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ADVANCED SECURITY EXTENSIONS IN APIGEE EDGE: HMAC, HttpSignature

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1

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SECURITY EXTENSIONS IN APIGEE EDGE: HMAC, HttpSignature

Mehta, Chiesa

2

Who is using Signatures?

AWS - custom HMAC-SHA256 signature over the [verb . host . uri . queryparams]
Google Maps API for Work - HMAC-SHA1 over URL+query (includes clientid)
Twitter - OAuth1.0a signatures (HMAC-SHA1) over headers + params
Azure storage - HMAC-SHA256 over [verb . contentmd5 . contenttype . date . url]
Github's outbound webhooks - HMAC-SHA1 over the body
(prospect) Automaker - XML DSIG over payload
(prospect) WW Retailer - HttpSignature (Signature applied to select headers)
(customer) Payeezy - custom HMAC-SHA256 over select headers and body
(customer) BBC – HMAC on calls from Salesforce.com, $$ Video-on-demand
(customer) Vodafone - HMAC
(customer) O2 - HMAC

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Why are these people using Message-level security?
Why are they requiring Signatures on their payloads?

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Let’s talk about MITM, Non-repudiation, Auditing

```
POST /accounts/12334566/update
API-Key: ryJIXSIAMjuyDii8
Host: api.example.com
Content-Type: application/json
Content-Length: 132

{
  "rty": "MRA",
  "n": "5SGw1jcqyFYEZaf3VduzmRk_jcBNFFLQgOf9U",
  "e": "AQAB",
  "gla": "Rm425",
  "use": "sig",
  "kid": "196"
}
```

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Let’s talk about MITM, Non-repudiation, Auditing

```
POST /accounts/12334566/update
API-Key: ryJIXSIAMjuyDii8
Host: api.example.com
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  "e": "AQAB",
  "gla": "Rm425",
  "use": "sig",
  "kid": "196"
}
```

- TLS encrypts all of this, except the hostname
- TLS is point-to-point
- What happens if you relay this message beyond the TLS-protected entry point?
- If this message gets archived, how to guarantee its integrity?

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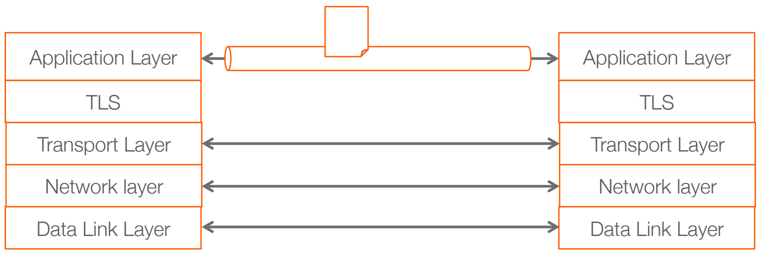
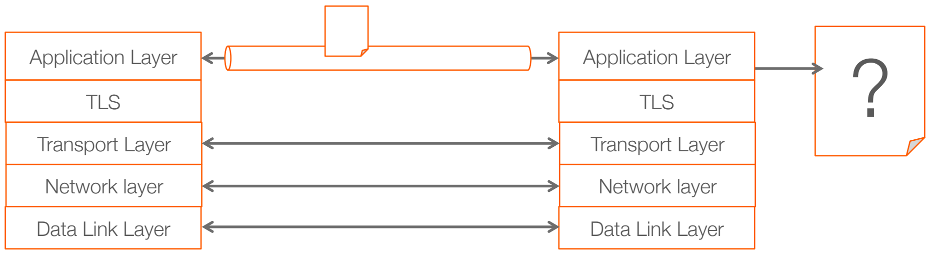
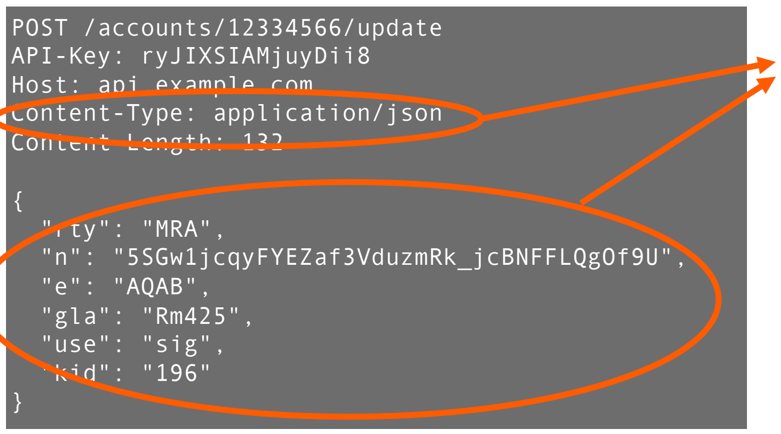
Transport-layer security secures data in transit



Message-layer security is independent of transport



Message-level Signatures protect the payload



```
POST /accounts/12334566/update
API-Key: ryJIXSIAMjuyDii8
Host: api.example.com
Content-Type: application/json
Content-Length: 132

{
  "kty": "MRA",
  "n": "5SGw1jcqyFYEZaf3VduzmRk_jcBNFFLQgOf9U",
  "e": "AQAB",
  "gla": "Rm425",
  "use": "sig",
  "kid": "196"
}
```

- Message-level signatures can protect these parts of the message, independently of transport
- Can optionally perform message-level encryption, encryption of selected fields, etc.

