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JSON-encoded ABAC (XACML) policies

Steven Davy, Bernard Butler, Leigh Griffin,
Brendan Jennings

FAME project
Waterford Institute of Technology

Presentation to OASIS XACML TC concerning JSON-encoded XACML policies, 2013-05-30

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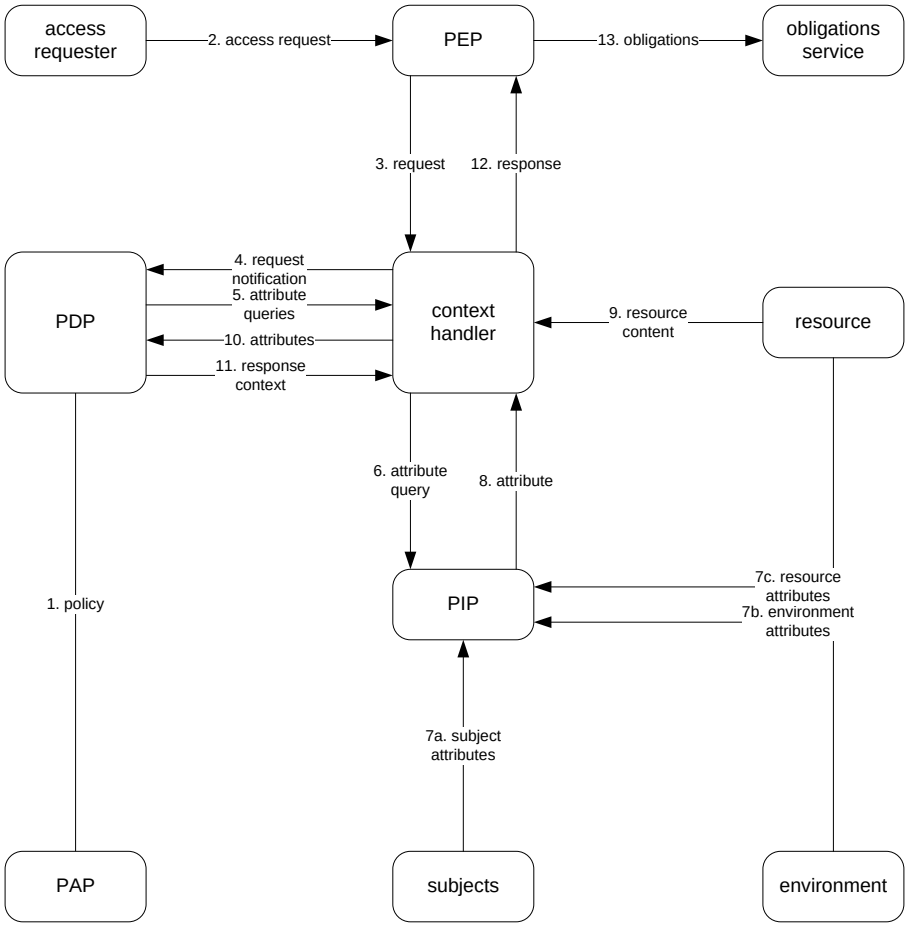
Outline

1. Introduction
   - Motivation
   - Response to challenge
   - Our contribution
2. Evaluation
   - Setup
   - Results
3. Discussion and Conclusions

Architecture outline



Source: XACML 2.0 specification

Problems with XACML's XML encoding

Policies

- Verbose
  - difficult to edit manually
  - communication and processing overhead
- Not "executable"
  - Harder to build user-friendly tooling c.f. Java IDEs
  - PDP has more work to do: functions, combination algorithms, . . .

Requests (and responses)

- Modern web services use "lighter" request/response formats
- Potential performance bottleneck - format conversion

Industry response

Policies

- Improved policy authoring tools (e.g., Quest One APS, Cisco EPM)
- Transforming simpler language to XACML (e.g., ALFA from Axiomatics)

Requests

OASIS XACML 3.0 JSON requests and responses!

