Towards a better language for WAF Core Rule Set

CRS community summit 2018

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Agenda

- Who we are
- Why are we doing this?
- Why not ModSecurity[*]?
- Ideas and Concepts
- Current status and next steps
- Questions and Discussion

* – This always means: ModSecurity – the language, not ModSecurity - the WAF Implementation

Who we are

- Mirko
  - Developed WAF like components for banking in 2000
  - Worked for WAF vendor(s) as lead engineer from 2005-2017
  - Co-author of OWASP Paper: Use of Web Application Firewalls
- Christian
  - Worked as Engineer + Product Manager for WAF vendor(s) since 2007
- Since 2017 working for Avi Networks WAF team
  - WAF is based on ModSecurity 3.x with some heavy changes
  - WAF is using OWASP CRS for base protection

Why are we doing this?

- ModSecurity* is not ideal for a WAF for various reasons
- The Core Rule Set is a valuable resource, both for commercial and for other open-source WAF‘s[2]
- The Core Rule Set should be in a format which can be consumed by other WAF implementations[2]

[2] for example lua-resty-waf, or a middleware input validation layer in your Django Web Stack

Why are we doing this?

OWASP

ModSecurity

Core Rule Set

Why are we doing this?

OWASP

~~ModSecurity~~

Core Rule Set

Why are we doing this?

OWASP

Core Rule Set

Why are we doing this?

OWASP

Core Rule Set

Why are we doing this?

OWASP

Core Rule Set

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ModSecurity Core Rule Set

Why not ModSecurity*?

- Assumptions:
  - WAF should be **configured** in a **declarative** style and not programmed.
  - In special cases, you need the power of a scripting language.
- ModSecurity* is too complex to be considered configuration or to automatically convert it to other execution models.
- It is not flexible enough to solve more complex problems. Lua support solves this.
- If you want to read my full rant about it, read [1] or talk to me in the next 2 days.

Why not ModSecurity*?

- Syntax – should never show this to a user
- Types (or the absence of types)
  - List of strings is really missed
  - No clear distinction between Number and String leads to subtle errors
- Chain rules
  - Mostly used to
    - a) extract part of the Requests into temp variables
    - b) implement a logical AND for conditions
- Regex is PCRE based
  - CRS is using PCRE extensions which are not available in other implementations, for example python-re or Google re2 lib

