

The Call Processing Language: User Control of Internet Telephony Services

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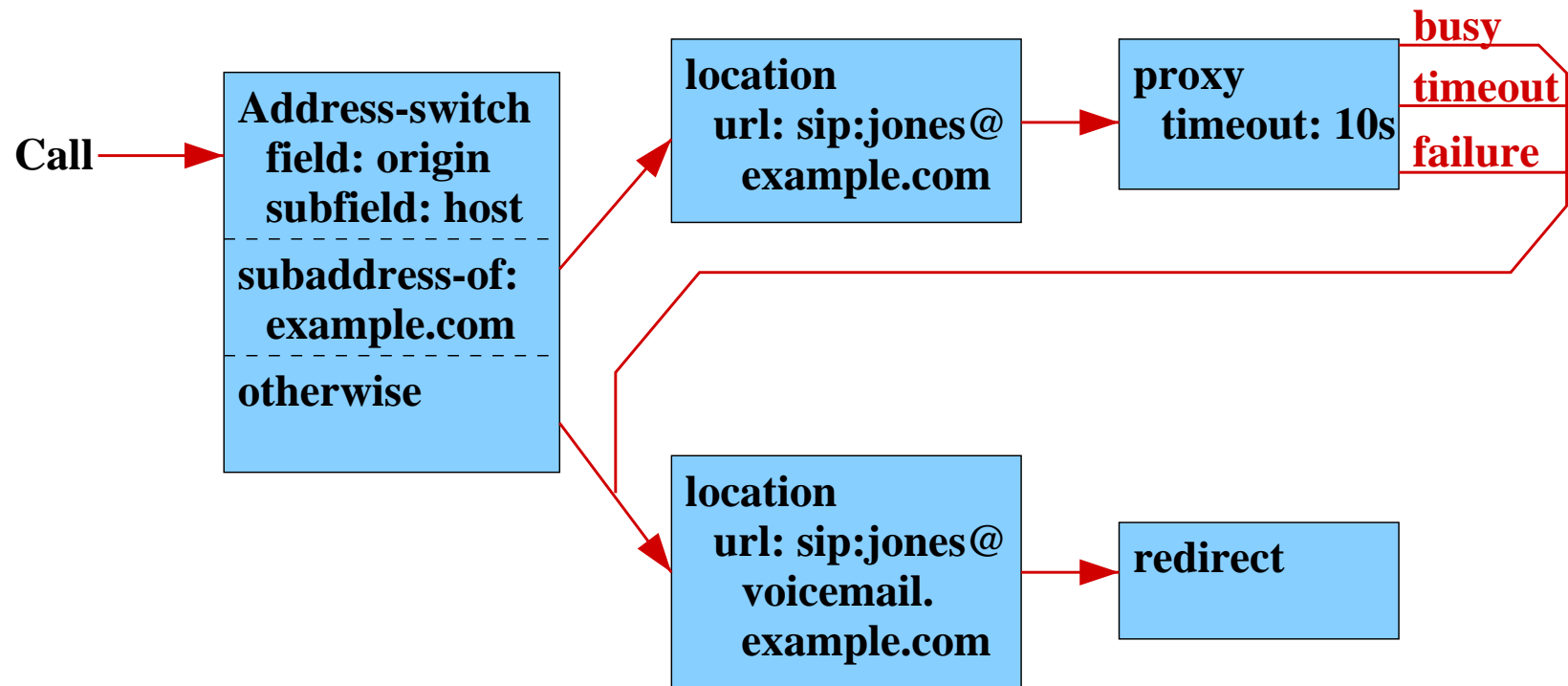
Motivation

- Internet telephony increasingly replacing circuit-switched network
- Need advanced telephony services for Internet telephony
 - Services comparable to traditional networks
 - * Call forwarding, call blocking, time-of-day routing, ...
 - New or enhanced services
 - * Interfaces with other parts of Internet
 - * Elaborate, custom services
- Need new ways of creating such services

Call Processing Language: Characteristics

- Creatable and editable both by simple graphical tools and by humans
- Independent of underlying signalling protocol
- Safe to run in servers
 - Automatically verifiable when uploaded to server
 - Resource usage (memory, processing time) inherently limited
 - Not Turing-complete: no loops, variables, recursion
 - Can't interact with inappropriate parts of the server
 - Predictable behavior
- Separate scripts for inbound, outbound, policy

Sample CPL: Graphical Representation



- Acyclic graph: start at root, progress downward
- Follow one output of each node, based on outcome