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MAC = Message Authentication Code
HMAC = keyed-hash MAC

MAC may be used to verify the integrity of a message.

HMAC injects a key into the normal hashing function. HMAC may be used to simultaneously verify both the integrity and the authentication of a message.

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You are Smart People,
So Obviously…

You want to verify HMACs in API Proxies.

Today, in Apigee Edge, You can't.

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Apigee Edge includes standard policies for many security tasks.

But it does not include a policy to generate or validate HMACs. You're stuck.

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Apigee Edge includes standard policies for many security tasks.

But it does not include a policy to generate or validate HMACs. You're stuck.

Or Maybe you're not?

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Code + Configure !

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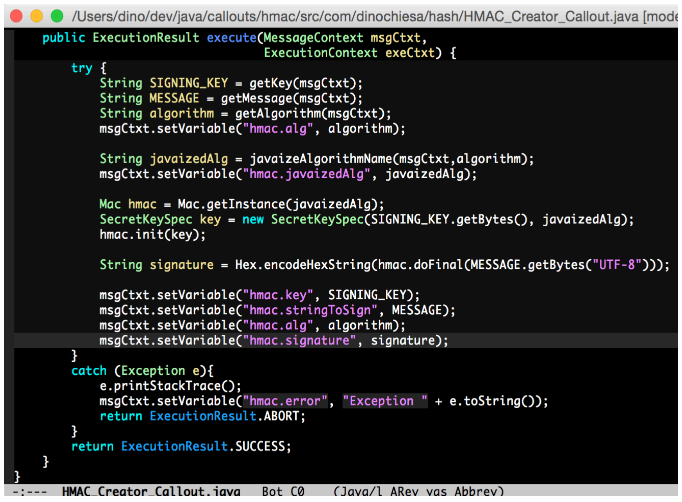
What are Java Callouts?

- Embed your Java code as a policy in Apigee Edge
- One Interface, one method, 2 parameters
- Can read policy configuration
- Can read and write context variables
- …anchor anywhere in Edge policy flow

- One of the ways to extend Edge with custom code. Also JavaScript, Python, nodejs.

- RTFM: http://apigee.com/docs/api-services/reference/java-callout-policy



/Users/dino/dev/java/callouts/hmac/src/com/dinochiesa/hash/HMAC_Creator_Callout.java [mode

```
    public ExecutionResult execute(MessageContext msgCtxt,
                                   ExecutionContext exeCtxt) {
        try {
            String SIGNING_KEY = getKey(msgCtxt);
            String MESSAGE = getMessage(msgCtxt);
            String algorithm = getAlgorithm(msgCtxt);
            msgCtxt.setVariable("hmac.alg", algorithm);

            String javaizedAlg = javaizeAlgorithmName(msgCtxt,algorithm);
            msgCtxt.setVariable("hmac.javaizedAlg", javaizedAlg);

            Mac hmac = Mac.getInstance(javaizedAlg);
            SecretKeySpec key = new SecretKeySpec(SIGNING_KEY.getBytes(), javaizedAlg);
            hmac.init(key);

            String signature = Hex.encodeHexString(hmac.doFinal(MESSAGE.getBytes("UTF-8")));

            msgCtxt.setVariable("hmac.key", SIGNING_KEY);
            msgCtxt.setVariable("hmac.stringToSign", MESSAGE);
            msgCtxt.setVariable("hmac.alg", algorithm);
            msgCtxt.setVariable("hmac.signature", signature);
        }
        catch (Exception e){
            e.printStackTrace();
            msgCtxt.setVariable("hmac.error", "Exception " + e.toString());
            return ExecutionResult.ABORT;
        }
        return ExecutionResult.SUCCESS;
    }
}
-:---  HMAC_Creator_Callout.java    Bot C0     (Java/l ARev yas Abbrev)
```

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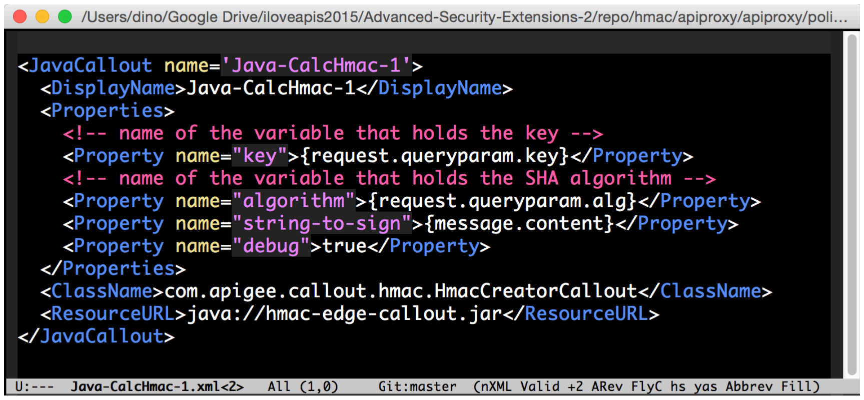
15

