Tutorial on KMIP and FCEAP/GPSK

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Where is this bus going?

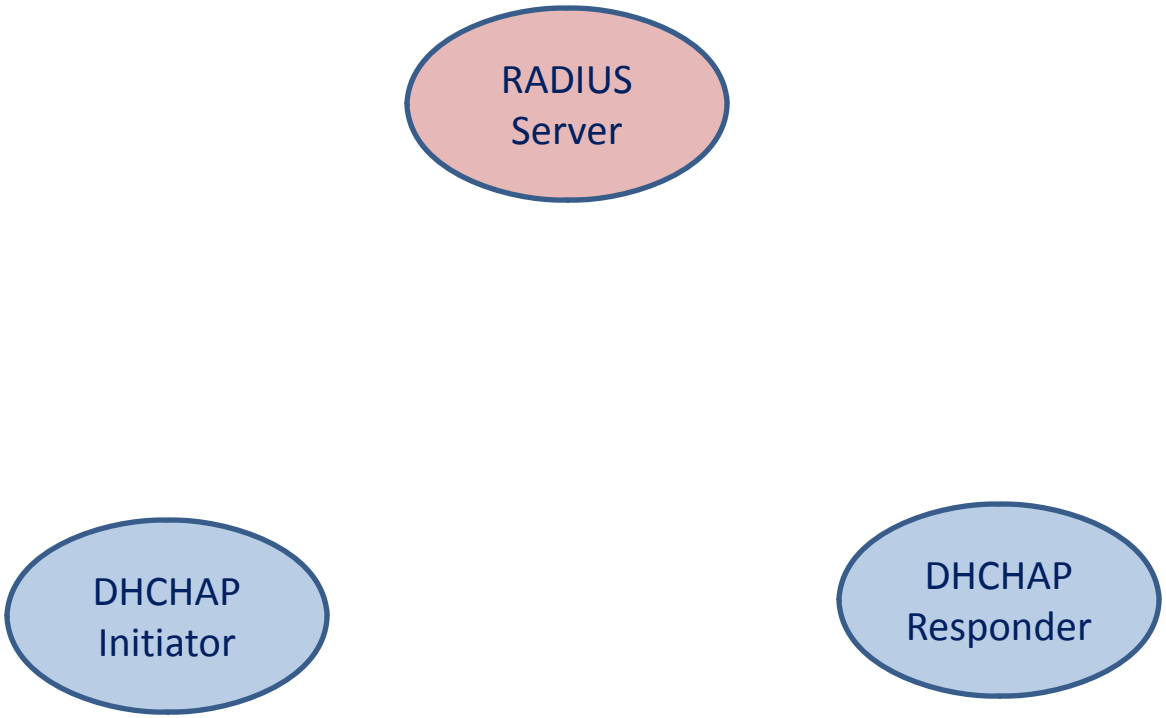
- What's the motivation for involving KMIP?
- What *is* KMIP?
- What does FC-EAP/GPSK need from KMIP?

What's the motivation for involving KMIP?

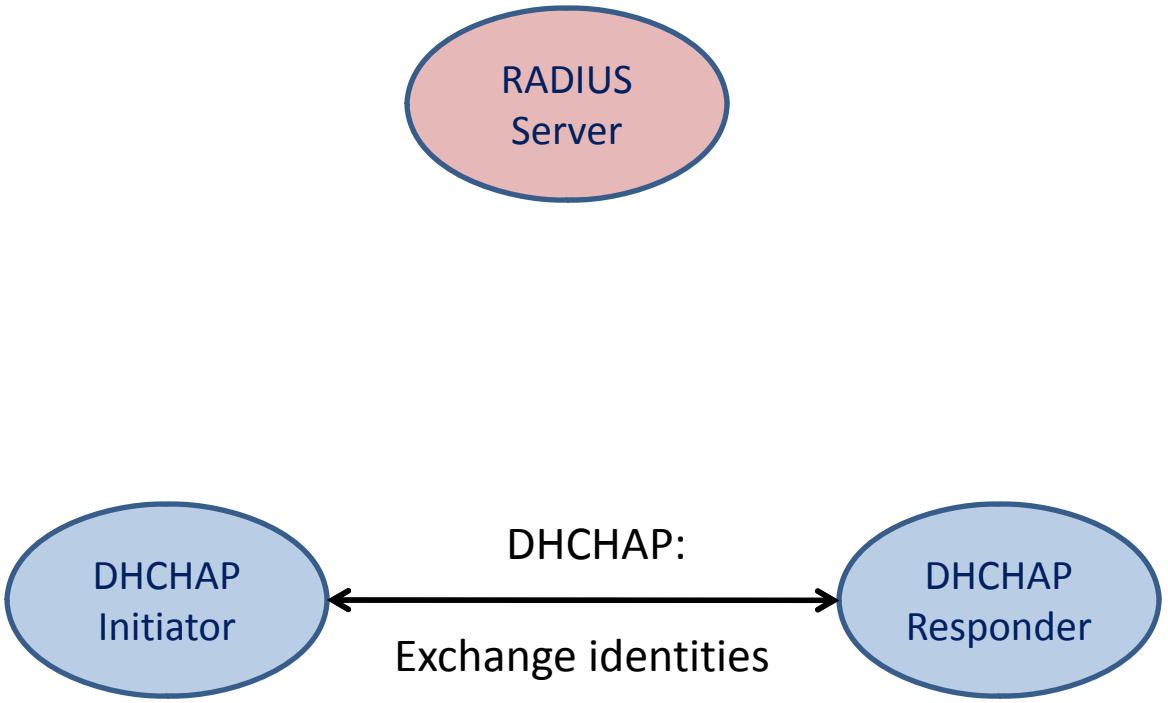
Who are the players?

