PIKA: Proof of Issuer Key Authority

OAuth interim meeting
June 4, 2024

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Today’s JWT lifecycle can sometimes be problematic

What if JWK Set is unavailable?
- Key has been rotated
- Server is down

Issue

JWT
“Iss”: “https://issuer.example”

GET /.well-known/...
Host: issuer.example
Use case: Applications using Verifiable Credentials

- Application software directly verifying signatures from OP when joining a session
  - No real caching of OP keys
  - Highly sensitive to OP downtime or latency
  - Many hits to JWK set endpoint from distributed relying parties
- Goal: Have app server fetch OP keys once and redistribute them to all relying parties
  - ... without trusting the app server!
Use case: Durable Signing (e.g. of Containers)

Goal: App wants to know that at some past time T:
- Container was signed by Developer with K_dev
- OP signed a credential using K_op associating K_dev with Developer
  - E.g., VC or OpenPubkey PK Token

Solution (partial):
- Assume a time-stamping authority TSA attesting “X existed at time T”
- TSA can prove that K_op and credential existed at time T
- How can we verify that the OP was using key K_op at time T? (“issuer key authority”)

Diagram:
- K_op
- Credential
- K_dev
- Signature
- Container
- Signature
Given similar requirements to OpenID Federation, we re-use the Federation Historical Keys Response format as a base format for PIKAs.
JWT Header:
{
    "alg": "ES256",
    "typ": "JWT",
    "x5c": "["MII..."]"
}

JWT Payload:
{
    "iss": "https://server.example.com",
    "iat": 123972394272,
    "exp": 124003930272,
    "keys": [
        {
            "kty": "EC",
            "crv": "P-256",
            "alg": "ES256",
            "x": "qiGKLwXRJmJR_AOQpWOHXL5uYIfzvPwDurWmZBwvw",
            "y": "ip8nyuLpJ5NpriZzcVKiG0TeqPMkrzjNUUQ8YFzeGdk",
            "kid": "2HnoFS3YnC9tjiCalvWLVLvJ3AxwGGz_98uRfagJEEs",
            "iat": 123972394872,
            "exp": 123974395972
        },
        {
            "kty": "RSA",
            "n": "ng5jr...",
            "e": "AQAB",
            "kid": "8KnoFS3YnC9tjiCalvWLVLvJ3AxwGGz_98uRfagJlJr",
            "iat": 123972394872,
            "exp": 123974394972,
            "revoked": {
                "revoked_at": 123972495172,
                "reason": "keyCompromise",
                "reason_code": 1
            }
        }
    ]
}

JWT Signature:
// Signature over JWT Header and Claims, as defined in RFC 7519

Sample PIKA

- X.509 certificates chain to root of WebPKI
- Validity interval of the PIKA
- OP key
- Validity interval for *signing* with OP's key
- Another OP key
- Signature using key in X.509 cert
Results of Adoption Call v1

Core value / interest in solving the problem: ✔

Issue 1: Use of PKI at the application layer ("x5c")
- ... as opposed to at the transport layer, for HTTPS
- PIKA bucks the long term trend away from X.509 at the application layer
  - JWK, OpenID Connect, OpenID Federation, etc.
- Need to make sure that systems using PIKA have a clear upgrade/interop path to alternatives to application-level certificates (e.g., OpenID Federation)

Issue 2: Security considerations using Web PKI certificates for PIKA signing
- Web servers might have different risks than PIKA-signing servers
- Compromise of a web server could allow the issuer to sign a PIKA
- Solution space: domain name prefix, lifetime limitation, ...
Adoption Call v2?

Core value / interest in solving the problem: ✅

Do we have enough clarity to believe the issues are solvable?