Java Callout for HMAC Verification or Generation

- Re-usable now in any of your Proxies
- Configure it with XML as any other policy
- Verify integrity of any payload
- Can read HMAC generated by third party libraries
- Relies on secret key or public/private key pair



/Users/dino/Google Drive/iloveapis2015/Advanced-Security-Extensions-2/repo/hmac/apiproxy/apiproxy/poli…

```
<JavaCallout name='Java-CalcHmac-1'>
  <DisplayName>Java-CalcHmac-1</DisplayName>
  <Properties>
    <!-- name of the variable that holds the key -->
    <Property name="key">{request.queryparam.key}</Property>
    <!-- name of the variable that holds the SHA algorithm -->
    <Property name="algorithm">{request.queryparam.alg}</Property>
    <Property name="string-to-sign">{message.content}</Property>
    <Property name="debug">true</Property>
  </Properties>
  <ClassName>com.apigee.callout.hmac.HmacCreatorCallout</ClassName>
  <ResourceURL>java://hmac-edge-callout.jar</ResourceURL>
</JavaCallout>
U:---  Java-CalcHmac-1.xml<2>   All (1,0)    Git:master  (nXML Valid +2 ARev FlyC hs yas Abbrev Fill)
```

https://github.com/apigee/iloveapis2015-hmac-httpsignature

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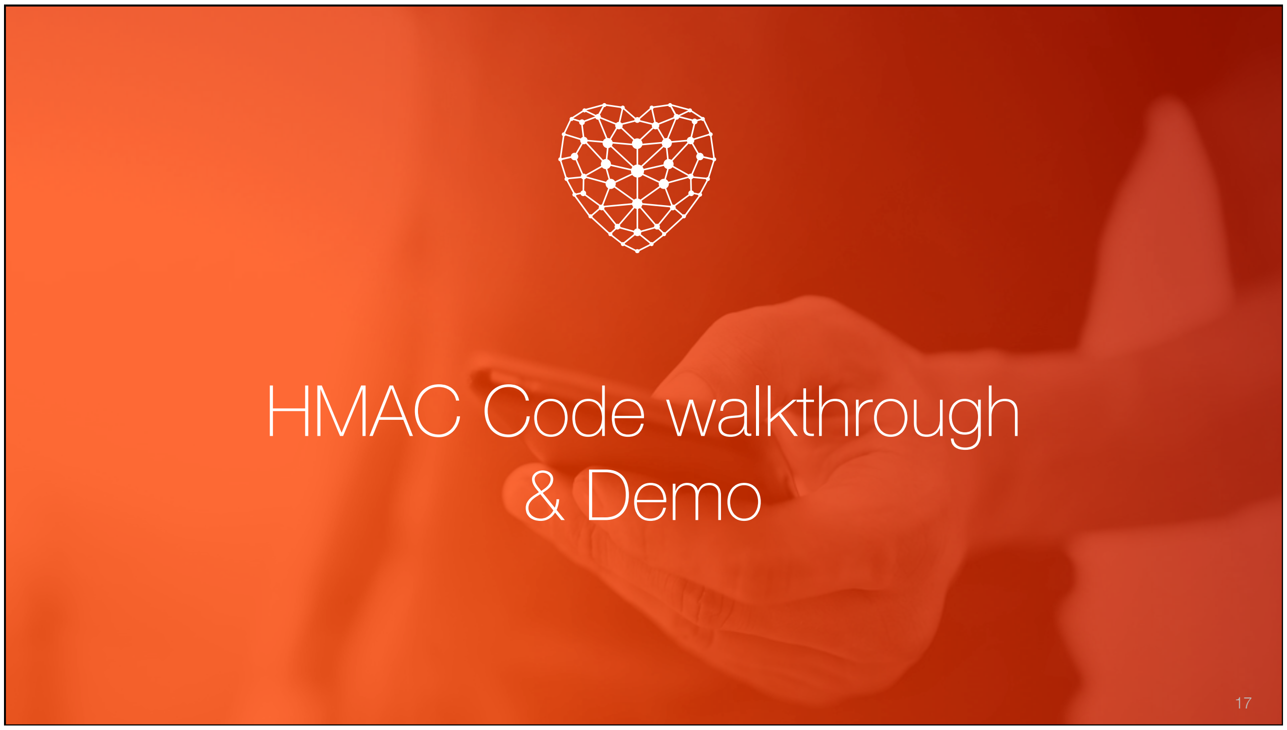
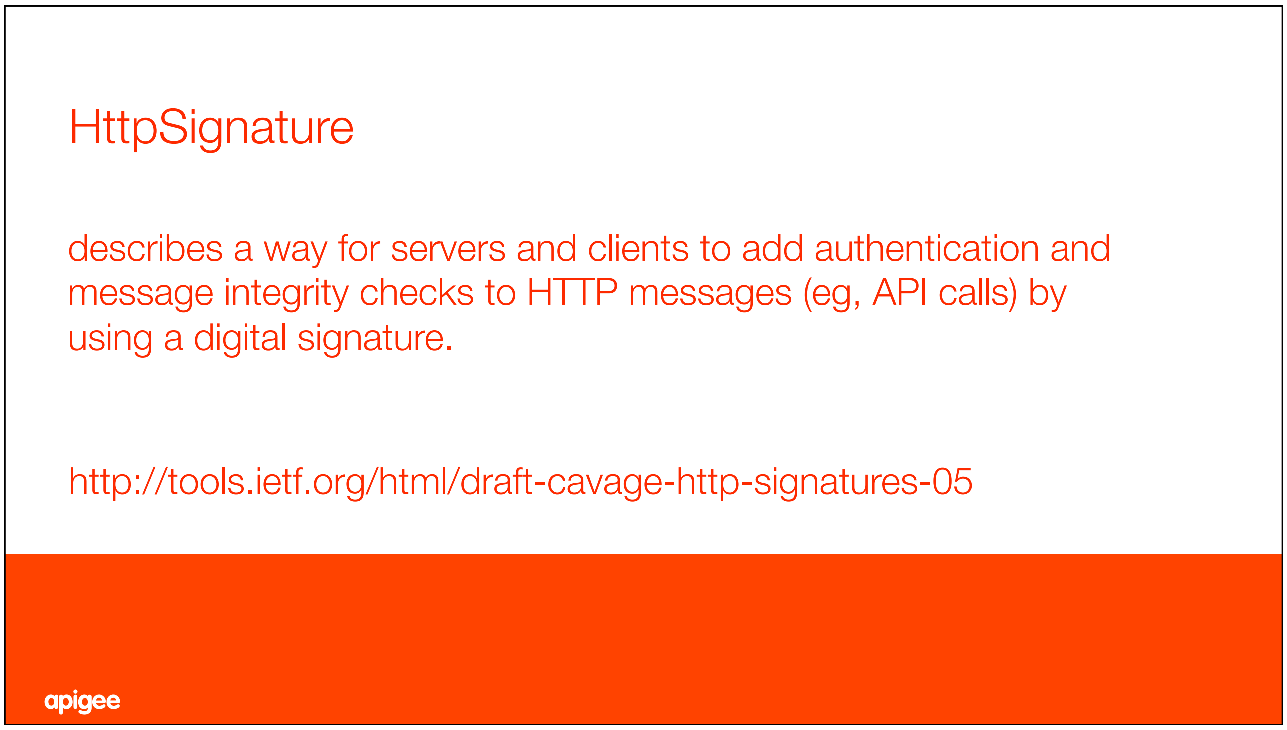
16