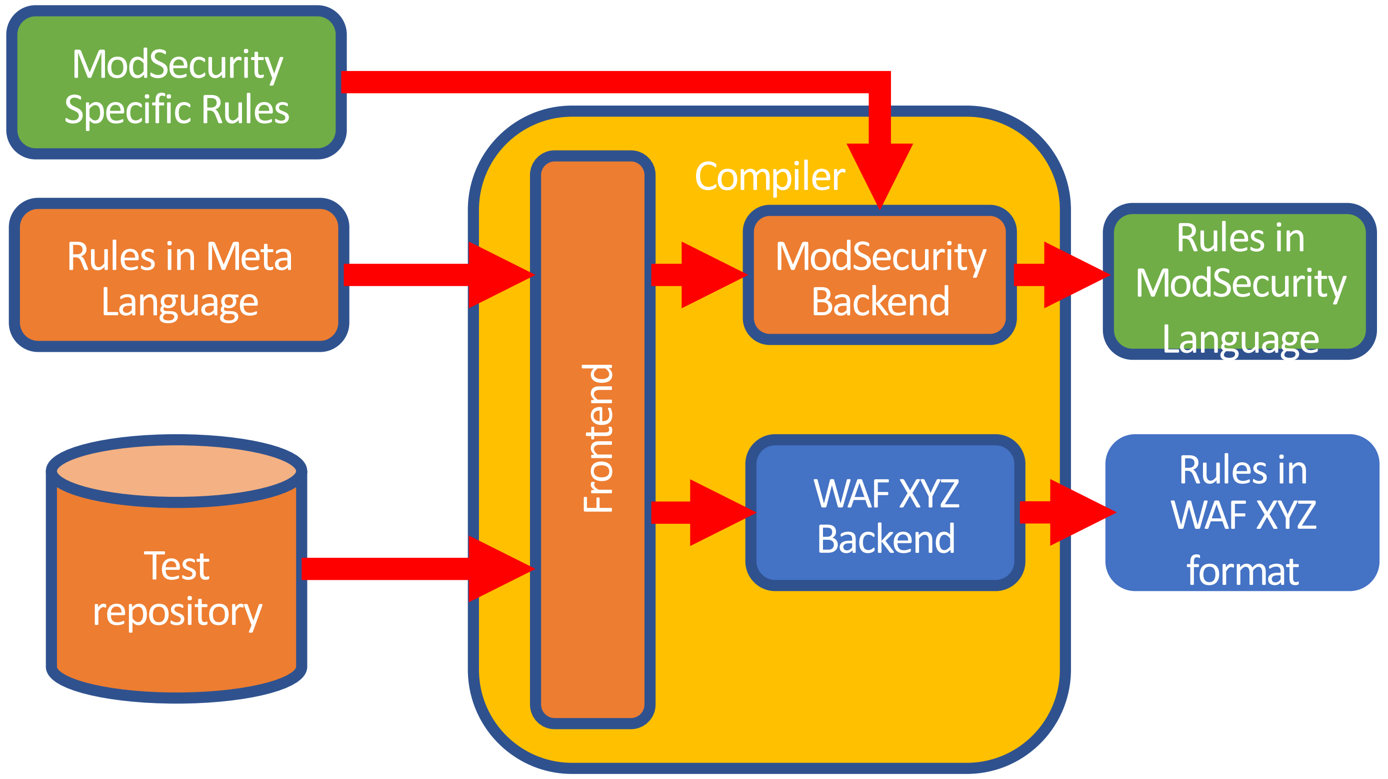
Ideas and Concepts

- Current CRS contains rules which implement WAF functionality but are not part of what we would consider a WAF CRS
  - The concrete way of how the features below are implemented
    - IP reputation, DOS protection
    - anomaly detection, rule corellation
    - Sampling, logging
- We believe that the other “interesting rules“ can be expressed in an easier and more declarative language.
- This is not a language to configure a specific WAF directly

Ideas and Concepts - Summary

- Have a declarative language which can describe (a subset of) current Core Rule Set
- Have compiler to automatically convert rules from this language to different WAF‘s native languages, like ModSecurity.
  - The goal is to create exactly the same rules CRS has today. This may need some backend specific hints in the rules for the compiler.

