Outline

- What?

- Why?

- Status Quo

- SDP OPS in OpenSIPS 3.6

- Future Work

About Me

- opensips developer & maintainer

@liviuchircu

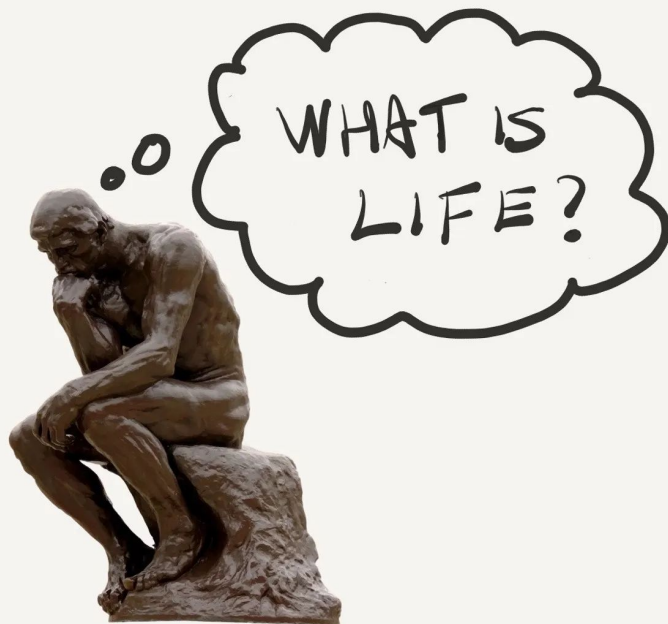- Design, Develop & Maintain SIP Platforms

What is SDP?

What is SDP??

Session Description Protocol

- **session**
- **streams**
- **attributes**

```
v=0
o=- 5314000948960589552 4 IN IP4 127.0.0.1
s=-
t=0 0
a=group:BUNDLE 0 1 2
a=extmap-allow-mixed
a=msid-semantic: WMS
461f346d-0614-4a74-897b-373dd7ae64cb
m=video 33737 UDP/TLS/RTP/SAVPF 96 97 102 103
c=IN IP4 67.159.8.210
a=rtcp:9 IN IP4 0.0.0.0
a=candidate:2807186827 1 udp 2122260223
169.254.166.135
…
```

Session Description Protocol

- RFC 2327, april 1998
  - Laid the foundation for session descriptions
- RFC 3264, june 2002
  - offer/answer model; dynamic negotiation of session params
- RFC 4566, july 2006
  - consolidation: improved ABNF (syntax); improved IPv6 support
- RFC 8866, jan 2021
  - terminology; align with ABNF syntax
  - mandatory RTCP for inactive media streams
  - reorganize IANA registries

Why edit the SDP?

Need to Edit SDP

- Packetization time   **a=ptime**:80

- Topology hiding
    - change origination username/address

        o=FreeSWITCH 2890844526 2890842807 IN IP4 **10.47.16.5**

- Multi-leg call scenarios (B2B, media_exchange, etc.)
                rtpproxy/rtpengine

Need to Edit SDP

```
rtpproxy_offer([flags], [ip_address], [set_id],
            [sock_var], [ret_var], [body_var])
```

(since 3.3)

SDP Payload Growth over Time

Era	Main Growth Contributors	Approx. Size Impact
Initial SDP (1998)	Basic media lines, static attributes	~200–400 bytes
Offer/Answer (2002)	Codec negotiation, RTP mapping	~500–1000 bytes
ICE & DTLS (~2010)	ICE candidates, credentials, DTLS fingerprints	+1–2 KB
WebRTC (~2015)	Simulcast, RID, BUNDLE, MID, MSID	+2–3 KB
Online Meetings	Multiple streams, SFU support, fine-grained attributes	+3–5 KB or more