- RADIUS
  - RADIUS Server (an Authentication Server)
  - RADIUS Client
- KMIP
  - KMIP Server (a Key Management Server)
  - KMIP Client
- FC-SP-2
  - Authentication Initiator
  - Authentication Responder

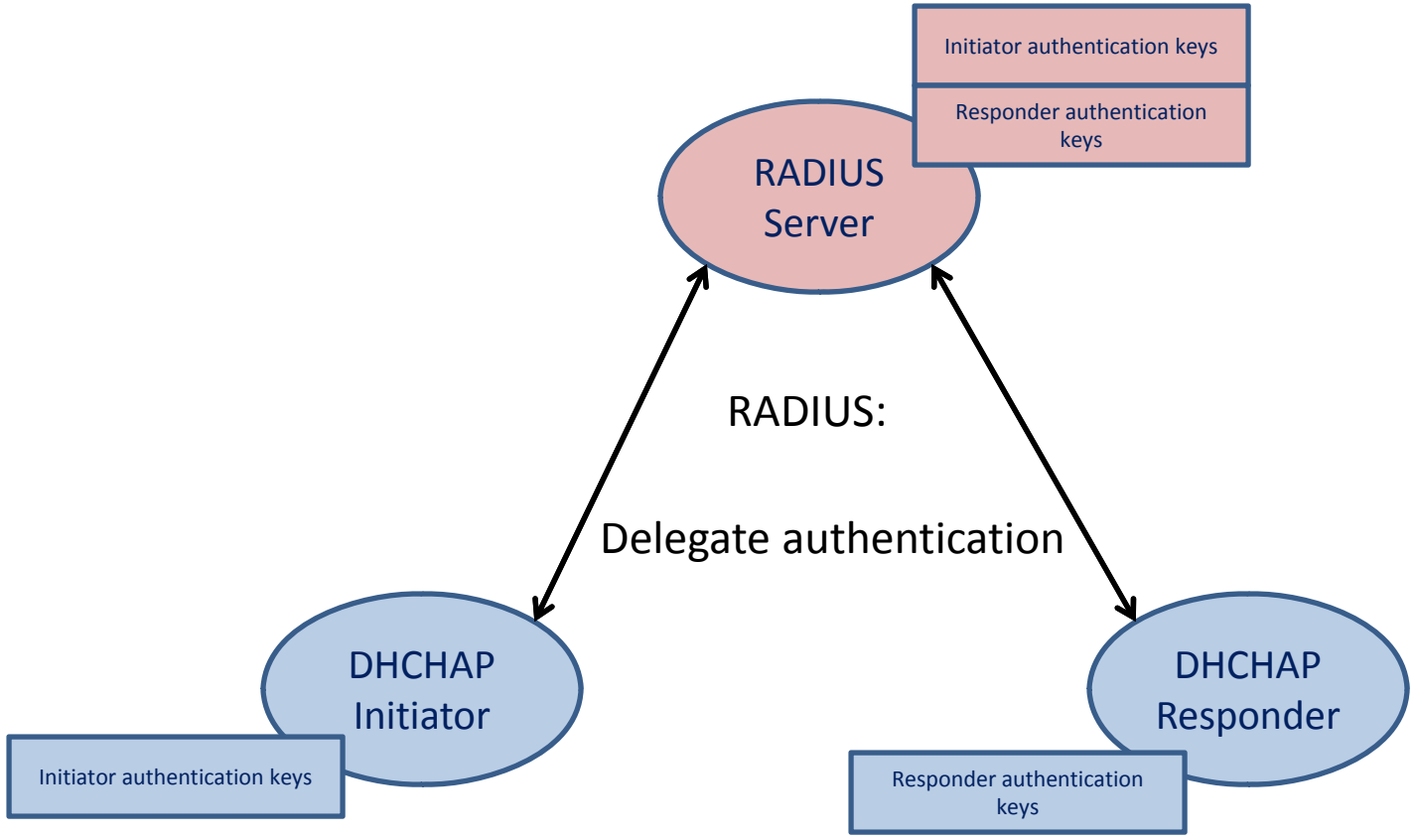
When using DHCHAP/RADIUS - 1



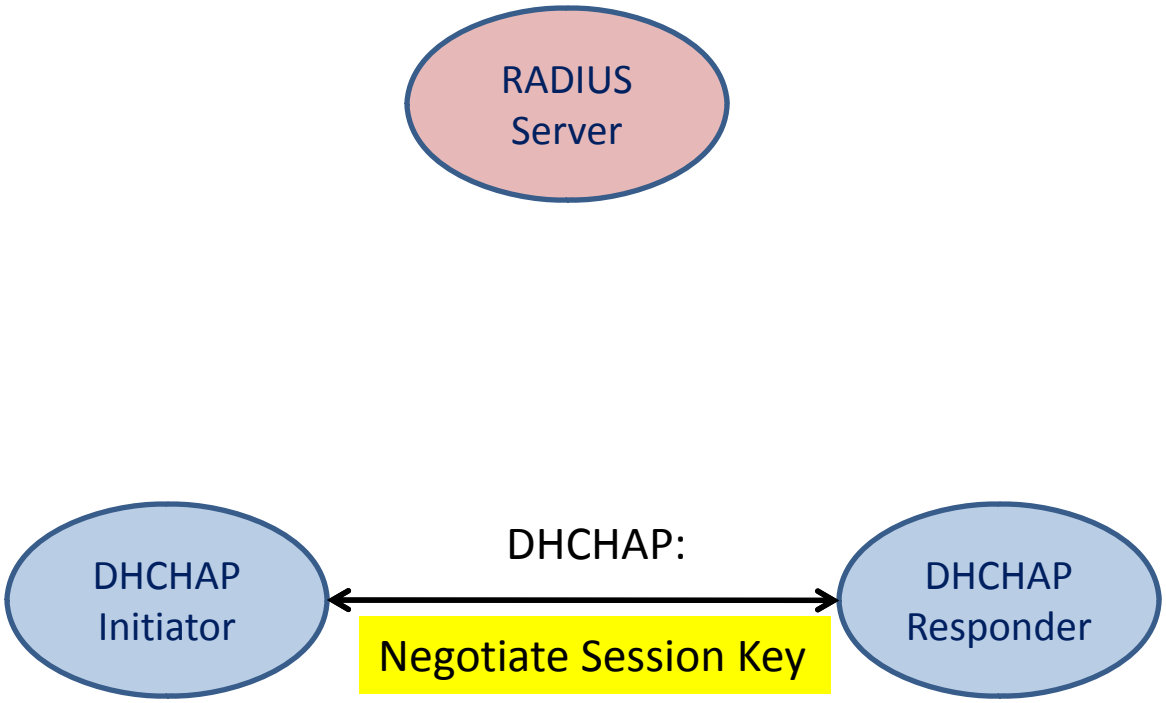
When using DHCHAP/RADIUS - 2



