



Kamailio

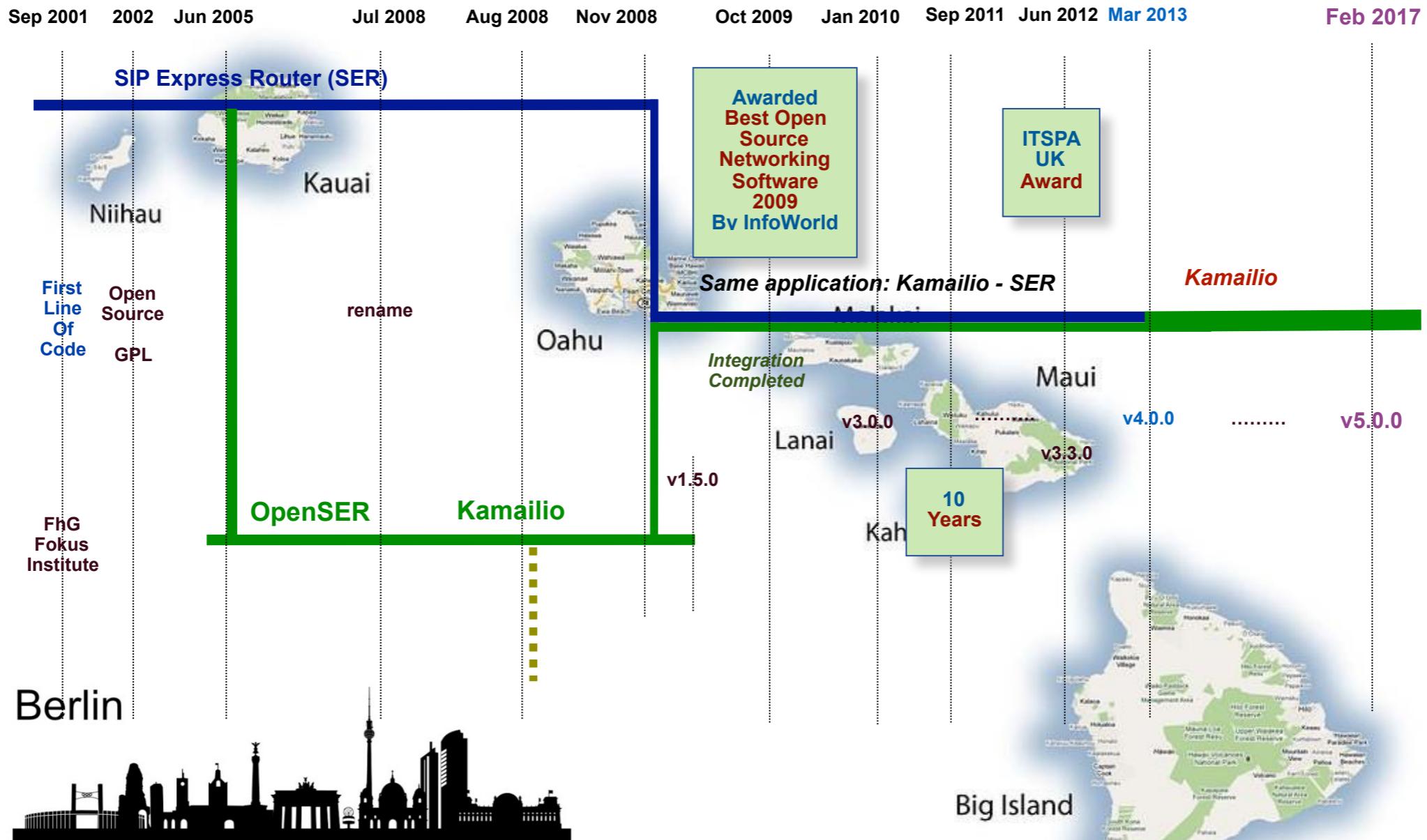
API and Scripting Languages for SIP Routing
in
Scalable and Secure VoIP Deployments



