Diameter End-to-End Security: Keyed Message Digests, Digital Signatures, and Encryption

draft-korhonen-dime-e2e-security-01

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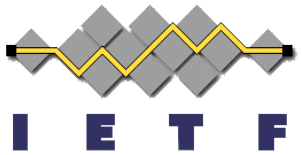
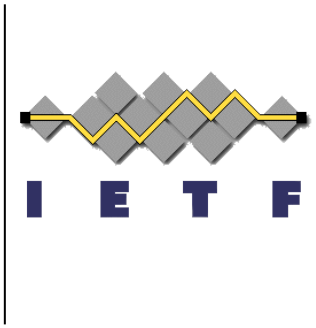
Dime WG, IETF#85

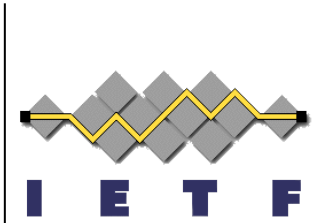


Overview



- Background
- Requirements
- Strawman solutions proposal
- Two aspects:
  - Authentication and Key Exchange
  - Actual AVP protection
- Changes from -00 to -01

Background

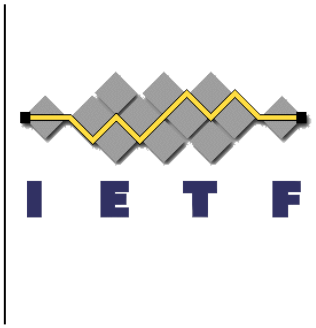


- Diameter has no end-to-end security framework at the moment. Acknowledged in RFC 6733.

- Folks deploying (=telco camp e.g., 3GPP and GSMA) large Diameter networks for roaming purposes realized that their security assumptions are not met. Solutions are needed now!

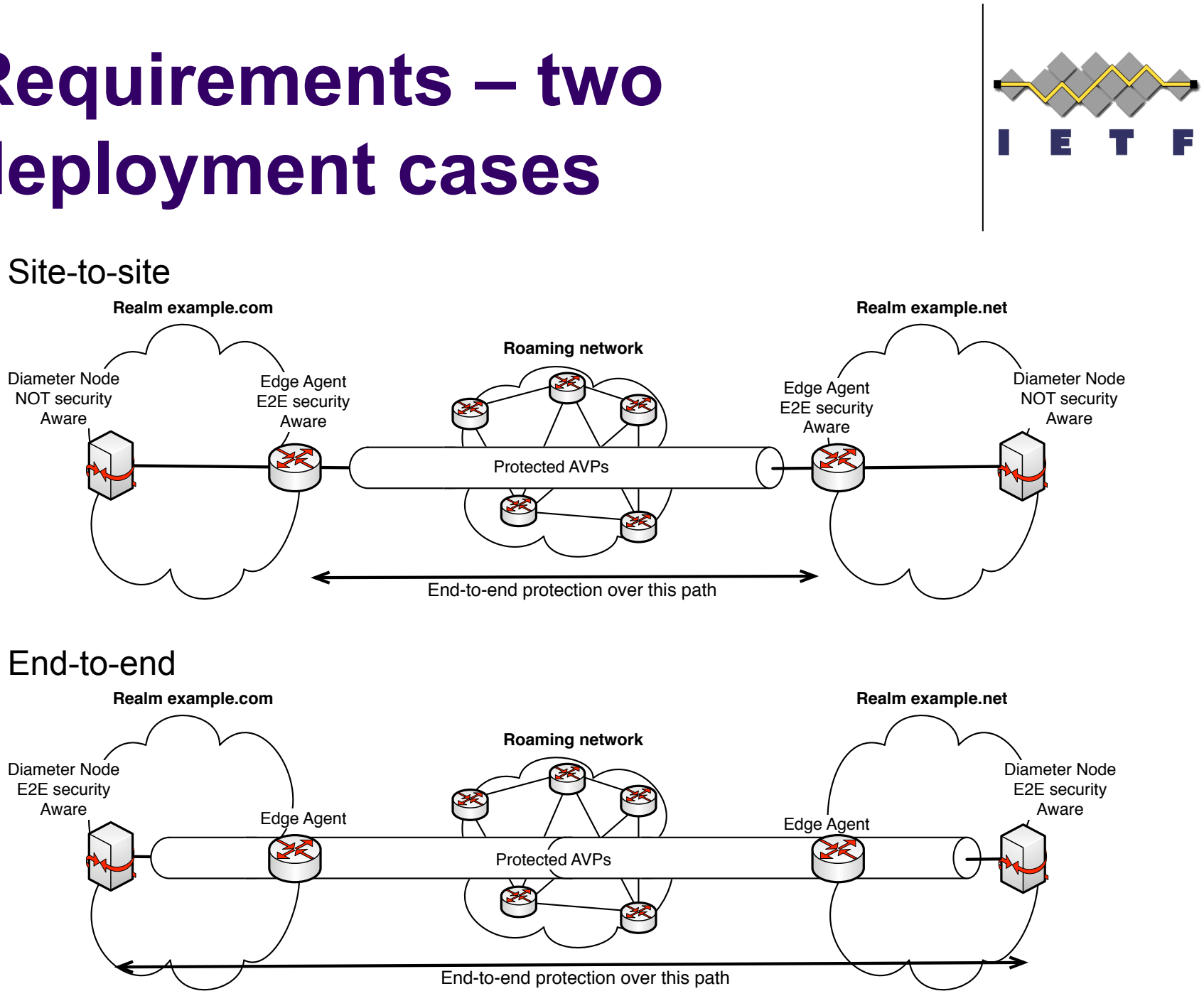
- Bilateral site-to-site VPNs with all your roaming partners does not scale in a long run and one loses the possible benefits of 3rd party “roaming proxies”.