When using DHCHAP/RADIUS - 3



When using DHCHAP/RADIUS - 4



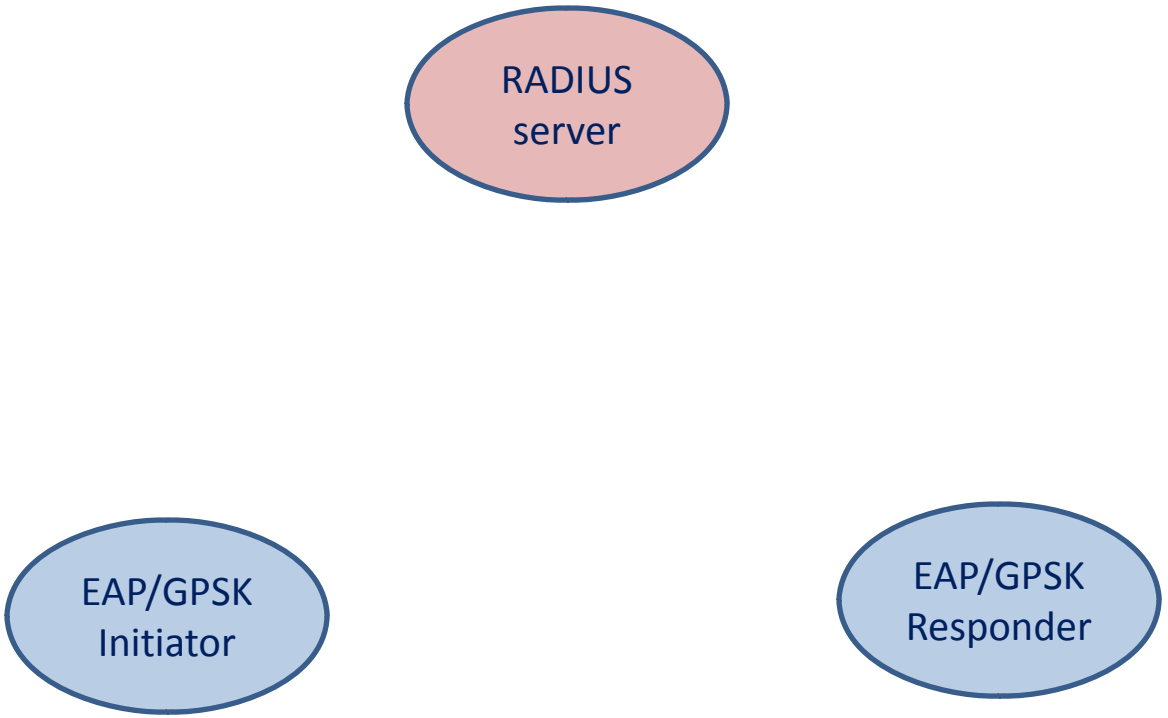
When using DHCHAP/RADIUS - 5

- Key management is centralized ☺
- Cryptographic math is delegated ☺
- …but the cryptography of RADIUS and CHAP are falling out of favor ☹

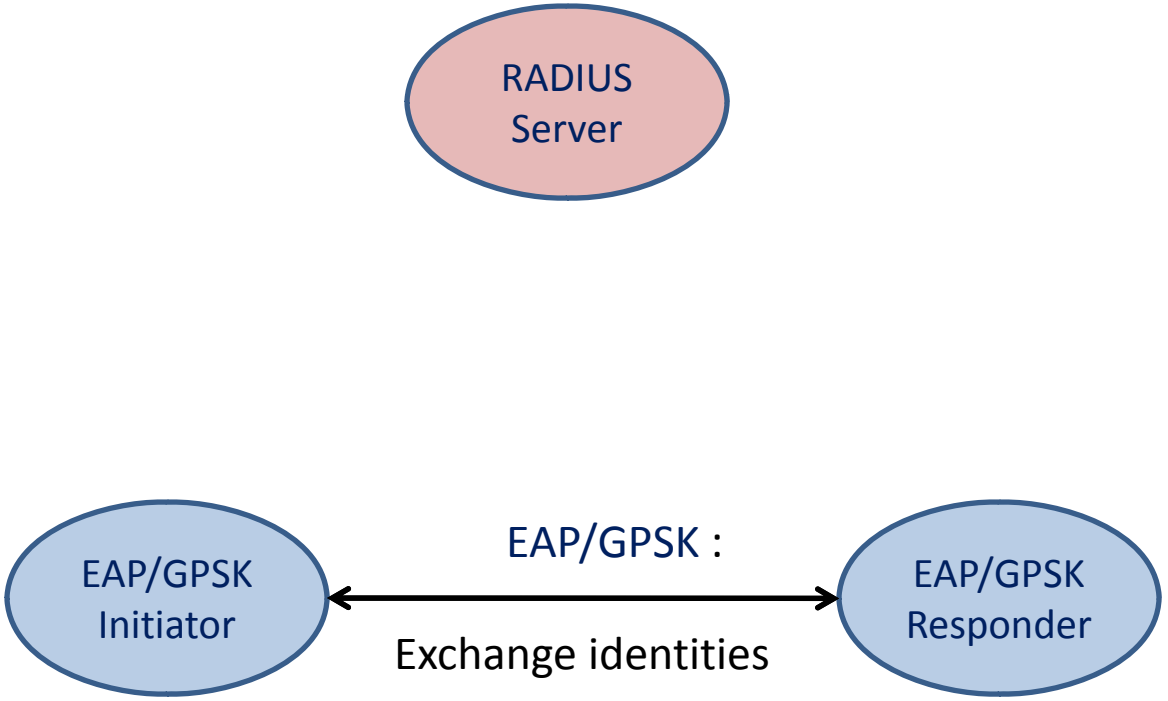
EAP/GPSK chosen for flexibility and security