Previous Limitations
In *opensips.cfg*

Buffer-driven Processing

```
v=0
o=- 5314000948960589552 4 IN IP4 127.0.0.1
s=-
t=0 0
a=group:BUNDLE 0 1 2
a=extmap-allow-mixed
m=msid-semantic: WMS 461f346d-0614-4a74-897b-373dd7ae64cb
m=video 33737 UDP/TLS/RTP/SAVPF 96 97 102 103 104 105 106 107 108 109 127 125 39 40 45 46 98 99 100 101 112 113 116 117 118
c=IN IP4 67.159.8.210
a=rtcp:9 IN IP4 0.0.0.0
a=candidate:2807186827 1 udp 2122260223 169.254.166.135 63973 typ host generation 0 network-id 2
a=candidate:998117842 1 udp 2122194687 192.168.1.49 51053 typ host generation 0 network-id 3
a=candidate:3763404216 1 udp 2122129151 192.168.1.244 63730 typ host generation 0 network-id 1 network-cost 10
a=candidate:844920887 1 udp 1685921535 79.125.240.120 63730 typ srflx raddr 192.168.1.244 rport 63730 generation 0 network-id 1 network-cost 10
a=candidate:981361652 1 udp 1685987071 79.125.240.120 51053 typ srflx raddr 192.168.1.49 rport 51053 generation 0 network-id 3
a=candidate:1509462303 1 tcp 1518280447 169.254.166.135 9 typ host tcptype active generation 0 network-id 2
a=candidate:3319055686 1 tcp 1518214911 192.168.1.49 9 typ host tcptype active generation 0 network-id 3
a=candidate:519711020 1 tcp 1518149375 192.168.1.244 9 typ host tcptype active generation 0 network-id 1 network-cost 10
a=candidate:1481471013 1 udp 25042943 67.159.8.210 33737 typ relay raddr 79.125.240.120 rport 56299 generation 0 network-id 3
a=ice-ufrag:9Fca
a=ice-pwd:2ECd9yM0Szx/pKhBA6LrEZOf
a=ice-options:trickle
a=fingerprint:sha-256 66:E2:0F:A0:B5:7A:0A:50:62:CA:DB:63:03:62:19:4B:F3:81:BA:C9:53:F9:EB:42:D9:E3:27:3E:D0:71:C9:C2
a=setup:actpass
a=mid:0
a=extmap:1 urn:ietf:params:rtp-hdrext:toffset
a=extmap:2 http://www.webrtc.org/experiments/rtp-hdrext/abs-send-time
a=extmap:3 urn:3gpp:video-orientation
a=extmap:4 http://www.ietf.org/id/draft-holmer-rmcat-transport-wide-cc-extensions-01
a=extmap:5 http://www.webrtc.org/experiments/rtp-hdrext/playout-delay
a=extmap:6 http://www.webrtc.org/experiments/rtp-hdrext/video-content-type
a=extmap:7 http://www.webrtc.org/experiments/rtp-hdrext/video-timing
a=extmap:8 http://www.webrtc.org/experiments/rtp-hdrext/color-space
a=extmap:9 urn:ietf:params:rtp-hdrext:sdes:mid
a=extmap:10 urn:ietf:params:rtp-hdrext:sdes:rtp-stream-id
a=extmap:11 urn:ietf:params:rtp-hdrext:sdes:repaired-rtp-stream-id
a=sendonly
a=msid:461f346d-0614-4a74-897b-373dd7ae64cb 74303c04-ac98-490e-836a-2378b453be74
a=rtcp-mux
a=rtcp-rsize
a=rtpmap:96 VP8/90000
a=rtcp-fb:96 goog-remb
a=rtcp-fb:96 transport-cc
a=rtcp-fb:96 ccm fir
a=rtcp-fb:96 nack
a=rtcp-fb:96 nack pli
a=rtpmap:97 rtx/90000
a=fmtp:97 apt=96
a=rtpmap:102 H264/90000
a=rtcp-fb:102 goog-remb
a=rtcp-fb:102 transport-cc
a=rtcp-fb:102 ccm fir
a=rtcp-fb:102 nack
a=rtcp-fb:102 nack pli
a=fmtp:102 level-asymmetry-allowed=1;packetization-mode=1;profile-level-id=42001f
a=rtpmap:103 rtx/90000
a=fmtp:103 apt=102
a=rtpmap:104 H264/90000
a=rtcp-fb:104 goog-remb
a=rtcp-fb:104 transport-cc
a=rtcp-fb:104 ccm fir
a=rtcp-fb:104 nack
```

Buffer-driven Processing

- `textops – regex ops`
  - `subst()`
  - `subst_body()`

CPU Inefficient!!