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www.kamailio.org

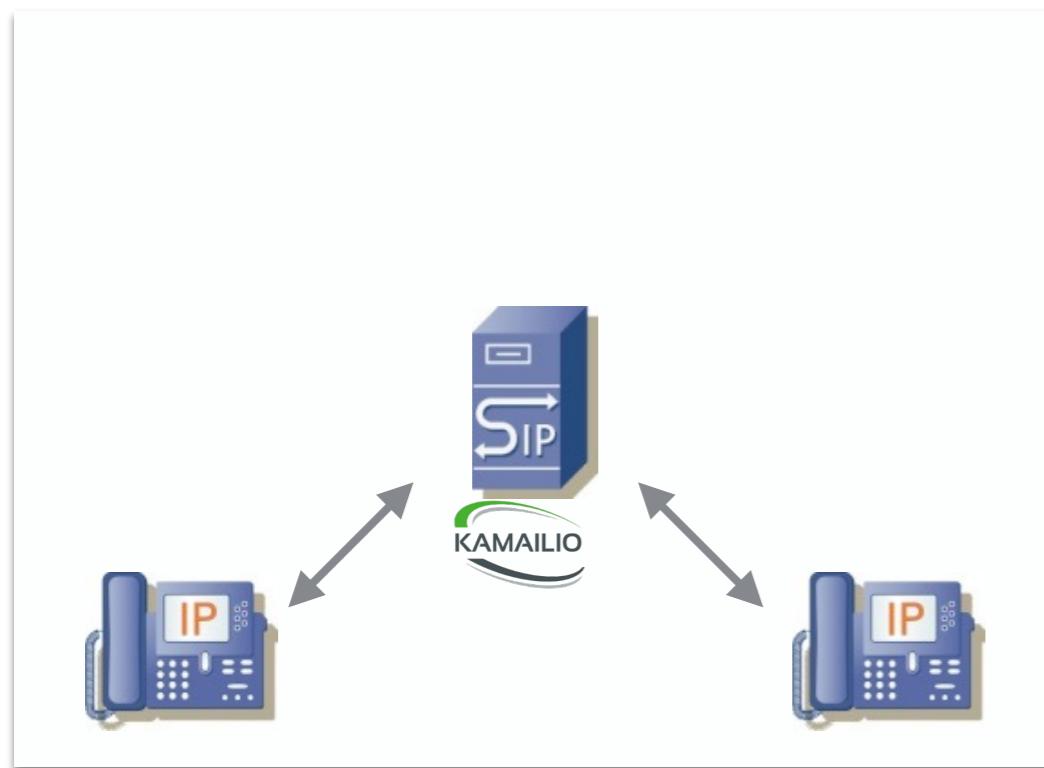
continuous development since 2001

a very large set of features

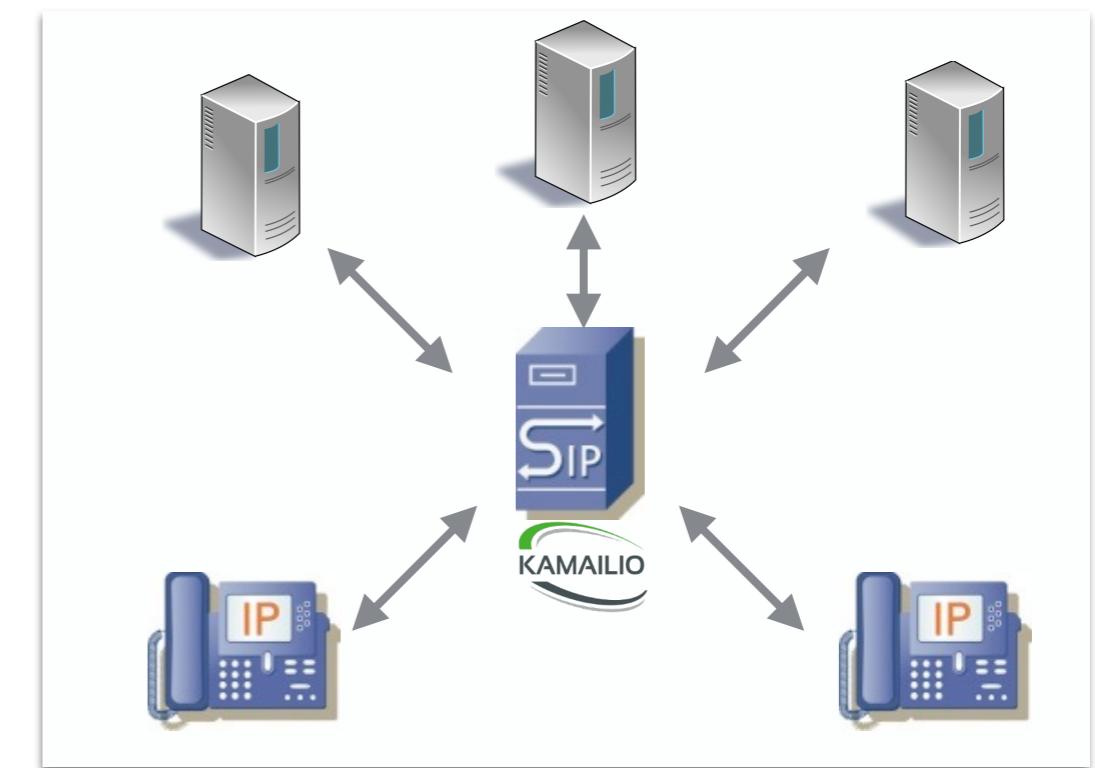


Use Cases

main signalling server



edge signalling server
(sbc)



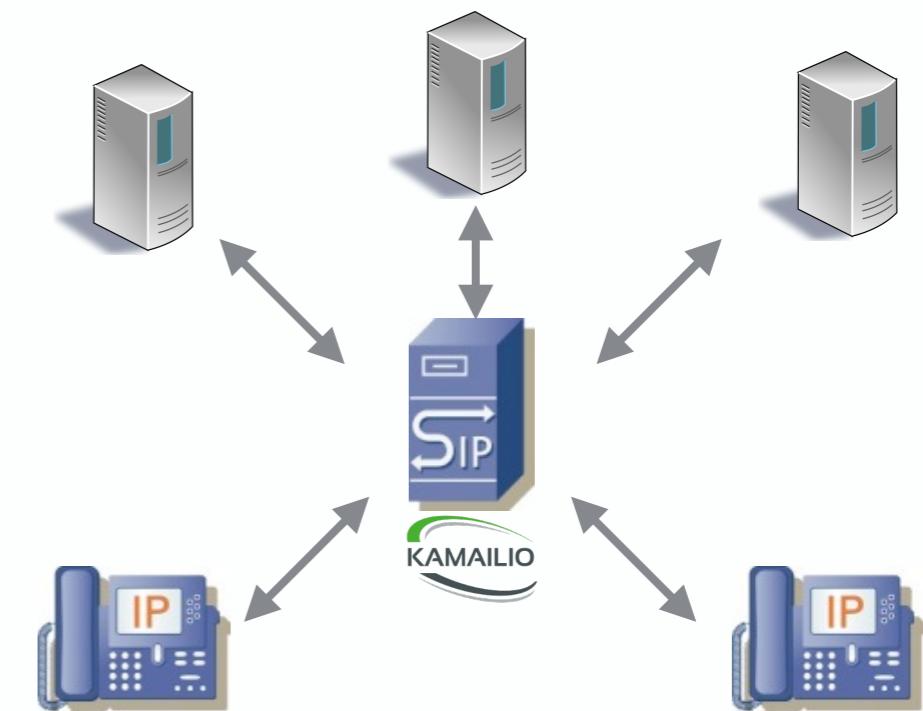


Load Balancer, LCR, VoLTE, WebRTC, IoT

dispatcher module

- list of balancing nodes from file or database
- monitoring of nodes (activate/inactivate automatically)
- re-route in case of failure
- various algorithms: hashing, weight distribution, round robin, call load distribution, priority routing
- reload list of nodes without restart

```
# Dispatch requests
route[DISPATCH] {
    # round robin dispatching on gateways group '1'
    if(!ds_select_dst("1","4")) {
        send_reply("404", "No destination");
        exit;
    }
    xdbg("--- SCRIPT: going to <$ru> via <$du>\n");
    t_on_failure("RTF_DISPATCH");
    route(RELAY);
    exit;
}
# Re-route in case of failure
failure_route[RTF_DISPATCH] {
    if (t_is_canceled()) {
        exit;
    }
    # next node - only for 500 or local timeout
    if (t_check_status("500") || (t_branch_timeout() && !t_branch_replied())) {
        if(ds_next_dst()) {
            t_on_failure("RTF_DISPATCH");
            route(RELAY);
            exit;
        }
    }
}
```





Kamailio 5.0

February 2017



Highlights 2016 - 2017

- ❖ new modules
 - ❖ app_jsdt
 - ❖ ims_ocs
 - ❖ nsq
 - ❖ pua_rpc
 - ❖ rabbitmq
 - ❖ ss7ops
 - ❖ app_sqlang (5.1)
 - ❖ call_obj (5.1)
 - ❖ evrexec (5.1)
 - ❖ ims_diameter_server (5.1)
 - ❖ keepalive (5.1)
 - ❖ topos_redis (5.1)
- ❖ config scripting languages
 - ❖ native - startup optimizations
 - ❖ lua - routing logic hot reload
 - ❖ javascript - routing logic hot reload
 - ❖ python - lots of libraries
 - ❖ squirrel language - routing logic hot reload