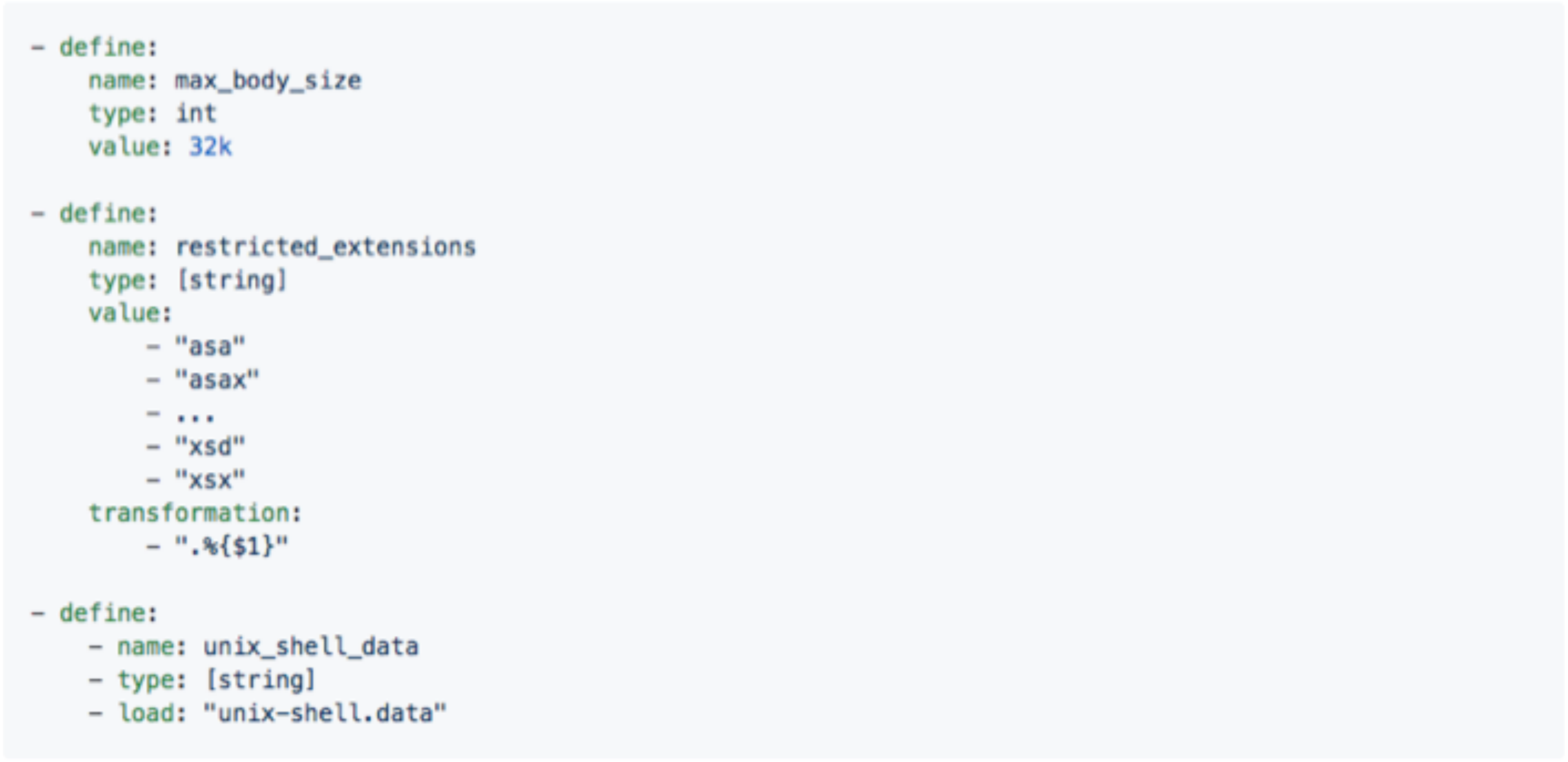
Ideas and Concepts - Summary



Ideas and Concepts – Language Spec

- Building Blocks are pluggable.
  - Constants (maybe request dependent). Do we need variables?
    - For the sake of discussion: A variable which is only set once is a constant.
  - Conditions
  - Actions
  - Rules
  - Control flow (explicit)
- Avoid state and state modification (get rid of setvar as much as possible)
- We do not want to discuss syntax right now, so we use YAML for all the examples.

Ideas and Concepts - Constants

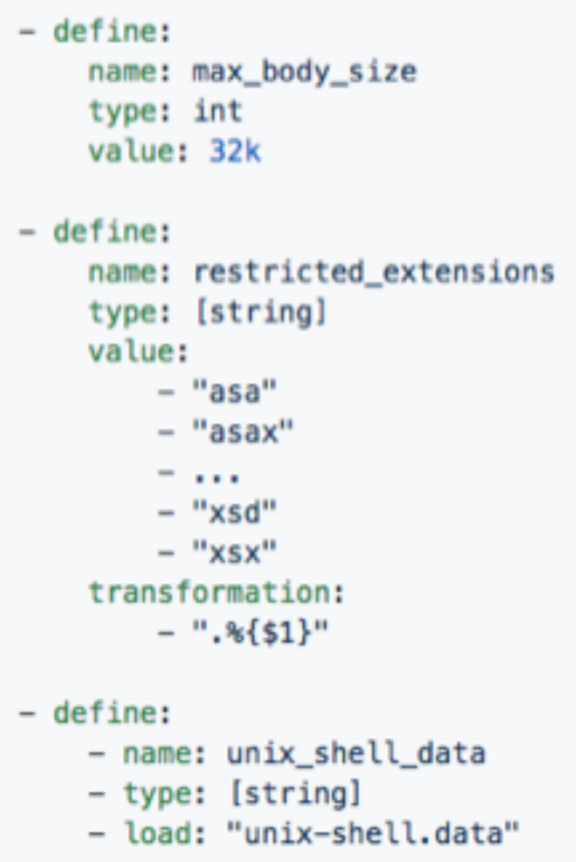


```yaml
- define:
    name: max_body_size
    type: int
    value: 32k

- define:
    name: restricted_extensions
    type: [string]
    value:
        - "asa"
        - "asax"
        - ...
        - "xsd"
        - "xsx"
    transformation:
        - ".%{$1}"

- define:
    - name: unix_shell_data
    - type: [string]
    - load: "unix-shell.data"
```