Multi-Streams Ambiguity

- Change VP8 codec from video stream #2, but not #1?

```
...
m=video 33737 UDP/TLS/RTP/SAVPF 96 97 102 103 104 ...
c=IN IP4 67.159.8.210
a=rtpmap:96 VP8/90000

...
m=audio 9 UDP/TLS/RTP/SAVPF 63 111 9 0 8 13 110 126
c=IN IP4 0.0.0.0

...
m=video 9 UDP/TLS/RTP/SAVPF 96 97 102 103 104 ...
c=IN IP4 0.0.0.0
a=rtpmap:96 VP8/90000

...
```

Changes are not real-time

OPENSIPS

- Cannot see changes
- Cannot verify changes
- Difficult to edit

```
...                                    VP8/80000
m=video 33737 UDP    S/RTP/SAVPF 96 97...
c=IN IP4 67.159.   10
a=rtpmap:96 VP8/90000
...
m=audio 9 UDP/TLS/RTP/SAVPF 63 111 9...
c=IN IP4 0.0. 1.2.3.4
...
m=video 9       /TLS/RTP/SAVPF 96 97 102...
c=IN IP4 0.0.0.0
a=rtpmap:96 VP8/90000
...
```

Cannot Edit Separate SDP

```
INVITE sip:18643072527@35.131.160.61 SIP/2.0
Via: SIP/2.0/UDP 35.131.160.54:5070;rport;branch=z9hG4bKgKFSZFFm15gZj
From: "Polycom VVX 350" <sip:18644791100@35.131.160.54>;tag=9yUDU0yv41DBQ
To: <sip:18643072527@35.131.160.61>
Call-ID: 5470786f-292e-4841-9eb5-4b544ea835e4
CSeq: 1 INVITE
User-Agent: oss-test-call
Content-Type: application/sdp
Content-Length: 10608
```

```
v=0
o=- 5314000948960589552 4 IN IP4 127.0.0.1
s=-
t=0 0
a=group:BUNDLE 0 1 2
a=extmap-allow-mixed
a=msid-semantic: WMS 461f346d-0614-4a74-897b-373dd7ae64cb
m=video 33737 UDP/TLS/RTP/SAVPF 96 97 102 103
```

```
...
m=video 33737 UDP/TLS/RTP/SAVPF 96 97 102 103 104 ...
c=IN IP4 67.159.8.210
a=rtpmap:96 VP8/90000
...
m=audio 9 UDP/TLS/RTP/SAVPF 63 111 9 0 8 13 110 126
c=IN IP4 0.0.0.0
...
m=video 9 UDP/TLS/RTP/SAVPF 96 97 102 103 104 ...
c=IN IP4 0.0.0.0
a=rtpmap:96 VP8/90000
...
```

Difficult to Extract Codec List

```
...
m=video 33737 UDP/TLS/RTP/SAVPF 96 97 102 103 104 ...
c=IN IP4 67.159.8.210
a=rtpmap:96 VP8/90000
...
m=audio 9 UDP/TLS/RTP/SAVPF 63 111 9 0 8 13 110 126
c=IN IP4 0.0.0.0
...
m=video 9 UDP/TLS/RTP/SAVPF 96 97 102 103 104 ...
c=IN IP4 0.0.0.0
a=rtpmap:96 VP8/90000
...
```

High Risk of Corruption

```
...
m=video 33737 UDP/TLS/RTP/SAVPF 96 97 102 103 104 ...
c=IN IP4 20.30.40.5067.159.8.210
a=rtpmap:96 VP8/90000a=rtpmap:96 VP8/90000
...
m=audio 9 UDP/TLS/RTP/SAVPF 63 111 9 0 8 13 110 126
c=IN IP4 0.0.0.0
...
m=video 9 UDP/TLS/RTP/SAVPF 96 97 102 103 104 ...
c=IN IP4 0.0.0.0
a=rtpmap:96 VP8/90000

...
```

New SDP Manipulation Support

New SDP Support

- standalone logic, data structures

- SDP changes attached to sip_msg

- **optional!!** -> zero impact on existing *opensips.cfg* files

SDP Body Read/Write

```
xlog("$sdp\n");              # DIRTY? -> full SDP rebuild!

xlog("$(<reply>sdp)\n");  # DIRTY? -> full SDP rebuild!

$sdp = $var(rtpengine_sdp);

$(<reply>sdp) = $var(rtpengine_sdp);
```