<https://www.kamailio.org/wiki/features/new-in-5.0.x>

<https://www.kamailio.org/wiki/features/new-in-devel>



KEMI Framework

- introduced in Kamailio v5.0.0
 - exports a function one time and becomes available in embedded interpreters
 - ***allows reloading routing script without restart***
 - over 60 modules exporting directly to kemi
- updated scripting language embedded interpreters
 - Lua
 - JavaScript
 - Python
 - Squirrel
- not yet updated scripting language embedded interpreters
 - Perl
 - Mono (.NET, C#, ...)
 - Java (?)
- native language still available
 - the old kamailio.cfg scripting language is still there



Source Code Tree Restructured

kamailio / kamailio

Unwatch 114 Unstar 517 Fork 296

Code Issues 46 Pull requests 4 Projects 0 Wiki Settings Insights

Kamailio - The Open Source SIP Server - <https://www.kamailio.org> Edit

kamailio sip voip webrtc volte iot telephony Manage topics

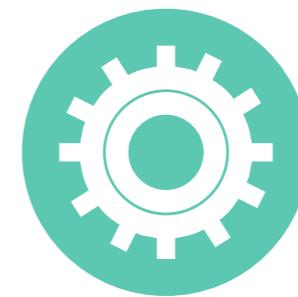
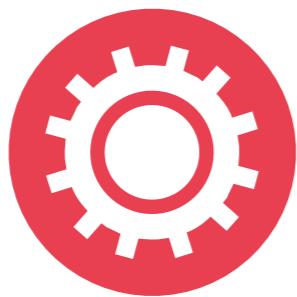
26,208 commits 34 branches 177 releases 149 contributors

Branch: master New pull request Create new file Upload files Find file Clone or download

Author	Commit Message	Time Ago
miconda	app_mono: added section ids	Latest commit 9229cb3 3 hours ago
.github	core: updated mailing list address in CONTRIBUTING.md	2 months ago
doc	doc/select_list: makefile - generate html with full section numbers	4 months ago
etc	kamailio.cfg: filter out sip scanner even when anti-flood is not enabled	2 months ago
misc	misc/examples: reorganized examples in subfolders	3 days ago
pkg	pkg/kamailio/alpine_docker: Fixed missed symbolic links	13 hours ago
src	app_mono: added section ids	3 hours ago
test	travis: use kamailio/pkg-kamailio-docker	8 months ago
utils	kamctl: do not set privileges on routing tables without id for pgsql	2 days ago
.clang-format	root: added .clang-format file	10 months ago
.gitignore	.gitignore: updated paths to be ignored by git	4 months ago
.travis.yml	travis-ci: use proper domain for sr-dev mailing list [skip ci]	4 months ago
COPYING	relocated old and not maintained text files from root to doc/misc	10 months ago

- **flexible routing api**
 - rest api interaction
 - http, netstring
 - ... synchronous and asynchronous
 - **realtime interaction with apps**
 - dynamic data pushed back
-
- **flexible routing language**
 - more data types
 - more extensions
 - ... do not reinvent the wheel
 - **hot reload of routing rules**
 - no restart to apply changes to routing blocks





API Based Routing



API-Based Routing

SIP Standard Handling

sip parsing
authentication
record routing
retransmissions
headers management
failure rerouting

...

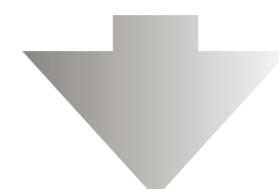


KAMAILIO

Business Decision

authorization
billing
next hops
cheapest route
qos
available resources

...