Outstanding problems: now

Policies

- Greater complexity of policy authoring toolchain
- Continued limited support for policy analysis
- PDP still has to handle multiple concerns
- Lost opportunity to apply *modern principles*

Requests

- OASIS activity has great potential to reduce impedance mismatch with clients
- Potential complexity if encoding for policies and for requests differ

Our contribution: language

JSON policies and "context"

- Developed independently of OASIS XACML TC
- Developed analog of XACML 2.0: JSONPL[a]
- Subject, Resource, Action, Environment attributes
- Rules and rule/policy combination
- 4-valued decisions: Permit, Deny, Indeterminate, Not Applicable
- JSONPL currently lacks
  - Obligations
  - XACML 3.0 new features (delegation, etc.)
  - Formal "schema"

[a] JSON Privilege Language

Language features and tools

Policy editing

- Structure of policy is identical to XACML 2.0
  - keywords and much of the syntax
  - hierarchies
  - relationships (grouping)
- Language features
  - (nested) associated arrays (hashes) and enumerated arrays
  - High-level keys: XACML 2.0 elements (Subject, Rule, etc.)
  - Low-level keys: Specific subject attributes, etc.
- Remove type declarations (string, number, date only)
- Remove namespace handling
- Use text editor; many are JSON-aware (well-formed)

Example JSONPL policy (fragment)

```
"Policy":{
    "id":"RPSlist.7.0.1",
    "target":{
        "subjects":{
            "subject":{
                "role":"admin"
            }
        },
        "resources":{
            "resource":{
                "isPending":"false"
            }
        },
        "actions":{
            "action":{
                "action-type":"write"
            }
        }
    },
    "rule":{
        "id":"RPSlist.7.0.1.r.1",
        "effect":"permit"
    }
}
```

Overall XACML policy set: 420Kb (311Kb).
Overall JSONPL policy set: 70Kb (17Kb).

Example JSONPL request (manually-generated)

```
{
  "subject": {
      "category": "access-subject",
          "role": "pc-chair"
   },
   "resource": {
      "isPending": "false",
      "resource-id": "DEFAULT RESOURCE"
   },
   "action": {
      "action-type": "write"
   }
}
```

Size comparison

- XACML request: 872b (842b).
- JSONPL request: 211b (158b).

Our contribution: prototype

Node.js, JavaScript, redis

- Node.js: server side JavaScript framework: new wave of scalable web services
- JavaScript: Reduced friction—JSONPL is based on JavaScript syntax
- redis: NoSQL, highly performant, key-value store—very fast lookup by key
- Present components: PDP, PEP, PRP
  - Prototype code!!!
  - Limited scope—see exclusions above
  - Limited robustness—edge cases, invalid input, etc.

Rationale for design decisions

Trends in web service development and deployment

- Traditional: Java/.NET, XML, SOAP
- Newer: Java/Scala/JavaScript/. . . , JSON, REST
- Growth of functional and domain-specific languages

Analysis of requirements

- Less verbose, but just as expressive
- (Semi-)executable (in JavaScript-based PDP)
- Low friction (from client request to server policy and back)
- Better performance (described in POLICY 2012 paper)

Setup

Policies and Requests

- CONTINUE-A policy set[a] (60 policies approx)
- Example requests (200 requests approx)
- Verification: Same decisions as *SunXACML* PDP

XACML $\rightarrow$ JSONPL conversion: done manually by Leigh
For comparison: automated XML-to-JSON

[a] Distributed with Xengine PDP

PDP, PRP, PEP

- PDP: Match JSON elements, lookup rule value, combine as necessary
- PEP: very light, forwards requests and responses
- PRP: thin wrapper for redis policy store

Performance experiments

STACS (Scalability Testbed for Access Control Systems)

- Factorial experiments: server, PDP, conversion_type,. . .
- Run tests, collect service times, etc.
- Analyze, compare and visualize results