Ideas and Concepts - Constants



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- define:
    name: max_body_size
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- define:
    name: restricted_extensions
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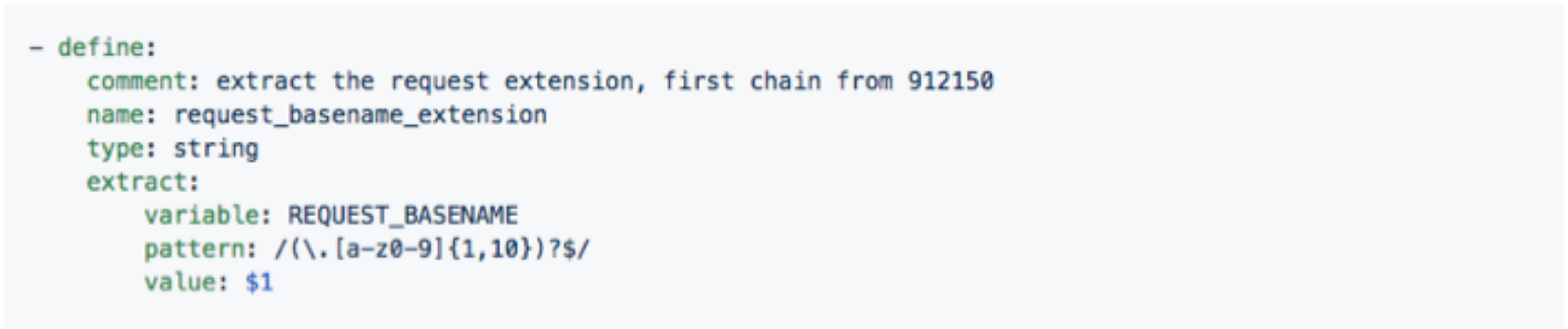
        - "asa"
        - "asax"
        - ...
        - "xsd"
        - "xsx"
    transformation:
        - ".%{$1}"

- define:
    - name: unix_shell_data
    - type: [string]
    - load: "unix-shell.data"
```