Line-Oriented SDP Processing - READ

```
$sdp.line(a=)
$sdp.line(a=[0])
$sdp.line(a=ptime[1])
$sdp.line(a=nortpproxy)
$sdp.line(a=[100]) # probably returns NULL
```

```
$sdp.line(m=audio[1])      # m=audio 27292 RTP/AVP 9 8 0 2 102 100 99
$sdp.line(m=audio[1]/[0])      # audio
$sdp.line(m=audio[1]/[1])      # 27292
$sdp.line(m=audio[1]/[2])      # RTP/AVP
$sdp.line(m=audio[1]/[9])      # 99
$sdp.line(m=audio[$var(i)]/[$var(j)])      # 99
$sdp.line(m=audio[1]/[10])     # NULL
$sdp.line(m=audio[1]/RTP)          # RTP/AVP
$sdp.line(m=audio[1]/RTP\/AVP)     # RTP/AVP
$sdp.line(m=audio[1]/RTP\/AVP[0]) # RTP/AVP
$sdp.line(m=audio[1]/RTP\/AVP[1]) # NULL
$sdp.line(m=audio[1]/RTQ)          # NULL
```

Line-Oriented SDP Processing - WRITE

```
# delete
$sdp.line(a=nortpproxy) = NULL;


# replace
$sdp.line(a=nortpproxy) = "a=rtprelay:yes";


# insert
$(sdp.line(a=ptime)[insert]) = "a=nortpproxy:yes";


# inject
$(sdp.line(a=ptime)[insertAfter]) = "a=nortpproxy:yes";
```

Stream-Oriented SDP Processing

```
...
m=video 33737 UDP/TLS/RTP/SAVPF 96 97 102 103 104 ...
c=IN IP4 67.159.8.210
a=rtpmap:96 VP8/90000
...
m=audio 9 UDP/TLS/RTP/SAVPF 63 111 9 0 8 13 110 126
c=IN IP4 0.0.0.0
...
m=video 9 UDP/TLS/RTP/SAVPF 96 97 102 103 104 ...
c=IN IP4 0.0.0.0
a=rtpmap:96 VP8/90000
...
```

Stream-Oriented SDP Processing

$sdp.stream(video[1]/a=fmtp:115/bitrate=)

(stream)   *(line)*   *(attribute)*

```
# within a stream, filter by line
$sdp.stream(/a=ptime);
$sdp.stream([1]/a=ptime);
$sdp.stream(audio[1]/a=ptime);
$sdp.stream(a[1]/a=ptime);
$sdp.stream(video[1]/a=nortpproxy) = NULL;
$sdp.stream(v[1]/a=nortpproxy:/[0]) = "yes";

# ... and, additionally, by attribute
$sdp.stream(video[1]/a=fmtp:115/bitrate=) = 48000;
$sdp.stream(video[1]/a=fmtp:115[3]) = NULL;
$sdp.stream(video[1]/a=fmtp:115/bitrate=) = 48000;
```

Session-Oriented SDP Processing

```
…
User-Agent: oss-test-call
Content-Type: application/sdp
Content-Length: 10608

v=0
o=- 5314000948960589552 4 IN IP4 127.0.0.1
s=-
t=0 0
a=group:BUNDLE 0 1 2
a=extmap-allow-mixed
a=msid-semantic: WMS 461f346d-0614-4a74-897b-373dd7ae64cb
m=video 33737 UDP/TLS/RTP/SAVPF 96 97 102 103
c=IN IP4 67.159.8.210
a=rtcp:9 IN IP4 0.0.0.0
…
```

Session-Oriented SDP Processing

```
$sdp.session(a=)
$sdp.session(a=[0])
$sdp.session(a=ptime[1])
$sdp.session(a=nortpproxy)
$sdp.session(a=[100]) # probably returns NULL
```

Easy to Test

opensips/

/test/test-sdp-ops.cfg

Interaction with Legacy Code

Interaction w/ Legacy SDP Ops

"L" Changes

rtpproxy_offer()

rtpengine_manage()

codec_move_up()

mc_compact()

L

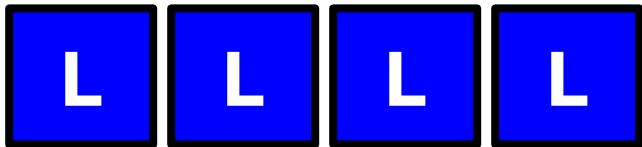**"RT" Changes**

$sdp.line([10]) = "ptime:80";