Summary of Results

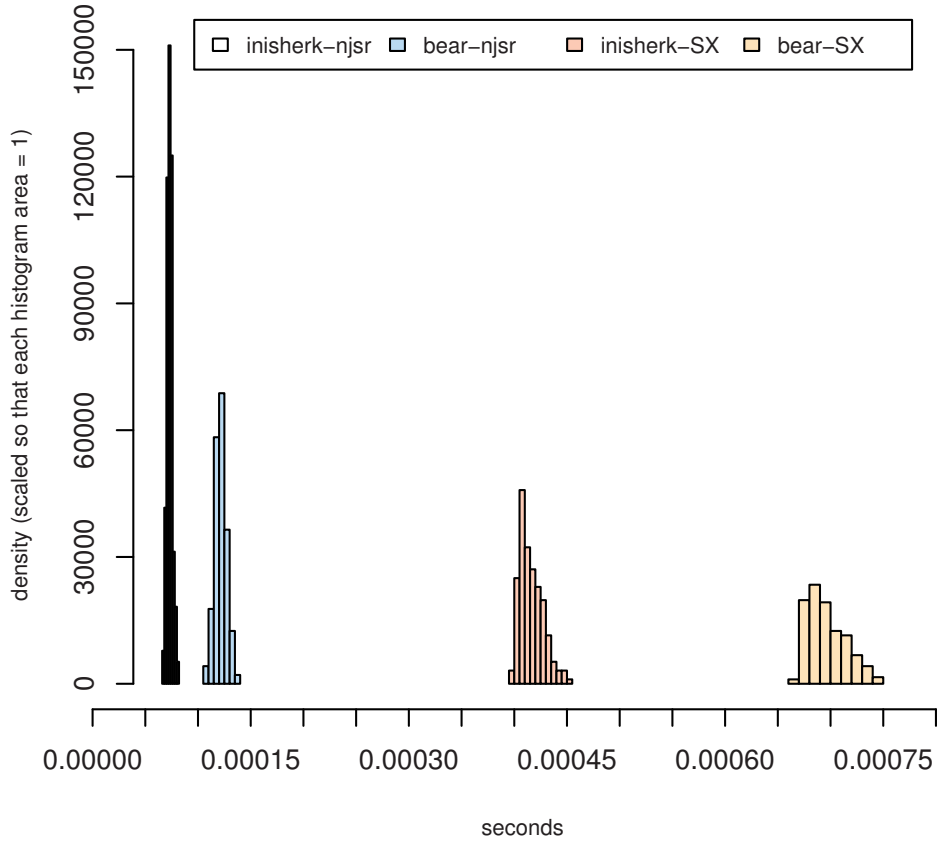
JSONPL

- ABAC with XACML “metamodel” and JSON encoding: proof of concept
- Reduced verbosity without reducing expressiveness
- Minimal friction (and even less with JavaScript-based PDP)

Prototype

- JavaScript PEP, PDP, PRP with JSON Privilege Language: proof of concept
- Simplicity of JavaScript-based PDP with JavaScript-based policies and context
- Performance and resource usage: dramatic improvements over *SunXACML* PDP
- Quantified improvements: conciseness $\ll$ language choice

Performance improvements



- `SX` is *SunXACML* PDP, `njsr` is the Node.js-redis prototype PDP.
- `bear` and `inisherk` are server instances.

Discussion

Strengths and weaknesses

- Results are very encouraging, but need to . . .
  - consider larger/more complex policy sets
  - policy editor/transformation tools
  - reference implementation, like *SunXACML*
  - consider migration path for existing XACML users and vendors
  - encourage STANDARDS and INDUSTRY ADOPTION!

Conclusions

Summary

- Presentation triggered by discussion on `xacml-users` list
- We welcome the opportunity to develop this further

Selected bibliography

POLICY 2012 Griffin, L.; Butler, B.; Leastar, E.; Jennings, B. and Botvich, D, “On the Performance of Access Control Policy Evaluation”, in IEEE International Symposium on Policies for Distributed Systems and Networks, 2012, pp. 25-32. http://dx.doi.org/10.1109/POLICY.2012.15

JSONPL 2012 L. Griffin, “JSONPL repository”, July 2012. https://github.com/lgriffin/JSONPL

Thanks for your attention!