```
SecRule &TX:restricted_extensions "@eq 0" \
   "id:901164, phase:1, pass, nolog,\
   setvar:'tx.restricted_extensions=.asa/ .asax/ .ascx/ .axd/ .backup/
.bak/ .bat/ .cdx/ .cer/ .cfg/ .cmd/ .com/ .config/ .conf/ .cs/ .csproj/ .csr/
.dat/ .db/ .dbf/ .dll/ .dos/ .htr/ .htw/ .ida/ .idc/ .idq/ .inc/ .ini/ .key/ .licx/
.lnk/ .log/ .mdb/ .old/ .pass/ .pdb/ .pol/ .printer/ .pwd/ .resources/
.resx/ .sql/ .sys/ .vb/ .vbs/ .vbproj/ .vsdisco/ .webinfo/ .xsd/ .xsx/'"
```

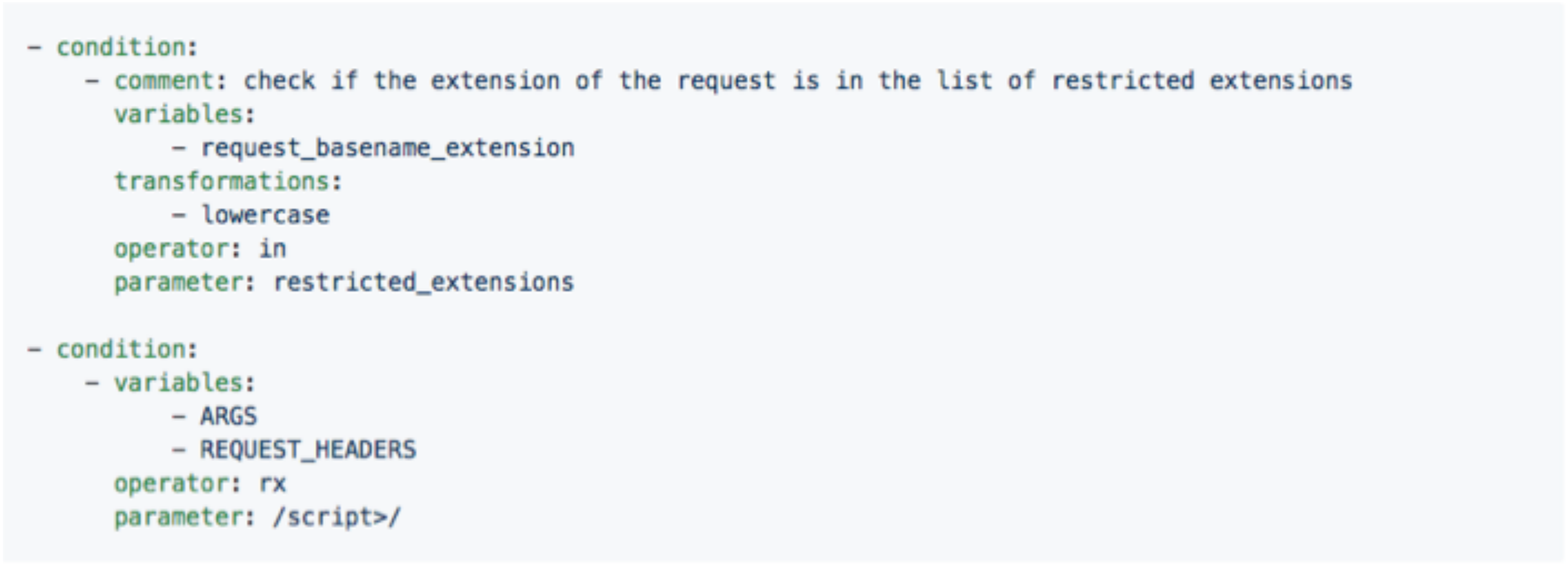
Ideas and Concepts – Extract Data

- Chain rules are often used to extract data from the request
- This should be explicit



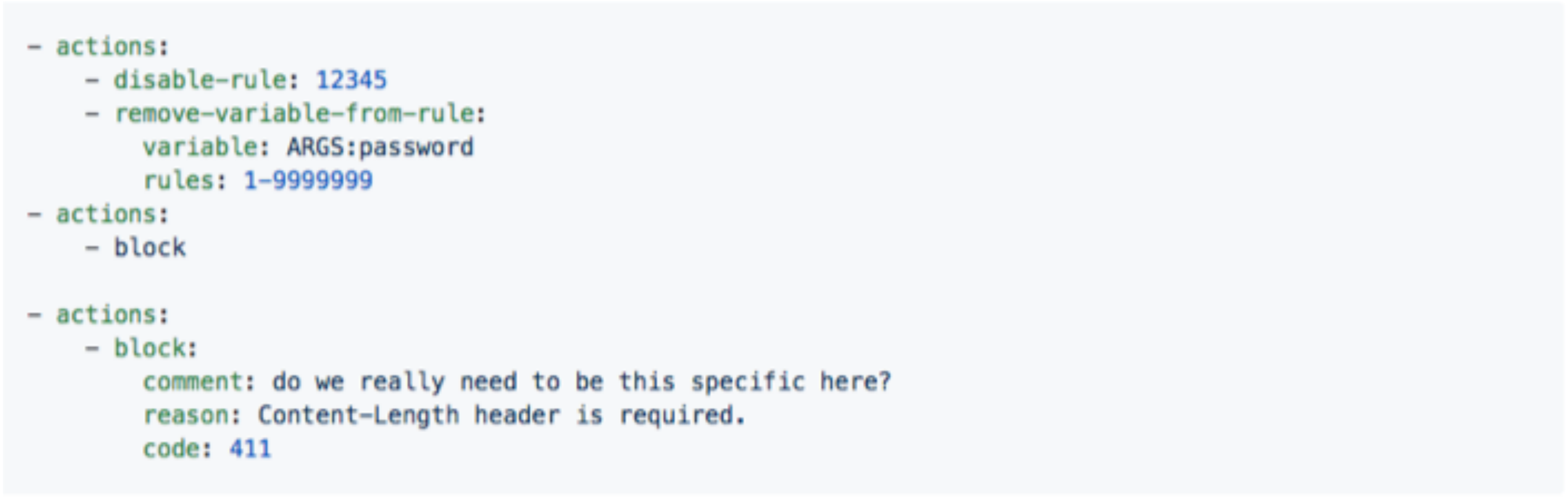
```
- define:
    comment: extract the request extension, first chain from 912150
    name: request_basename_extension
    type: string
    extract:
        variable: REQUEST_BASENAME
        pattern: /(\.[a-z0-9]{1,10})?$/
        value: $1
```

Ideas and Concepts – Conditions



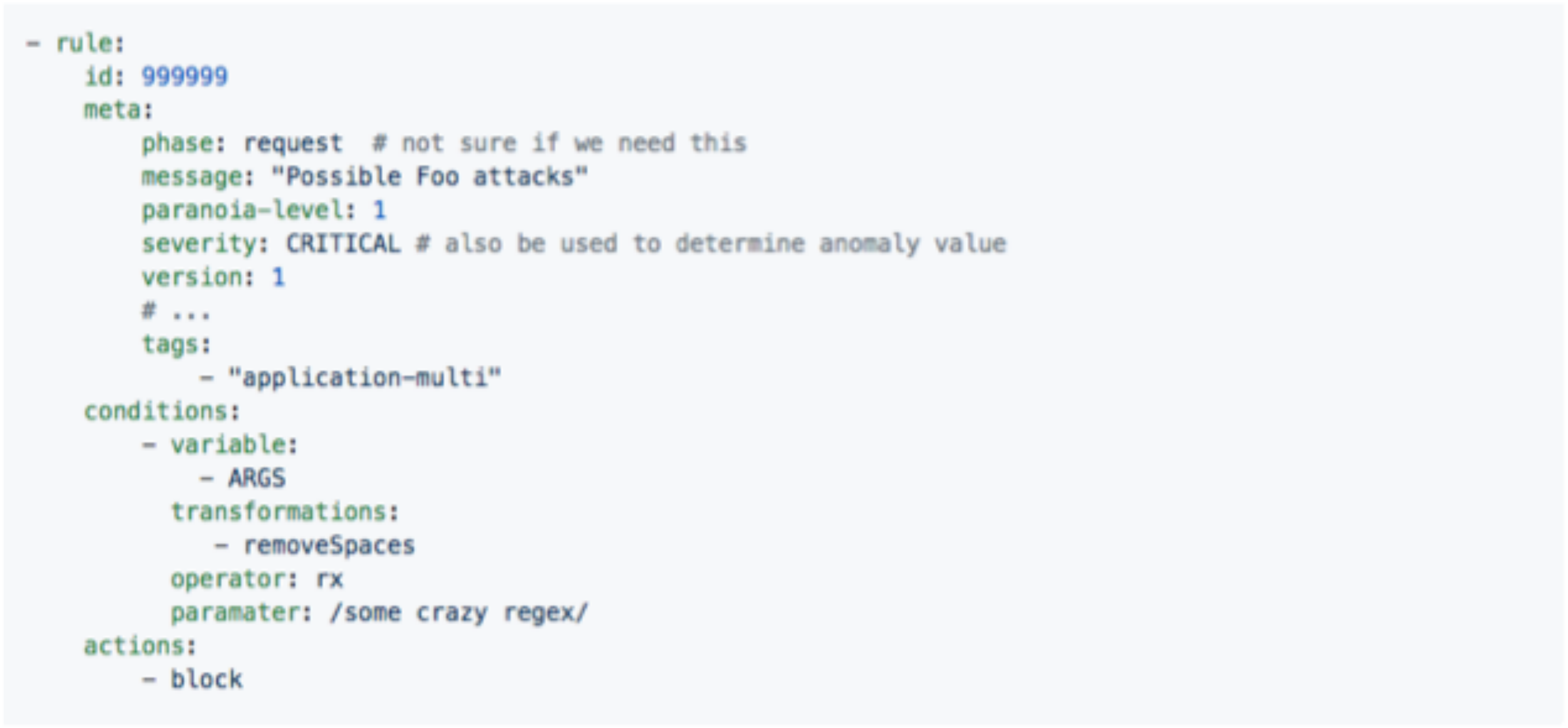
```yaml
- condition:
    - comment: check if the extension of the request is in the list of restricted extensions
      variables:
          - request_basename_extension
      transformations:
          - lowercase
      operator: in
      parameter: restricted_extensions