But lacks an obvious management system

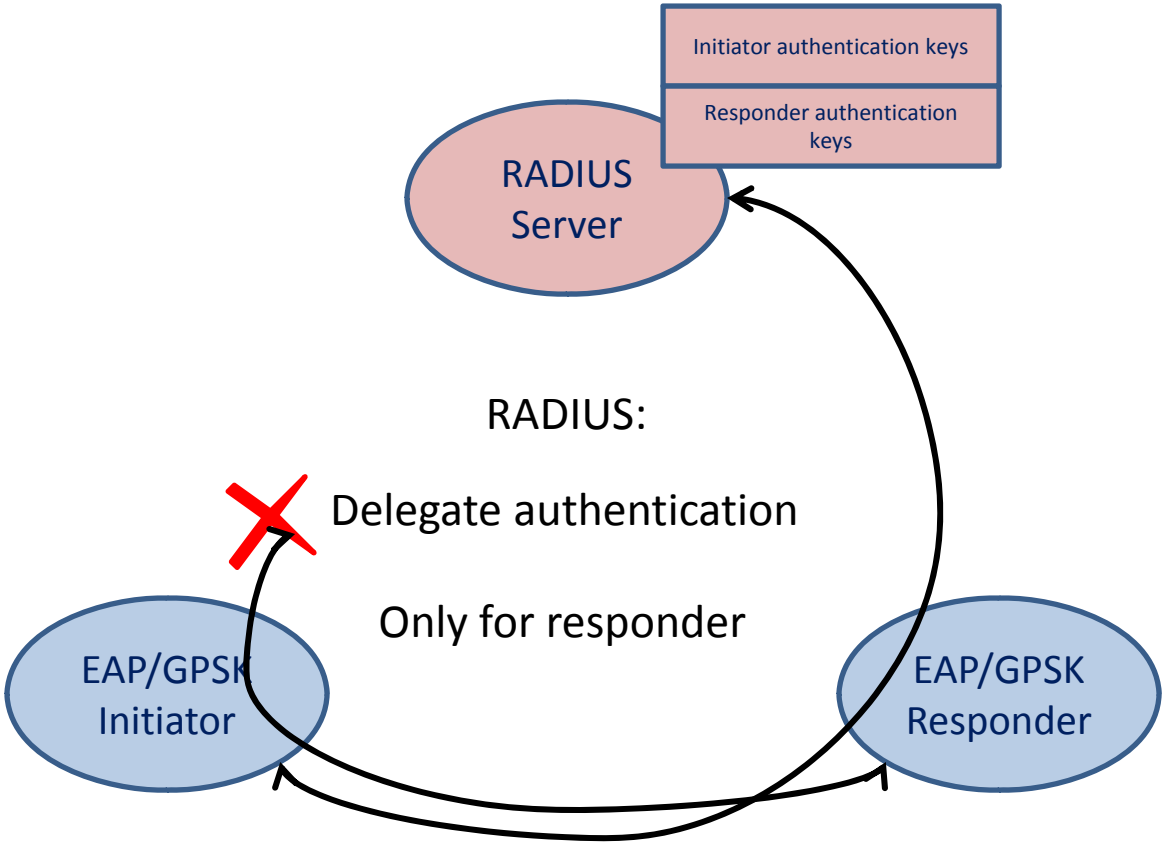
Would EAP/GPSK work with RADIUS? - 1



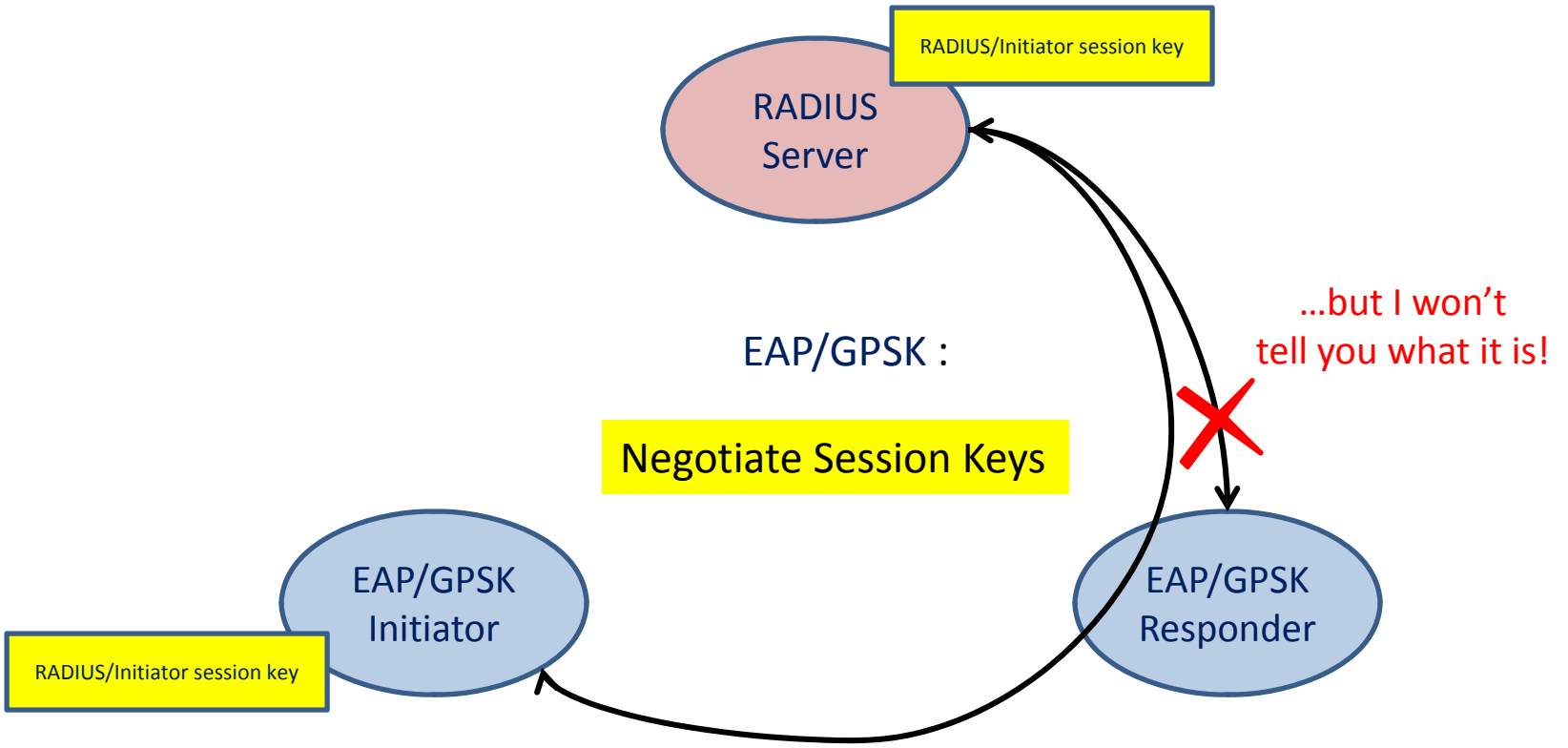
Would EAP/GPSK work with RADIUS? - 2



Would EAP/GPSK work with RADIUS? - 3



Would EAP/GPSK work with RADIUS? - 4