HMAC Code walkthrough & Demo

17



HttpSignature

describes a way for servers and clients to add authentication and message integrity checks to HTTP messages (eg, API calls) by using a digital signature.

http://tools.ietf.org/html/draft-cavage-http-signatures-05

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HttpSignature

Complements API Key or Token-based authentication.

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HttpSignature

The client sends in a Signature header that contains 4 things:

- keyid - identifying the key used by the client. The meaning is app dependent.
- algorithm - can be RSA-SHA (public/private key) or HMAC-SHA (shared key)
- list of HTTP headers - optional; space delimited; these are included in the signing base
- a computed signature of those headers

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HttpSignature

Each element is formed as key="value" and they are separated by commas.
This must be passed in an HTTP header named "Signature".
The resulting header might look like this:

```
Signature: keyId=”mykey",algorithm="hmac-sha256",headers="(request-
target) date",signature="udvCIHZAafyK+szbOI/KkLxeIihexHpHpvMrwbeoErI="
```

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Apigee Edge includes standard policies for many security tasks.

But it does not include a policy to validate HttpSignature. Sound Familiar?

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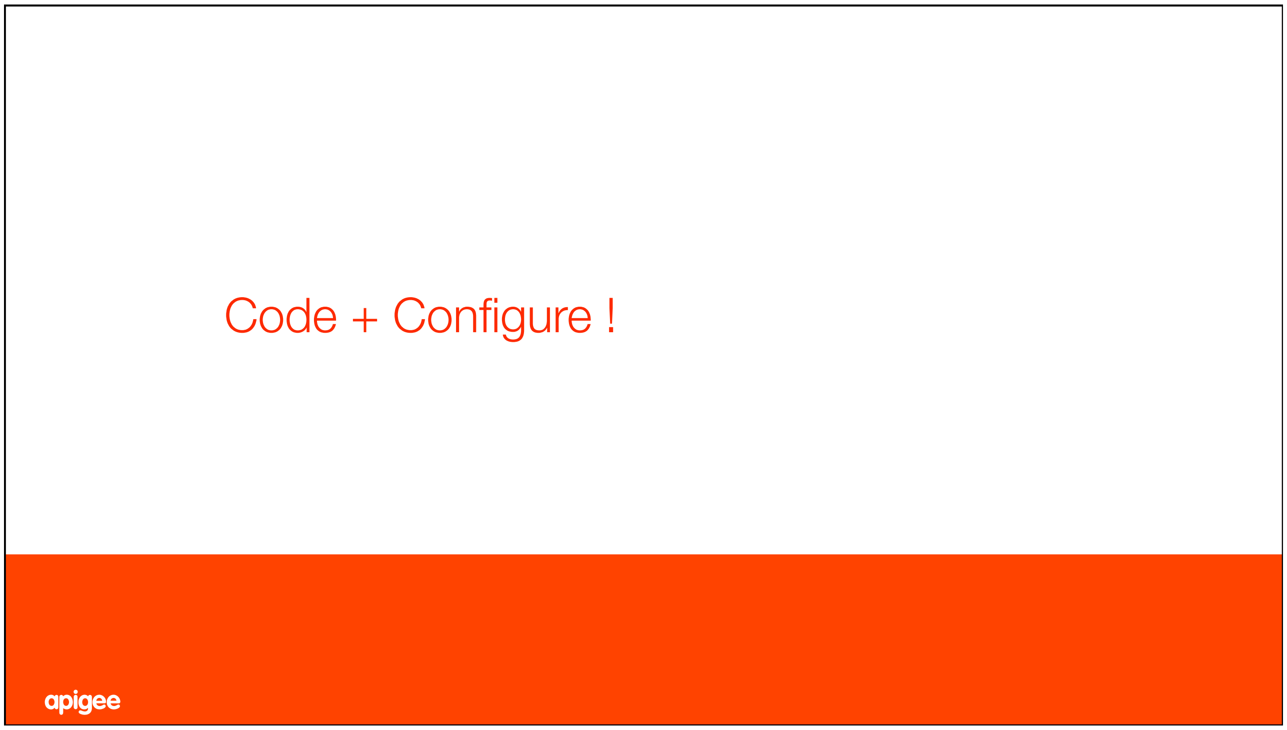

Code + Configure !

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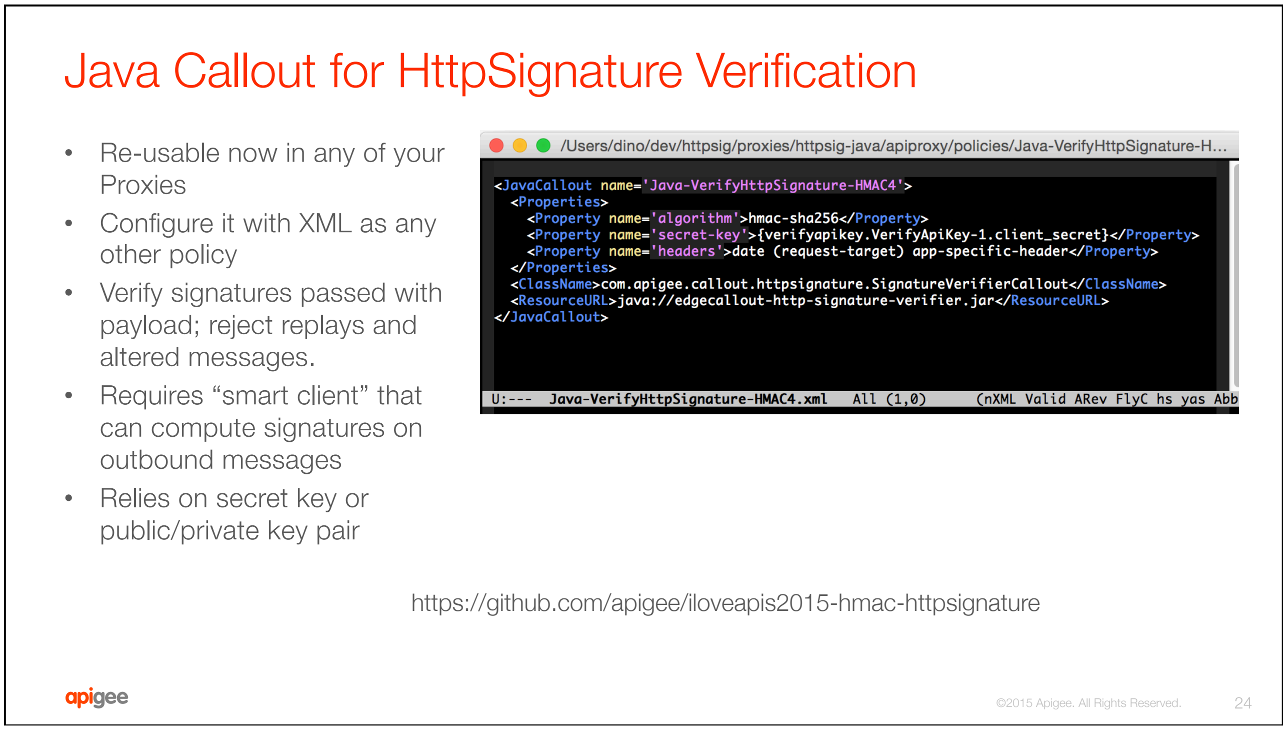
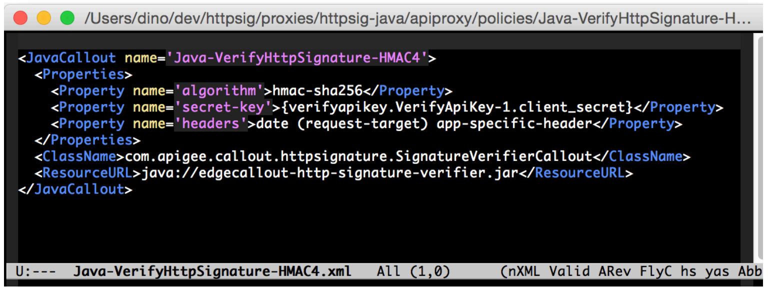