Representation: XML

- Why XML?
 - Easy to parse
 - Easy to edit
 - Naturally encodes tree structure
 - * add simple links for acyclic graph
- Representation specifics
 - Top level tag is `call`
 - Nodes and outputs are both tags
 - Node parameters are tag attributes
 - `link` tag connects branches

Example CPL Script

```
<?xml version="1.0" ?>
<!DOCTYPE call SYSTEM "cpl.dtd">

<call>
  <address-switch field="origin" subfield="host">
    <address subaddress-of="example.com">
      <location url="sip:jones@example.com">
        <proxy>
          <busy> <link ref="voicemail" /> </busy>
          <noanswer> <link ref="voicemail" /> </noanswer>
          <failure> <link ref="voicemail" /> </failure>
        </proxy>
      </location>
    </address>
    <otherwise>
      <location url="sip:jones@voicemail.example.com"
        id="voicemail">
        <redirect />
      </location>
    </otherwise>
  </address-switch>
</call>
```

CPL Nodes

Switches

Address Switch
String Switch
Priority Switch
Time Switch

Signalling Actions

Proxy
Redirect
Response

Locations

Basic Location
Location Lookup
Location Filter

Other Actions

Mail
Log

Links

Location Model

- Scripts have an implicit global variable: the location set
- Location nodes add to, replace, or filter location set
- The behavior of **Proxy** and **Redirect** actions is based on the current set of locations
- Allows flexible location handling

(Possible) Downsides to XML

- Location scheme is implicit, not explicit
 - Not possible to have other variables
 - But is this bad or good?
- Some syntax has to be done two-level, moderately ugly
 - e.g. time-switches:

```
<time  
  timeofday="1310-1425,1440-1555,1610-1725"  
  day="2,4">
```
- Verbose

Status

- Standardization
 - Work item of IETF IPTel working group, for Proposed Standard
 - Some interest from ITU for H.323 bindings
- Implementation
 - Implemented in Lucent “GosSIP” Server
(but status of this is uncertain)
 - Interest from other Lucent groups
 - In progress for Columbia SIP server
 - Interest from other organizations

Example Scripts

Example: Call Redirect Unconditional

```
<?xml version="1.0" ?>
<!DOCTYPE call SYSTEM "cpl.dtd">

<call>
  <location url="sip:smith@phone.example.com">
    <redirect />
  </location>
</call>
```

Example: Call Forward Busy/No Answer

```
<?xml version="1.0" ?>
<!DOCTYPE call SYSTEM "cpl.dtd">

<call>
  <location url="sip:jones@jonespc.example.com">
    <proxy timeout="8s">
      <busy>
        <location url="sip:jones@voicemail.example.com" merge="clear"
          id="voicemail" >
          <proxy />
        </location>
      </busy>
      <noanswer>
        <link ref="voicemail" />
      </noanswer>
    </proxy>
  </location>
</call>
```

Example: Call Screening

```
<?xml version="1.0" ?>
<!DOCTYPE call SYSTEM "cpl.dtd">

<call>
  <address-switch field="origin" subfield="user">
    <address is="anonymous">
      <response status="reject"
        reason="I don't accept anonymous calls" />
    </string>
  </string-switch>
</call>
```

Example: Time-of-day Routing

```
<?xml version="1.0" ?>
<!DOCTYPE call SYSTEM "cpl.dtd">

<call>
  <time-switch>
    <time day="1-5" timeofday="0900-1700">
      <lookup source="registration">
        <success>
          <proxy />
        </success>
      </lookup>
    </time>
    <otherwise>
      <location url="sip:jones@voicemail.example.com">
        <proxy />
      </location>
    </otherwise>
  </time-switch>
</call>
```

Example: Non-call Actions

```
<?xml version="1.0" ?>
<!DOCTYPE call SYSTEM "cpl.dtd">

<call>
  <lookup url="http://www.example.com/cgi-bin/locate.cgi?user=jones"
    timeout="8s">
    <success>
      <proxy />
    </success>
    <failure>
      <mail url="mailto:jones@example.com;subject=lookup%20failed" />
    </failure>
  </lookup>
</call>
```


Example: A Complex Example

```
<call>
  <location url="sip:jones@phone.example.com">
    <proxy timeout="8s">
      <busy>
        <location url="sip:jones@voicemail.example.com"
          id="voicemail">
          <redirect />
        </location>
      </busy>
    <noanswer>
      <address-switch field="origin">
        <address contains="boss@example.com">
          <location url="tel:+19175551212">
            <proxy />
          </location>
        </address>
        <otherwise>
          <link ref="voicemail" />
        </otherwise>
      </address-switch>
    </noanswer>
  </proxy>
</location>
</call>
```