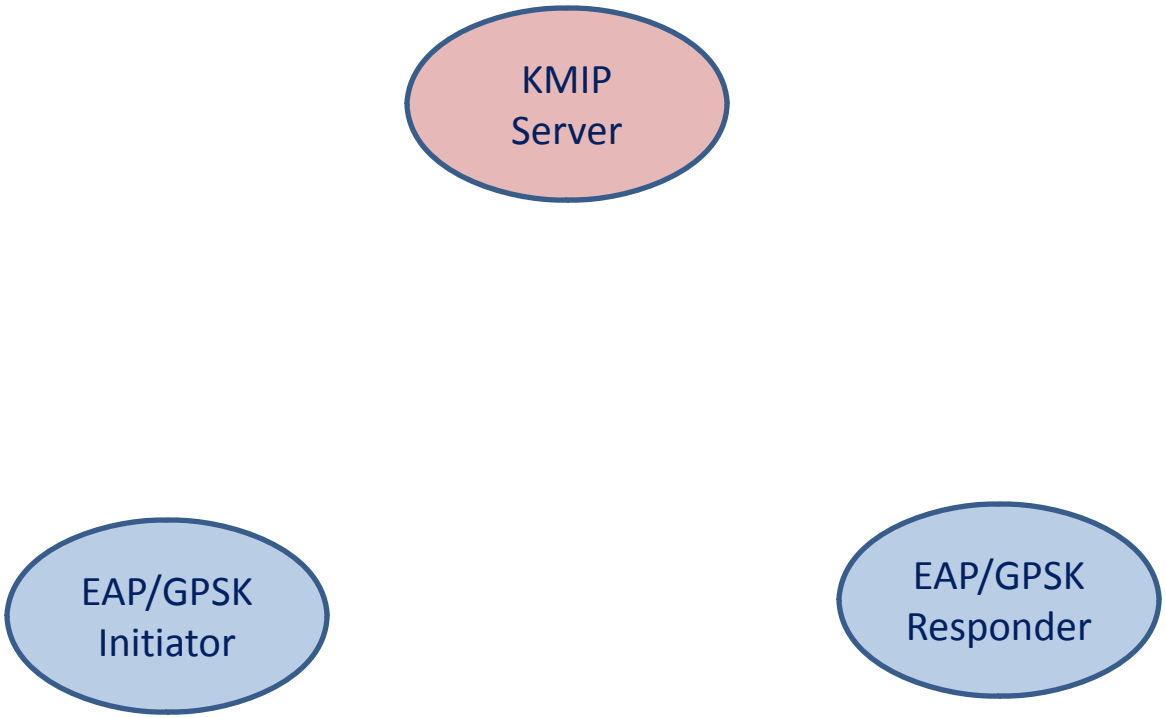


Would EAP/GPSK work with RADIUS? - 5

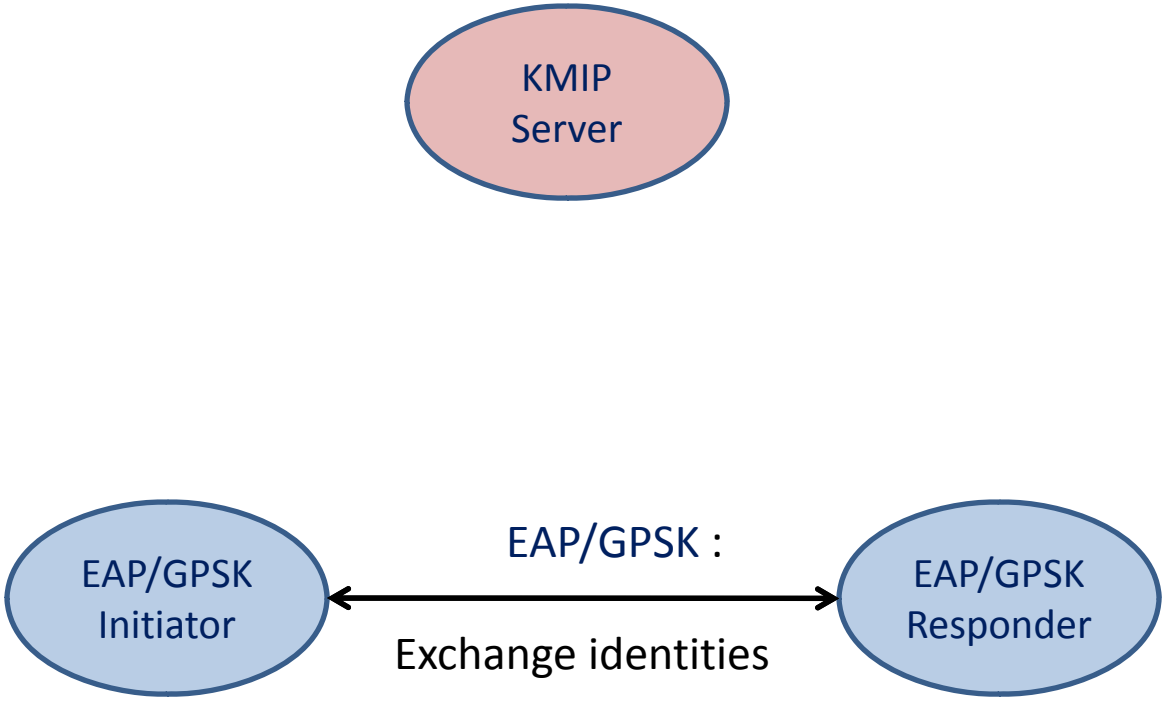
- …only the Authentication Responder can delegate the cryptographic math ☹
- …and you can't extend the trust to an FC-SEC session ☹ ☹