Java Callout for HttpSignature Verification

- Re-usable now in any of your Proxies
- Configure it with XML as any other policy
- Verify signatures passed with payload; reject replays and altered messages.
- Requires “smart client” that can compute signatures on outbound messages
- Relies on secret key or public/private key pair



/Users/dino/dev/httpsig/proxies/httpsig-java/apiproxy/policies/Java-VerifyHttpSignature-H…

```
<JavaCallout name='Java-VerifyHttpSignature-HMAC4'>
  <Properties>
    <Property name='algorithm'>hmac-sha256</Property>
    <Property name='secret-key'>{verifyapikey.VerifyApiKey-1.client_secret}</Property>
    <Property name='headers'>date (request-target) app-specific-header</Property>
  </Properties>
  <ClassName>com.apigee.callout.httpsignature.SignatureVerifierCallout</ClassName>
  <ResourceURL>java://edgecallout-http-signature-verifier.jar</ResourceURL>
</JavaCallout>
```

```
U:---  Java-VerifyHttpSignature-HMAC4.xml   All (1,0)     (nXML Valid ARev FlyC hs yas Abb
```

https://github.com/apigee/iloveapis2015-hmac-httpsignature

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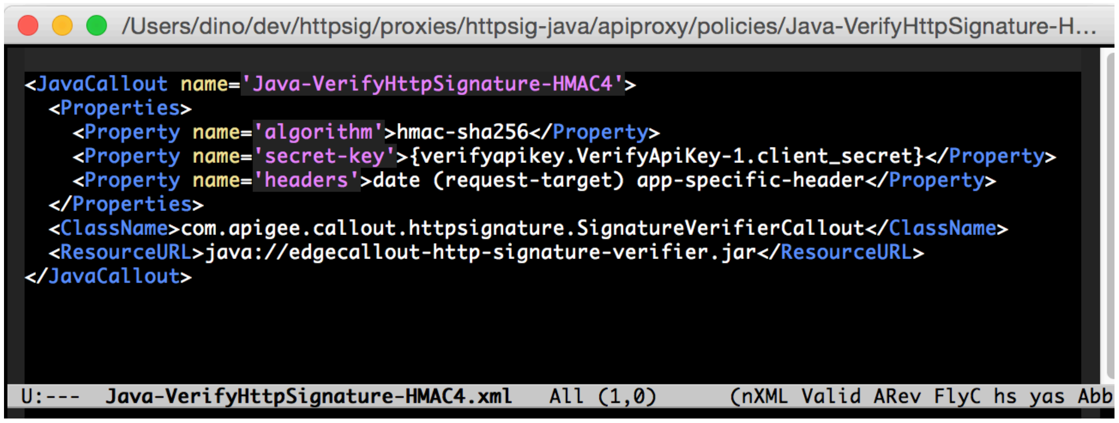
Java Callout for HttpSignature Verification


/Users/dino/dev/httpsig/proxies/httpsig-java/apiproxy/policies/Java-VerifyHttpSignature-H…

```
<JavaCallout name='Java-VerifyHttpSignature-HMAC4'>
  <Properties>
    <Property name='algorithm'>hmac-sha256</Property>
    <Property name='secret-key'>{verifyapikey.VerifyApiKey-1.client_secret}</Property>
    <Property name='headers'>date (request-target) app-specific-header</Property>
  </Properties>
  <ClassName>com.apigee.callout.httpsignature.SignatureVerifierCallout</ClassName>
  <ResourceURL>java://edgecallout-http-signature-verifier.jar</ResourceURL>
</JavaCallout>
```

```
U:---  Java-VerifyHttpSignature-HMAC4.xml   All (1,0)     (nXML Valid ARev FlyC hs yas Abb
```