Requirements



- Provide end-to-end security properties to Diameter on top of existing hop-by-hop security model.
  - End-to-end is between two nodes with any number of intermediates in between. This allows “site-to-site” type of deployments as well.
- Works with existing request routing and through proxy agents.
- Decouple key management from end-to-end AVP protection.
- Offer both integrity and confidentiality protection.
- Easy to integrate into existing Diameter applications (integrity protection).

Requirements – two deployment cases



Strawman Proposal in
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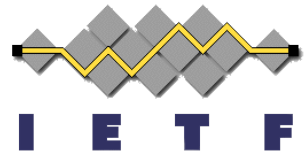


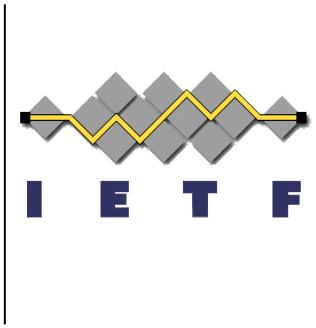
- This solution focuses on protecting Diameter AVPs. To offer the functionality two AVPs are defined:
  - Signed-Data (octet string) for integrity protection of one or more AVPs.
  - Encrypted-Data (octet string) for confidentiality protection of one or more AVPs.

- We selected JSON-based approach:
  - JSON Web signature (JWS) for integrity protection.
  - JSON Web Encryption (JWE) for confidentiality protection.
  - Encoding is “Diameter friendly” – not JSON style text strings.
  - Reuses JSON IANA registries.

- Not tied to a specific Diameter application.

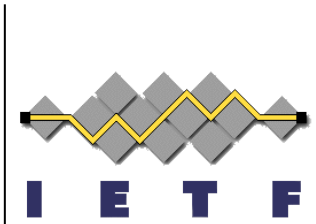
- Authentication and key management is not part of this proposal:
  - Likely that “one size fits all” approach will not work due to different deployment environments

Signed-Data AVP



- The AVP carries JSON Web Signature (JWS) of one or more of AVPs. Each protected AVP is hashed and the hash is included into the JWS payload.
- Hashed AVPs are linked to “originals” using their AVP Code. If there are multiple instances of the same AVP, you hash them all and do one by one verification -> allows for rearranging AVPs and detection of addition/removal/modification of AVPs.
- Both JWS Payload and signature use the same hash algorithm of the cryptographic algorithm indicated in the JWS Header.
- Can be included into ***existing*** Diameter applications.

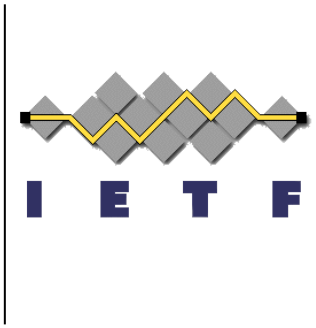
Encrypted-Data AVP



- The AVP carries JSON Web Encryption (JWE) data structure and the JWE Payload embeds of one or more protected AVPs.

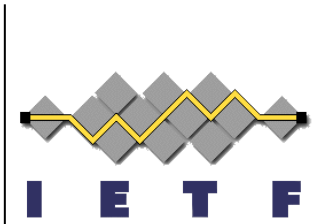
- Cannot be used with existing Diameter applications since encrypted AVPs are embedded inside the Encrypted-Data AVP(s).