YOUR API



Kamailio.cfg Building Blocks

- ❖ fetching the next routing hops
 - ❖ raw data (text, json, xml)
 - ❖ http/rpc results + parsing
 - ❖ http_client, json, jansson, xmlops
 - ❖ structured data
 - ❖ rtjson
- ❖ processing
 - ❖ synchronous
 - ❖ http_client, exec, sql-nosql connectors
 - ❖ config wait & act
 - ❖ asynchronous
 - ❖ http_async_client, async
 - ❖ evapi, mqueue & rtimer





The Basic SIP Routing Concepts

Parallel Forking

```
request_route {  
...  
    append_branch("sip:103@kamailio.org");  
    append_branch("sip:104@kamailio.org");  
  
    $var(newdst) = "sip:105@kamailio.org";  
    append_branch("$var(newdst)");  
  
    t_relay();  
}
```

Serial Forking

```
request_route {  
...  
  
    $ru = "sip:102@kamailio.org";  
    $xavp(newdst) = "sip:103@kamailio.org";  
    $xavp(newdst) = "sip:104@kamailio.org";  
  
    t_on_failure("RETRY");  
    t_relay();  
}  
  
failure_route[RETRY] {  
    if (t_is_canceled()) {  
        exit;  
    }  
    if($xavp(newdst) != $null) {  
        $ru = $xavp(newdst);  
        $xavp(newdst) = $null;  
        t_on_failure("RETRY");  
        t_relay();  
        exit;  
    }  
}
```



Simple HTTP API For Routing

the `http_clinet_query()` from `http_client module`

https://www.kamailio.org/docs/modules/stable/modules/http_client.html#http_client.f.http_query

```
http_client_query("http://myapi.lab/sip.php?src=$(fU{s.escape.param})&dst=$(rU{s.escape.param})",  
"$var(result)")
```

```
<?php  
echo "sip:" . $_GET["dst"] . "@1.2.3.4;transport=tls"  
. " | "  
. "sip:" . $_GET["dst"] . "@2.3.4.5;transport=sctp";  
?>
```



Simple HTTP API For Routing

Serial Forking

```
request_route {  
    ...  
  
    http_query("http://myapi.local/sip.php?src=$(ru{s.escape.param})&dst=$(fu{s.escape.param})",  
               "$var(result)");  
    $ru = $(var(result){s.select,0,|});  
    $xavp(newdst) = $(var(result){s.select,1,|});  
  
    t_on_failure("RETRY");  
    t_relay();  
}  
  
failure_route[RETRY] {  
    if (t_is_canceled()) {  
        exit;  
    }  
    if($xavp(newdst) != $null) {  
        $ru = $xavp(newdst);  
        $xavp(newdst) = $null;  
        t_on_failure("RETRY");  
        t_relay();  
        exit;  
    }  
}
```





RTJSON Module

- ❖ use json input to fill routing attributes
 - ❖ request uri
 - ❖ outbound proxy
 - ❖ intermediary hops
 - ❖ local socket
 - ❖ caller/callee addresses
 - ❖ extra headers
 - ❖ ringing timeout
 - ❖ flags

{ JSON }

<http://kamailio.org/docs/modules/stable/modules/rtjson.html>



RTJSON Module

```
{  
    "version": "1.0",  
    "routing": "serial",  
    "routes": [  
        {  
            "uri": "sip:127.0.0.1:5080",  
            "dst_uri": "sip:127.0.0.1:5082",  
            "path": "<sip:127.0.0.1:5084>, <sip:127.0.0.1:5086>",  
            "socket": "udp:127.0.0.1:5060",  
            "headers": {  
                "from": {  
                    "display": "Alice",  
                    "uri": "sip:alice@127.0.0.1"  
                },  
                "to": {  
                    "display": "Alice",  
                    "uri": "sip:alice@127.0.0.1"  
                },  
                "extra": "X-Hdr-A: abc\r\nX-Hdr-B: bcd\r\n"  
            },  
            "branch_flags": 8,  
            "fr_timer": 5000,  
            "fr_inv_timer": 30000  
        },  
        ...  
    ]  
}
```



RTJSON Module

...

```
route[RTJSON] {
```

```
    http_client_query("http://myapi.lab/sip.php?src=$fU&dst=$rU",
                      "$var(rtmmsg)");
```

```
    rtjson_init_routes("$var(rtmmsg)");
    rtjson_push_routes();
```

```
    t_on_branch("MANAGE_BRANCH");
    t_on_failure("MANAGE_FAILURE");
    route(RELAY);
    exit;
```

```
}
```

...