- condition:
    - variables:
          - ARGS
          - REQUEST_HEADERS
      operator: rx
      parameter: /script>/
```

Ideas and Concepts – Actions



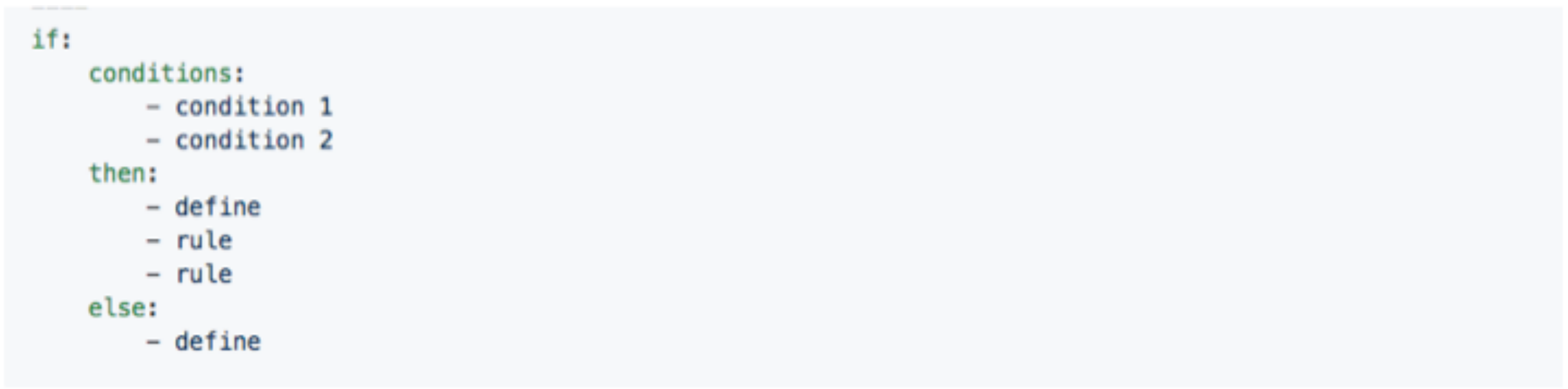
```
- actions:
    - disable-rule: 12345
    - remove-variable-from-rule:
        variable: ARGS:password
        rules: 1-9999999
- actions:
    - block