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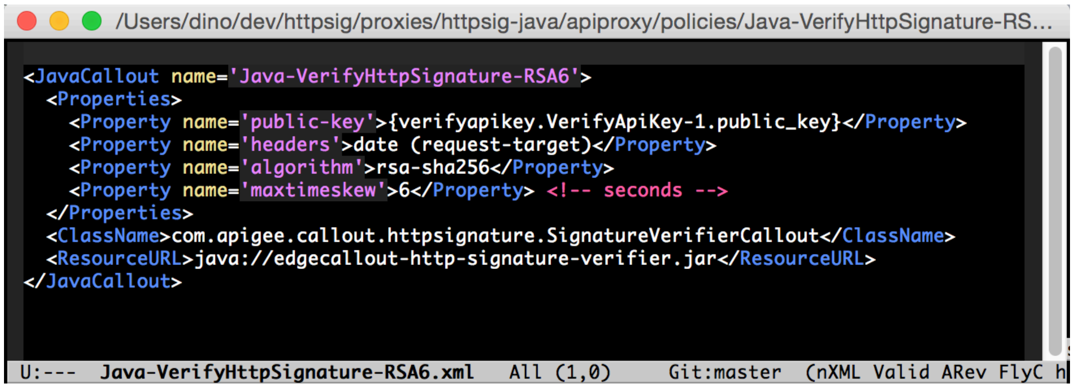
Java Callout for HttpSignature Verification


/Users/dino/dev/httpsig/proxies/httpsig-java/apiproxy/policies/Java-VerifyHttpSignature-RS…

```
<JavaCallout name='Java-VerifyHttpSignature-RSA6'>
  <Properties>
    <Property name='public-key'>{verifyapikey.VerifyApiKey-1.public_key}</Property>
    <Property name='headers'>date (request-target)</Property>
    <Property name='algorithm'>rsa-sha256</Property>
    <Property name='maxtimeskew'>6</Property> <!-- seconds -->
  </Properties>
  <ClassName>com.apigee.callout.httpsignature.SignatureVerifierCallout</ClassName>
  <ResourceURL>java://edgecallout-http-signature-verifier.jar</ResourceURL>
</JavaCallout>
```

```
U:---  Java-VerifyHttpSignature-RSA6.xml   All (1,0)    Git:master  (nXML Valid ARev FlyC h
```

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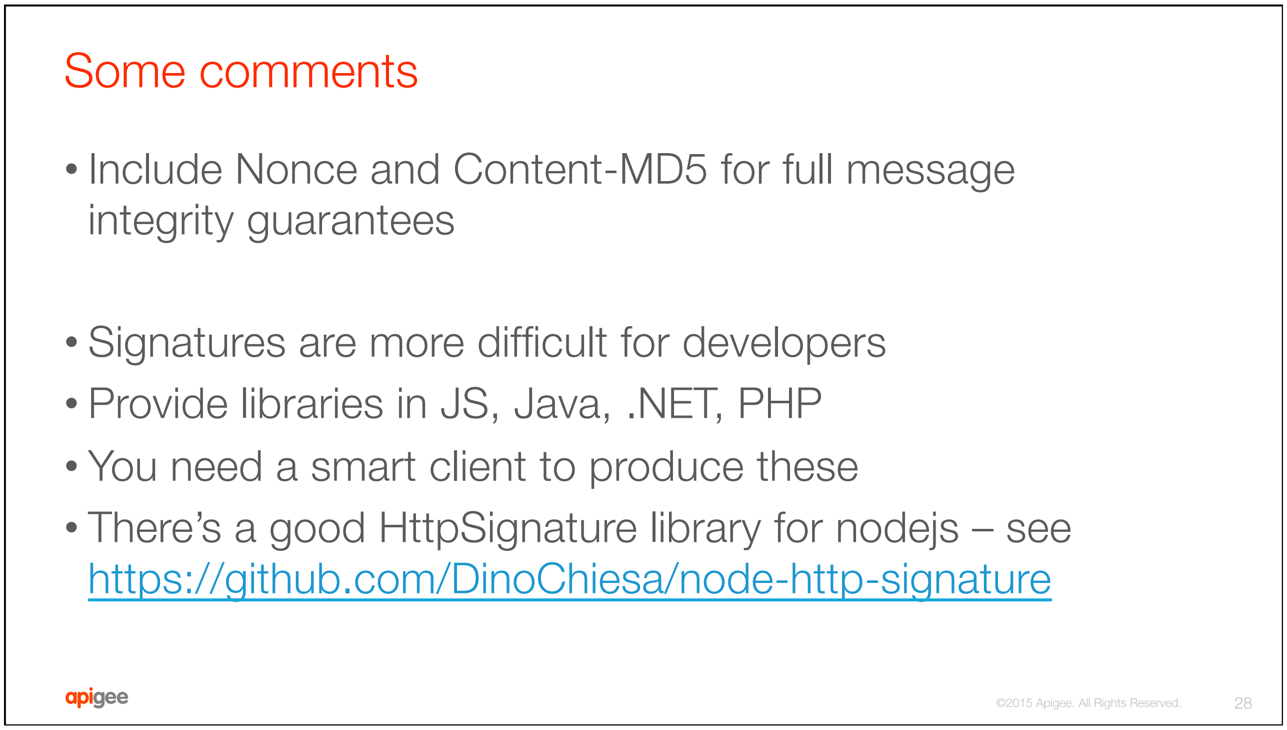
HttpSignature Code walkthrough & Demo

27



Some comments

- Include Nonce and Content-MD5 for full message integrity guarantees
- Signatures are more difficult for developers
- Provide libraries in JS, Java, .NET, PHP
- You need a smart client to produce these
- There's a good HttpSignature library for nodejs – see https://github.com/DinoChiesa/node-http-signature

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28

When to use HMAC, HttpSignature?