Error Handling



- Transient failures
  - DIAMETER_KEY_UNKNOWN – A Signed-Data or an Encrypted-Data AVP is received that was generated using a key that cannot be found in the key store. To recover a new end-to-end key establishment procedure may need to be invoked.
  - DIAMETER_HEADER_NAME_ERROR (TBD12 – This error code is returned when a Header Parameter Name is not understood in the JWS-Header AVP or in the JWE-Header AVP.
- Permanent failures
  - DIAMETER_DECRYPTION_ERROR – This error code is returned when an Encrypted-Data AVP is received and the decryption fails for an unknown reason.
  - DIAMETER_SIGNATURE_ERROR – This error code is returned when a Signed-Data AVP is received and the verification fails for an unknown reason.

Changes from -00 to -01



- Clarification that both end-to-end and site-to-site approaches are in scope.

- Reworked the encoding of protected AVPs. They are now more Diameter like and compact. Still using JSON framework.

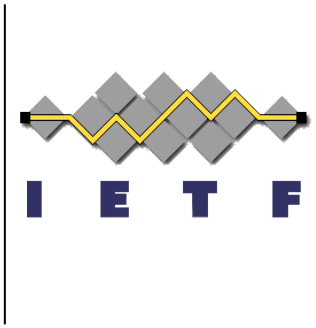
- New DIAMETER_HEADER_NAME_ERROR error code added.

Example of signature..

```
Signed-Data  ::= < AVP Header: TBD1 >
                   { JWS-Header }
                 * { JWS-AVP-Payload }
                   { JWS-Signature }
                 * [ AVP ]
```

The JWS Header used in this example is:

```
{"typ":"JWT",
 "alg":"HS256",
 "kid":"abc123"
}
```



Signed-Data Grouped AVP:

```
0x00000nnn  // Signed-Data code 'nnn'
0x000000e8  // Flags=0, Length=232(8+49+3+44+44+44+40)
```

JWS Header encoded into the JWS-Header AVP:

```
0x00000xxx  // JWS-Header code 'xxx'
0x00000031  // Flags=0, Length=49
'{"typ":"JWT","alg":"HS256","kid":"abc123"}'  // 41
0x00,0x00,0x00  // 3 octets padding
```

JWS Payload encoded into three JWS-AVP-Payload AVPs:

```
0x00000zzz  // JWS-AVP-Payload code 'zzz'    <--+
0x0000002c  // Flags=0, Length=44               |
0x00000107  // 263, Session-Id, 4 octets        |
0xca8362ed,0x69a32ffb  // 256 bits hash of      |
0x9092ca98,0x745239da  // Session-id            |
0x6960af73,0x6386bc38                           |
0x407e518b,0xe4760548                           |
0x00000zzz  // JWS-AVP-Payload code 'zzz'       |
0x0000002c  // Flags=0, Length=44               |
0x00000108  // 264, Origin-Host, 4 octets       |
0x64b52a15,0xa75a8157  // 256 bits hash of      |
0x151993a6,0xb9839866  // Origin-Realm          |
0x3b94afa3,0x85568552                           |
0x46602ccc,0x3f9d9a77                           |
0x00000zzz  // JWS-AVP-Payload code 'zzz'       |
0x0000002c  // Flags=0, Length=44               |
0x00000128  // 296, Origin-Realm, 4 octets      |
0x3c7c0b17,0x4a1c58d0  // 256 bits hash of      |
0xdc2844a3,0x28580385  // Origin-Realm          |
0x25eb08b0,0xeb20c941  //                       |
0xcd52f74c,0xf55ae9ab  //                    <--+
```

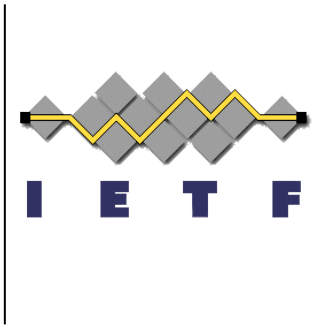
Individual AVP hash

Signature over this binary blob

JWS Signature encoded into the JWS-Signature AVP:

```
0x00000yyy  // JWS-Signature code 'yyy'
0x00000028  // Flags=0, Length=40
0x70ec221e,0xe0300ec1,0xb7ce968d,0x6ec6ad9e
0x8afbe983,0x2b0e331c,0x2e1f51ac,0xf9af0188
```

Questions? Comments?



- First: is the end-to-end AVP protection **framework** approach feasible (forget JSON at this point)??
- Second: is **reusing** JSON ideas a feasible approach (forget encoding details at this point)??
- Third: does the WG think this I-D is a good **starting point**??