$(sdp.line([15])[insert]) = "a=rtpproxy:yes";

$sdp.line([5]) = NULL;

RT

1. Legacy-only Changes

- no difference in behavior
- lumps evaluated lazily, as before
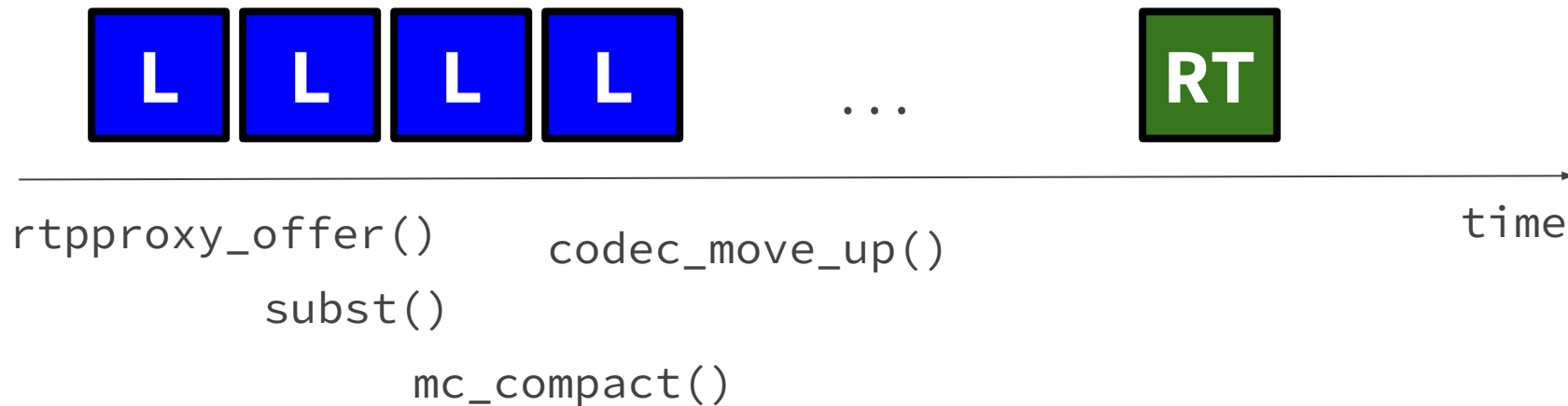- can apply lumps w/ get updated body part()
  - added in 3.3!

2. SDP-Ops only Changes

- **real-time** SDP changes
  - no more lumps!
- readable code
  - no more complex SDP regex (hard to maintain)
- accurate edits
  - less risk of corrupting the SDP

RT **RT** **RT** **RT**   ...

→ time

3. Legacy + SDP-Ops Changes

L L L L ... RT

→ time

`rtpproxy_offer()`

`subst()`

`codec_move_up()`

`mc_compact()`

4. SDP-Ops + Legacy Changes

RT **RT** **RT** **RT**   ...   **L**

mc_compact()

Resources

Documentation

https://www.opensips.org/Documentation/Script-CoreVar-3-7#sdp

https://www.opensips.org/Documentation/Script-CoreVar-3-7#sdp.line

https://www.opensips.org/Documentation/Script-CoreVar-3-7#sdp.stream

https://www.opensips.org/Documentation/Script-CoreVar-3-7#sdp.session

https://www.opensips.org/Documentation/Script-CoreVar-3-7#sdp.stream.idx

Next Steps

Next Steps

- Beta: polish implementation
  - negative indexing
  - named (custom) SDP holders
  - stream/session full delete/replace
- Write more tests
- 3.6 -> get feedback on SDP-Ops

Future Work

Future Work

Future Work

- optimize – remove legacy "body lumps" code
- expose SDP operations API, to fit module needs
- fully remove msg.body_lumps
- rewrite module code to use new SDP ops API
  - (rtpproxy, rtpengine, media_proxy, sipmsgops, nathelper, compression)
  - LOTS OF TESTING, RISK OF BREAKAGE – OpenSIPS 4.0 ???

L → **RT**

Liviu Chircu
OpenSIPS Project / SIPhub

Take-Away Message

New & Powerful SDP Management Toolkit in OpenSIPS 3.6+

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