- actions:
    - block:
        comment: do we really need to be this specific here?
        reason: Content-Length header is required.
        code: 411
```

Ideas and Concepts – Rules



```
- rule:
    id: 999999
    meta:
        phase: request  # not sure if we need this
        message: "Possible Foo attacks"
        paranoia-level: 1
        severity: CRITICAL # also be used to determine anomaly value
        version: 1
        # ...
        tags:
            - "application-multi"
    conditions:
        - variable:
            - ARGS
          transformations:
             - removeSpaces
          operator: rx
          paramater: /some crazy regex/
    actions:
        - block
```

Ideas and Concepts – Control Flow



```
if:
    conditions:
        - condition 1
        - condition 2
    then:
        - define
        - rule
        - rule
    else:
        - define
```

Current status and next steps

- Proposal for language semantics, needs validation and iteration
- Python lib which can convert between ModSecurity* rule format, an internal object representation of these rules and an equivalent JSON format.
- TODO:
  - semi-automatically translating ModSecurity rules from the ModSecurity* representation to the new meta language, apply this to a subset of current CRS
  - translator from this meta-language to ModSecurity*
  - Implement an engine in Python to execute these new language directly as proof of concept and for test integrations

Open Questions

- Will it work?
- What about a positive security model?
- What about test integration into FTW
- How make the regex more readable?
  - Having a “readable version“ and a automatically generated „optimized“ regex may help.
  - Also, integrating test strings to the regexes which should or should not match could help as better documentation

Questions and Discussion

- [1] https://github.com/avinetworks/owasp-crs-technical-discussion
- We would welcome any feedback and contributions
- We would love to talk to you about this or other ideas in the next couple of days