Not so useful

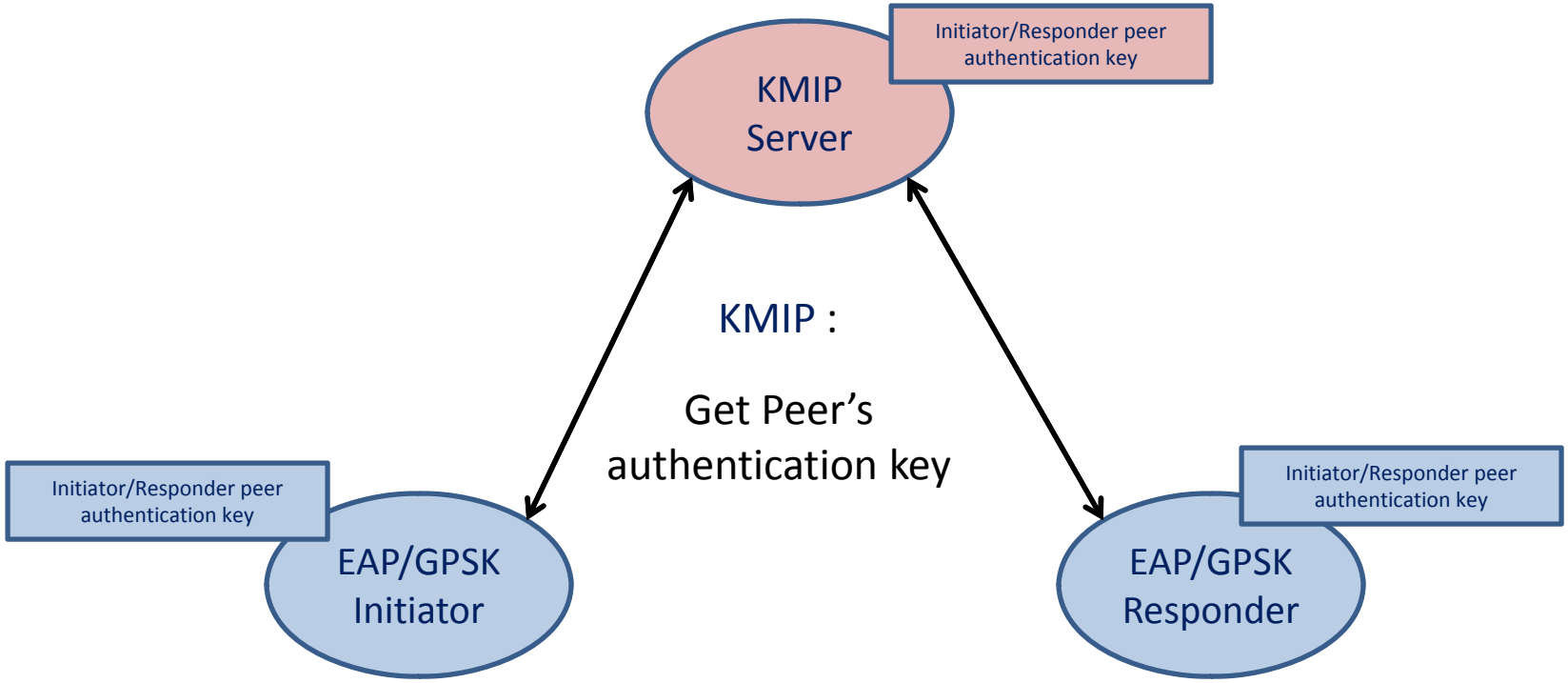
When using EAP/GPSK/KMIP - 1



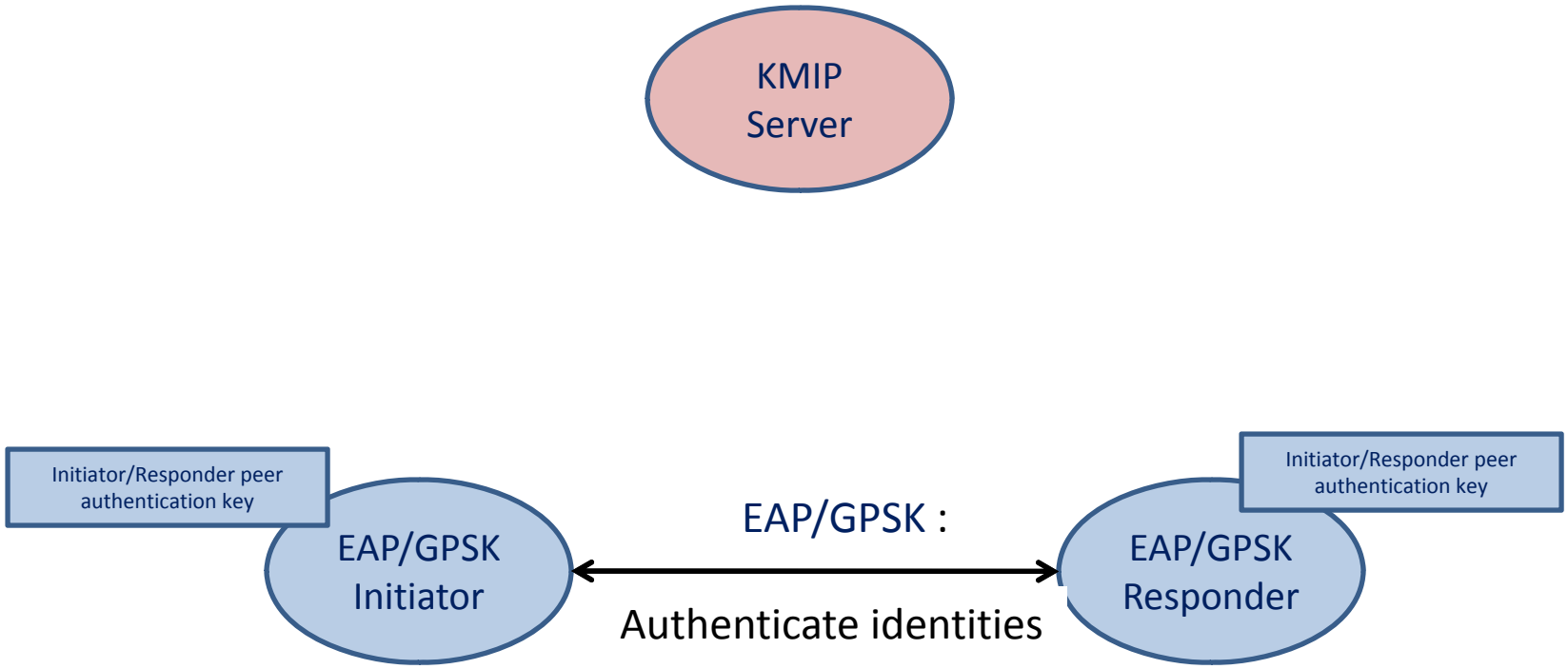
When using EAP/GPSK/KMIP - 2



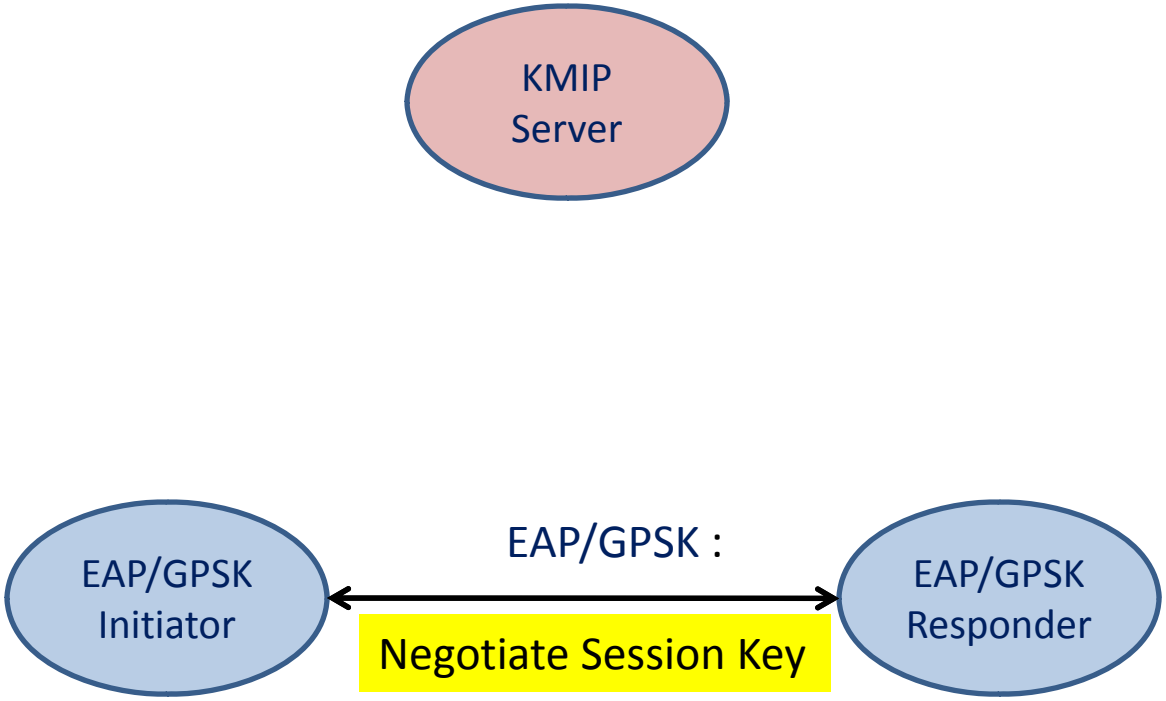
When using EAP/GPSK/KMIP - 3



When using EAP/GPSK/KMIP - 4



When using EAP/GPSK/KMIP - 5



When using EAP/GPSK/KMIP - 6

- More secure than DHCHAP/RADIUS ☺
- Key management is centralized ☺
- Cryptographic math is not delegated 😐
  - "EAP-GPSK should be easy to implement" (RFC 5433) ☺
  - …Doesn't help for EAP-NEXT, though ☹

Net gain, it appears

What is KMIP?

KMIP

≡ Key Management Interoperability Protocol

- It's a protocol standard, not a server design.

Intention is that it be "front-ended" to existing and future proprietary server designs.

- It covers management, not authorization.

Intention is that, although a certain minimum is expected, a design is free to elaborate its authorization capability (or import it, e.g., from a corporate directory).