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- Use these callouts whenever you want to add HMAC or HttpSignature verification to your proxies
- To avoid MITM risks
- To Layer Message-level protection on top of TLS
- Scenarios :
  Non-Repudiation and archival
      eg, medical records release consent
  Message-layer Integrity

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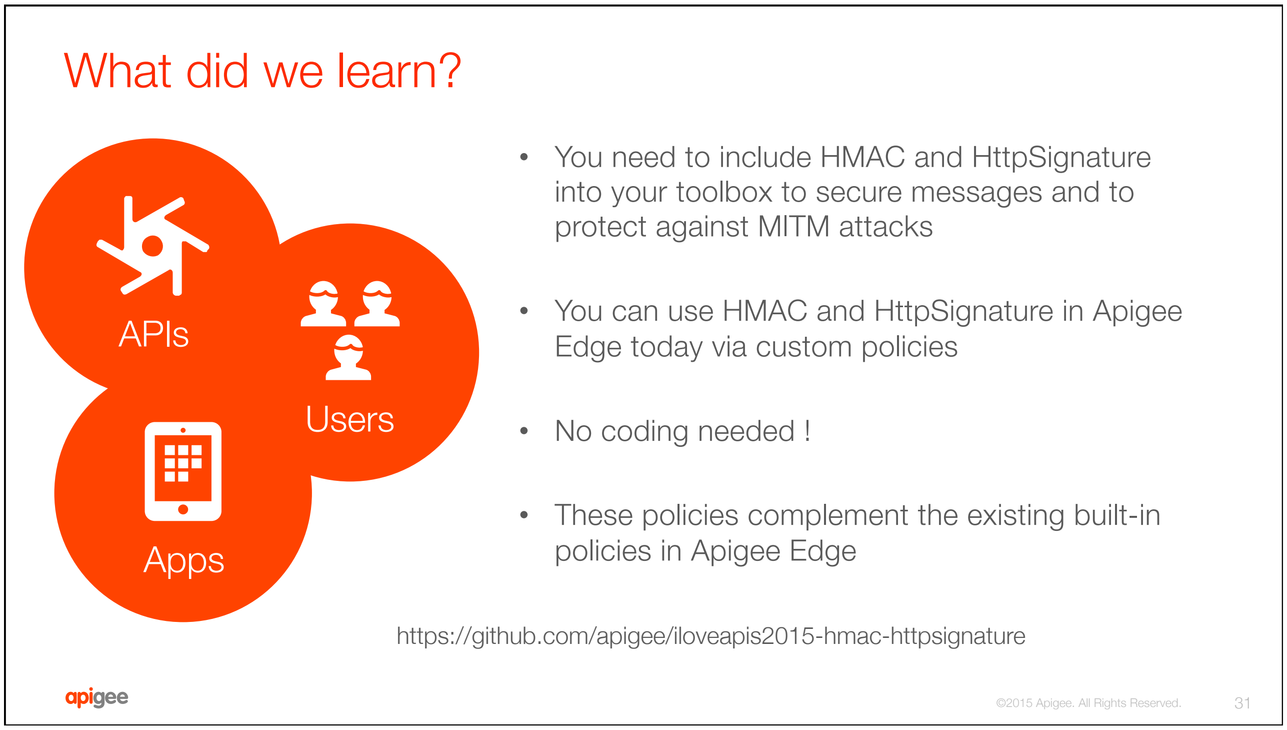
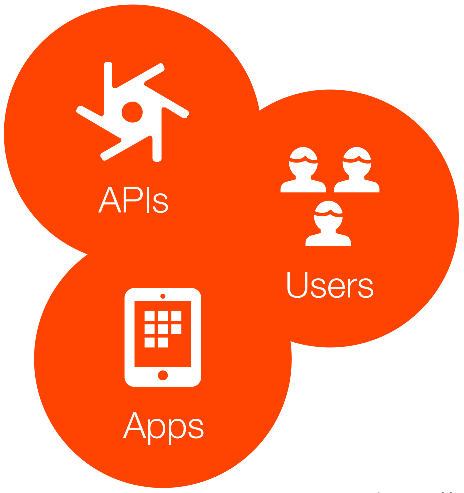


What did we learn?



- You need to include HMAC and HttpSignature into your toolbox to secure messages and to protect against MITM attacks
- You can use HMAC and HttpSignature in Apigee Edge today via custom policies
- No coding needed !
- These policies complement the existing built-in policies in Apigee Edge

https://github.com/apigee/iloveapis2015-hmac-httpsignature

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