzQdsD/j/+gX/7cBJucH/XmjAKBggqhkJOPQQDAgNJADBGAi\
AtxQ3+ILGBPItSh4b9WXhXNuhqSP6H+b/LC/fVYDjQ6oCIQDG2uRCHlVq3y\
B58TXMUbzH8+0lhWUv0lRD3VEqDdcQw=="
  ]
}
```

<CODE ENDS>

Payload:

```
<CODE BEGINS> file "parboiled_voucher_request_01-payload.b64"
```

```
{
  "ietf-voucher-request:voucher": {
    "serial-number": "0123456789",
    "nonce": "eDs++/FuDHGUnRxN3E14CQ==",
    "prior-signed-voucher-request": "eyJhbGciOiAiRVMyNTYiLC\
ieDVjIjogWyJNSUlCMmpDQ0FZQ2dBd0lCQWdJR0FXZWdkY1NMTUFvR0NDcU\
TTTTQ5QkFNQ01EMHhDekFKQmd0VkJBwVRBa0ZSTVJVd0V3WURWUVFLREF4S2\
XNW5TbWx1WjB0dmNuQXhGekFWQmd0VkJBTU1Ea3BwYm1kS2FXNW5WR1Z6ZE\
0Qk1DQVhEVEU0TVRJeE1qQXpNamcxTVZvWUR6azVPVGt4TWpNeE1qTTFPVF\
1V2pCU01Rc3dDUVlEVlFRR0V3SkJVVEVWTUJNR0ExVUVDZ3dNU21sdVowcH\
ibWREYjNKd01STXdFUVlEVlFRRkV3b3dNVEl6TkRVMk56ZzVNUmN3RlFZRF\
RUUREQTVLYVc1b1NtbHVhVAMFJsZG1salpUQlNkQk1HQnlxR1NNNDlBZ0VHQ0\
xR1NNNDlBd0VIQTBJQUJNVkdHOFo1cGpmNwpybnlyVXJYeVoxa1BncUJlM0\
YdTFkVEFEZStyL3Y2SnpJSgwzNTVJZ2NIQzNheHBpYnFKTS9iV1JhRXlqcW\
DSmo0akprb3dDdWpWVEJUTUN3R0NTc0dBUVFCZ3U1U0FnUWZEQjF0WVh0aE\
YUmxjM1F1YzJsbGJXVnVjeTFpZEM1dVpYUTZPVFEwTXpBVEJnTlZlU1VFRE\
BS0JnZ3JCZ0VGQlFjREFqQU9CZ05WSFE4QkFm0EVCQU1DQjRBd0NnWUllb1\
JemowRUF3SURTQUF3U1FJZ1d0UHpsSVhZMml4UlhKdEV4S0VoaFpkYTRYK0\
wbFpnbUVJMNpBMGRzam9DSVFDMD0pwUW1SWE1Hbi9wNEJlOWl6aWk5MmVjbF\
4NC9PNHJsbTdNeUxxa2hkQT09Il19.eyJpZXRmLXZvdWNoZXItcmVxdWVzd\
p2b3VjaGVyIjogeyJjcmVhdGVkLW9uIjogIjIwMjAtMTAtMjJUMDI6Mzc6M\
kuMDAwWiIsICJub25jZSI6ICJlRHMkY9GdURIR1VuUnh0M0UxNENRPT0iL\
Aic2VyaWFsLW51bWJlciI6ICJlMTIzNDU2Nzg5In19.Vj9pyo43KDEq0e5t\
kwHpNhVM0uUkLCatwnQxfSCKH8GRQ2iTT2fqD39k40M-7S-vheDHHuBHFSW\
502EPwkdA",
    "created-on": "2020-10-22T02:37:39.235Z"
  }
}
```

```
<CODE ENDS>
```

Signature:

```
<CODE BEGINS> file "parboiled_voucher_request_01-signature.b64"
```

```
S3BRYIKHbsqwQEzSBgJlCOIVAx02NPEc5oo_BnXK_JkQfStTIEHFCALdv5M\
YdTu9myJ01muaSFEIu_NFMSFJA
<CODE ENDS>
```

A.3. Example Voucher Result (from MASA to Pledge, via Registrar)

The following is an example voucher sent from the Registrar to the MASA. This example is from the Siemens reference MASA system.

<CODE BEGINS> file "voucher_01.b64"

eyJhbGciOiJFUzI1NiIsIng1YyI6WyJNSUlcCa3pDQ0FUaWdBd0lCQWdJR0F\
RkQjQ2tZTUfVr0NDcUdTTTQ5QkFNQ01EMHhDekFKQmd0VkJBWRBa0ZSTVJ\
d0V3WURWUvFLREF4S2FXNW5TbWx1WjB0dmNuQXhGekFWQmd0VkJBTU1Ea3B\
Ym1kS2FXNW5WR1Z6ZEV0Qk1CNFhEVEU0TURFeU9URXd0VEkwTUZvWERUSTR\
REV5T1RFd05USTBNRm93VHpFTE1Ba0dBmVVFQmhNQ1FWRXhGVEFUQmd0VkJ\
b01ERXBWYm1kS2FXNW5RMj15Y0RFcE1DY0dBmVVFQXd3Z1NtbHVAMHBWYm1\
RGIzSndJRlp2ZFd0b1pYSWdVMmxuYm1sdVp5QkxawGt3V1RBVEJnY3Foa2p\
UFFJQkJnZ3Foa2pPUFFNQk1J3TKNBQVNDNmJlTEFtZXExVnc2aVFyUnM4UjB\
Vys0YjFHV3lkbVdzMkdBTUZXd2JpdGYybklYSDNPcUhlVnU4czJSdmlCR05\
dk9LR0JISHRCZGlGRVpadmI3b3hJd0VEQU9CZ05WSFE4QkFm0EVCQU1DQjR\
d0NnWUllb1pJemowRUF3SURTUUF3UmdJaEFJNFBZYnh0c3NIUDJWSHgvdHp\
b1EvU3N5ZEwzMERRSU5FdGN00W1DVfHQQWlFQXZJYjNvK0ZPM0JUbmNMRnN\
SlpSQWtkn3pPdXNuLy9aS09hRUtic1ZEaVU9Il19.eyJpZXRMlXZvdWNoZX\
6dm91Y2hlciI6eyJhc3NlcnRpb24iOiJsb2dnZWQiLCJzZXJpYWwtbnVtYm\
yIjoimDEyMzQ1Njc4OSIsIm5vbmNlIjoizURzKysvRnVESEdVblJ4TjNFMT\
DUT09IiwiY3JlYXRlZC1vbiI6IjIwMjAtMTAtMjJUMDI6Mzc6MzkuOTIxWi\
sInBpbm5lZC1kb21haW4tY2VydCI6Ik1JSUJwRENDQVvtZ0F3SUJBZ0lHQV\
wZUx1SCtNQW9HQ0NxR1NNNDlCQU1DTURVeEV6QVJCZ05WQkFvTUNrMTVRbl\
6YVclbGMzTXhEVEFMQmd0VkJBY01CRk5wZEdVeER6QU5CZ05WQkFNTUJsUm\
jM1JEUVRBZUz3MHhPVEE1TVRFd01qTTNNekphRncweU9UQTVNVEV3TWpNM0\
6SmFNRfV4RXpBUKJnTlZCQW9NQ2sxNVFuVnphVzVsYzNNeERUQUxCZ05WQk\
jTUJGTnBKR1V4RHpbTKJnTlZCQU1NQmxSbGMzUkRRVEJATUJNR0J5cUdTTT\
5QWdFR0NDcUdTTTQ5QXdfSEEWsUFCT2t2a1RIIdThRbFQzRkhKMVvhSTcrV3\
IT2IwVVMzU0FMdEc1d3VLUURqaWV4MDYyVU2NZNVBKawJ2Z0hUQitGL1FUam\
lbEhHeTFZS3B3Y05NY3NTewFqUlRCRE1CSUdBMVVKRXdfQi93UUlNQVlCQW\
4Q0FRRXdEZ1lEVlIwUEFRSC9CQVFEQWdJRUICMEdBMVVKRGdRV0JCVG9aSU\
6UWRzRC9qLytnWC83Y0JKdWNIL1htakFLQmdncWhrak9QUVFEQWd0SkFEQk\
BaUVBdHhRMytJTEdCUEl0U2g0Yj1XWGHYtNvocVNQNkgRYi9MQy9mVllEal\
2b0NJUURHMnVSQ0hsVnEzeWhCNThUWE1VYnpIOctPbGhXVXZPbFJEM1ZFcU\
kY1F3PT0ifX0.u1i0_VB6xIhE8QuhKDGgCxxksnR20IoL0p6qYKpYBDtgkR\
2ykD0_QFjk7W8P5ATW-CQnWlJ3ILSeiwMf9nIOg

<CODE ENDS>

It contains the following three parts:

Header:

```
<CODE BEGINS> file "voucher_01-header.b64"
```

```
{
  "alg": "ES256",
  "x5c": [
    "MIIBkzCCATigAwIBAgIGAWFBjCkYMAoGCCqGSM49BAMCMD0xCzAJBg\
    VBAYTAKFRMRUwEwYDVQQKDAxKaw5nSmluZ0NvcnAxZzAVBgNVBAMMDkppbm\
    Kaw5nVGVzdENBMB4XDTE4MDEyOTEwNTI0MFoXDTI4MDEyOTEwNTI0MFowTz\
    LMAkGA1UEBhMCQVExFTATBgNVBAoMDEppbmdKaw5nQ29ycDEpMCCGA1UEAw\
    gSmluZ0ppbmdDb3JwIFZvdWNoZXIguZ2lnbmLuZyBLZXkwWTATBgqhkJOPQ\
    BBggqhkJOPQMBBwNCAASC6beLAmeq1Vw6iQrRs8R0ZW+4b1GWydWws2GAMF\
    wbitf2nIXH30qHKVu8s2RviBGNiv0KGBHHtBdiFEZZvb7oxIwEDA0BgNVHQ\
    BAf8EBAMCB4AwCgYIKoZIzj0EAwIDSQAwwRgIhAI4PYbxtssHP2VHx/tzUoQ\
    SsydL30DQINETcN9mCTXPAiEAvIb3o+F03BTncLFsaJZRAkd7z0usn//ZK0\
    EKbsVDiU="
  ]
}
<CODE ENDS>
```

Payload:

```
<CODE BEGINS> file "voucher_01-payload.b64"
```

```
{
  "ietf-voucher:voucher": {
    "assertion": "logged",
    "serial-number": "0123456789",
    "nonce": "eDs++/FuDHGUnRxN3E14CQ==",
    "created-on": "2020-10-22T02:37:39.921Z",
    "pinned-domain-cert": "MIIBpDCCAUmGAWIBAgIGAW0eLuH+MAoG\
    CqGSM49BAMCMDUxEzARBgNVBAoMCK15QnVzaW5lc3MxDTALBgNVBACMBFNp\
    GUxDzANBgNVBAMMBLRLc3RDQTAeFw0xOTA5MTEwMjMzMzJaFw0yOTA5MTEw\
    jM3MzJAMDUxEzARBgNVBAoMCK15QnVzaW5lc3MxDTALBgNVBACMBFNpdGUx\
    zANBgNVBAMMBLRLc3RDQTBZMBMGByqGSM49AgEGCCqGSM49AwEHA0IAB0kv\
    THu8QlT3FHJ1UaI7+WsH0b0US3SALtG5wuKQDjiex06/ScY5PJibvgHTB+F\
    QTjgeLHGy1YKpwcNMcsSyajRTBDMBIGA1UdEwEB/wQIMAYBAf8CAQEwDgYD\
    R0PAQH/BAQDAgIEMBOGA1UdDgQWBBToZIMzQdsD/j/+gX/7cBJuch/XmjAK\
    ggqhkJOPQQDAgNJADBGAIeAtxQ3+ILGBPItSh4b9WXhXNuhqSP6H+b/LC/f\
    YDjQ6oCIQDG2uRCHlvq3yhB58TXMUbzH8+0lhWUv0lRD3VEqDdcQw=="
  }
}
<CODE ENDS>
```

Signature:

<CODE BEGINS> file "voucher_01-signature.b64"

u1i0_VB6xIhE8QuhKDGgCxkzsnR20IoL0p6qYKpYBDtgkRT2ykD0_QFjk7W\
P5ATW-CQnWlJ3ILSeiwMf9nI0g

<CODE ENDS>

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