KMIP 1.0 is an OASIS Standard

- Actually, two OASIS Standards
  - KMIP Specification
  - KMIP Profiles
- Two supporting OASIS Committee Specifications
  - KMIP Use Cases (consider them as test specs)
  - KMIP Usage Guide (“Informative Annex”)

KMIP Specification

Oversimplifying:

- The Protocol is composed of a sequence of Request/Response pairs
- A Request or Response is a Message
- A Message is a header followed by one or more Batch Items
- A Batch Item is an Operation Code and a Payload
- A Payload is a Sequence of Objects and Attributes
- An Object is zero or more subordinate Objects and zero or more Attributes
- An Attribute is one or more primitive data types
- Everything is encoded as a TTLV structure

TTLV

≡ Tag, Type, Length, Value

Tag (3 bytes), Type (1 byte), Length (4 bytes), Value (see Length)

- Tag: What is it? (e.g., a Symmetric Key, a Lease Time)
- Type: How is it encoded? (e.g., a byte string, a substructure)
- Length: How long is the Value (in bytes)? (e.g., an Integer Length is 4)
- Value: What is the value? (OK, so that's circular. This is a KMIP tutorial, it's not Philosophy 301)

TTLV Example

(from KMIP Specification)

- A Text String with the value "Hello World":

42 00 20 | 07 | 00 00 00 0B |

48 65 6C 6C 6F 20 57 6F 72 6C 64 00 00 00 1733 00 00

Simple , right?

Another TTLV Example

(from KMIP Use Cases)

Create (symmetric key)
In: objectType="00000002" (Symmetric Key), attributes={ CryptographicAlgorithm="00000003" (AES),
CryptographicLength="128", CryptographicUsageMask="0000000C" }

Tag: Request Message (0x420078), Type: Structure (0x01), Data:
- Tag: Request Header (0x420077), Type: Structure (0x01), Data:
  - Tag: Protocol Version (0x420069), Type: Structure (0x01), Data:
    - Tag: Protocol Version Major (0x42006A), Type: Integer (0x02), Data: 0x00000001 (1)
    - Tag: Protocol Version Minor (0x42006B), Type: Integer (0x02), Data: 0x00000000 (0)
  - Tag: Batch Count (0x42000D), Type: Integer (0x02), Data: 0x00000001 (1)
- Tag: Batch Item (0x42000F), Type: Structure (0x01), Data:
  - Tag: Operation (0x42005C), Type: Enumeration (0x05), Data: 0x00000001 (Create)
  - Tag: Request Payload (0x420079), Type: Structure (0x01), Data:
    - Tag: Object Type (0x420057), Type: Enumeration (0x05), Data: 0x00000002 (Symmetric Key)
    - Tag: Template-Attribute (0x420091), Type: Structure (0x01), Data:
      - Tag: Attribute (0x420008), Type: Structure (0x01), Data:
        - Tag: Attribute Name (0x42000A), Type: Text String (0x07), Data: Cryptographic Algorithm
        - Tag: Attribute Value (0x42000B), Type: Enumeration (0x05), Data: 0x00000003 (AES)
      - Tag: Attribute (0x420008), Type: Structure (0x01), Data:
        - Tag: Attribute Name (0x42000A), Type: Text String (0x07), Data: Cryptographic Length
        - Tag: Attribute Value (0x42000B), Type: Integer (0x02), Data: 0x00000080 (128)
      - Tag: Attribute (0x420008), Type: Structure (0x01), Data:
        - Tag: Attribute Name (0x42000A), Type: Text String (0x07), Data: Cryptographic Usage Mask
        - Tag: Attribute Value (0x42000B), Type: Integer (0x02), Data: 0x0000000C (Encrypt, Decrypt)

KMIP Profiles

Oversimplifying:

- A profile specifies a subset of the optional features in the KMIP Specification that someone believes would be useful and sufficient for some class of applications
  - Note that what is required by the KMIP Specification is generic to the point that it is practically useless except when extended by a profile.
  - Note that the KMIP Specification requires compliance to at least one profile.
- A profile is a pairing of an Authentication Suite and a Conformance Clause.
- A profile is specified for servers. Clients' requirements may be inferred.

Authentication Suite

- An Authentication Suite
  - Requires a channel security method providing confidentiality and integrity
  - May require certain options for the channel security method
  - May require a means of client authentication
- If the channel is TCP, TLS 1.0 support is required by the KMIP Specification. An Authentication Suite may add to that.

Example Authentication Suite

- KMIP Basic Authentication Suite includes
  - Requirement for TLSv1.0 protocol, exclusions of SSL
  - Requirement for the TLS_RSA_WITH_AES_128_CBC_SHA cipher suite
  - Requirement for TLS mutual authentication
  - Requirement for consideration of per request credentials if provided by the client
  - Etc.

Conformance Clause

- A Conformance Clause
  - Requires support for the KMIP Server conformance clause
  - Requires support for specific KMIP options
  - May forbid certain KMIP options
  - Typically explicitly permit any KMIP options and extensions outside the standard that are not explicitly listed and not contradictory of any requirements

Example Conformance Clause

- The KMIP Secret Data Server Conformance Clause includes
  - Requirement to support for the KMIP Server conformance clause
  - Requirement to support the optional Secret Data object, of type Password (the Server conformance clause requires support for a generic key, but no specific kind of key)
  - Requirement to support the optional Register operation (the Server conformance clause does not specify how any object gets *into* a server)
  - etc.
  - Permission to support anything that doesn't conflict.

What does FC-EAP/GPSK need from KMIP?

My guesses…

Expert advice enthusiastically solicited!

Authentication

- Presuming our channel to be TCP/IP, TLSv1.0 support is required. Any expert advice why we would not use it?
  - TLSv1.2 fixes a published security issue. Is 1.2 generally implemented?
  - Is IPSEC an alternative?
- Require the server to support object authorization rules
  - Modify only administratively
  - Read only by an administratively specified group of two or more entities

Necessary information

- Symmetric key objects
  - Does TLSv1.0 provide sufficient confidentiality that we don't need key wrapping?
  - Do we need Start/Stop usage dates?
- Uninterpreted Text String Names for keys (the only alternative is URI)
- 128-bit and 256-bit key lengths
- AES and HMAC-SHA256 algorithms

Questions?

Suggestions…

please?