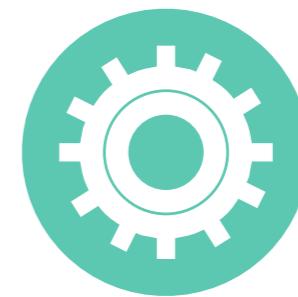
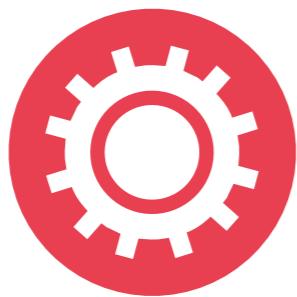
```
failure_route[MANAGE_FAILURE] {
```

```
    route(NATMANAGE);
    if (t_is_canceled()) {
        exit;
    }
```

```
    if(rtjson_next_route()) {
        t_on_branch("MANAGE_BRANCH");
        t_on_failure("MANAGE_FAILURE");
        route(RELAY);
        exit;
    }
```

```
}
```

...



Scripting Based Routing



Scripting-Based Routing

Native (Custom) Routing Language Since 2001

Kamailio Embedded Interpreter Interface - K E M I

- introduced in Kamailio v5.0.0
 - split parts: **passive** (global and module params) and **active** (routing blocks)
 - live reload of active part
- working for next scripting languages (embedded interpreters)
 - Lua
 - JavaScript
 - Python
 - Squirrel
- not yet updated for next existing embedded interpreters
 - Perl
 - Mono (.NET, C#, ...)
 - Java (?)
- *native language still available*
 - *the old kamailio.cfg scripting language is still there*



Native SIP Scripting Routing

<https://github.com/kamailio/kamailio/blob/master/misc/examples/kemi/kamailio-basic-kemi-native.cfg>

```
298 # Routing to foreign domains
299 route[SIPOUT] {
300     if (uri==myself) return;
301
302     append_hf("P-hint: outbound\r\n");
303     route(RELAY);
304     exit;
305 }
```



SIP Scripting Routing in Lua

- **app_lua**
 - existing since 2010 offering inline execution of Lua scripts
 - https://www.kamailio.org/docs/modules/stable/modules/app_lua.html
- **highlights**
 - very small interpreter, fast
 - decent number of extensions (native lua libraries)
 - popular in gaming space, also in RTC (Asterisk, Freeswitch)



<https://github.com/kamailio/kamailio/blob/master/misc/examples/kemi/kamailio-basic-kemi-lua.lua>

```
324 -- Routing to foreign domains
325 function ksr_route_sipout()
326     if KSR.is_myself(KSR.pv.get("$ru")) then return 1; end
327
328     KSR.hdr.append_hf("P-Hint: outbound\r\n");
329     ksr_route_relay();
330     KSR.x.exit();
331 end
```



SIP Scripting Routing in JavaScript

- introduced in Kamailio v5.1 (devel)
 - not in stable version
 - https://www.kamailio.org/docs/modules/devel/modules/app_jsdt.html
- highlights
 - duktape.org engine - small, easy to embed by importing source code files
 - very popular scripting language
 - no external dependencies
 - reload of routing script
 - not many extensions



<https://github.com/kamailio/kamailio/blob/master/misc/examples/kemi/kamailio-basic-kemi-jsdt.js>

```
331 // Routing to foreign domains
332 function ksr_route_sipout()
333 {
334     if (KSR.is_myself(KSR.pv.get("$ru"))) { return; }
335
336     KSR.hdr.append_hf("P-Hint: outbound\r\n");
337     ksr_route_relay();
338     KSR.x.exit();
339 }
```



SIP Scripting Routing in Python

- **app_python**
 - introduced in 2010 for inline execution of Python scripts
 - https://www.kamailio.org/docs/modules/stable/modules/app_python.html
- **highlights**
 - popular scripting language with extensive number of extensions
 - object oriented, perceived as slower than other scripting languages
 - reloading of the routing script not implemented yet



<https://github.com/kamailio/kamailio/blob/master/misc/examples/kemi/kamailio-basic-kemi-python.py>

```
332      # Routing to foreign domains
333      def ksr_route_sipout(self, msg):
334          if KSR.is_myself(KSR.pv.get("$ru")) :
335              return 1;
336
337          KSR.hdr.append("P-Hint: outbound\r\n");
338          self.ksr_route_relay(msg);
339          return -255;
```



SIP Scripting Routing in Squirrel

- **app_sqlang**
 - introduced in Kamailio 5.1 (devel)
 - https://www.kamailio.org/docs/modules/devel/modules/app_sqlang.html
- **highlights**
 - <http://www.squirrel-lang.org>
 - very small interpreter
 - embedded by importing its source code
 - no external dependency
 - reload of scripting script
 - pre-compilation options

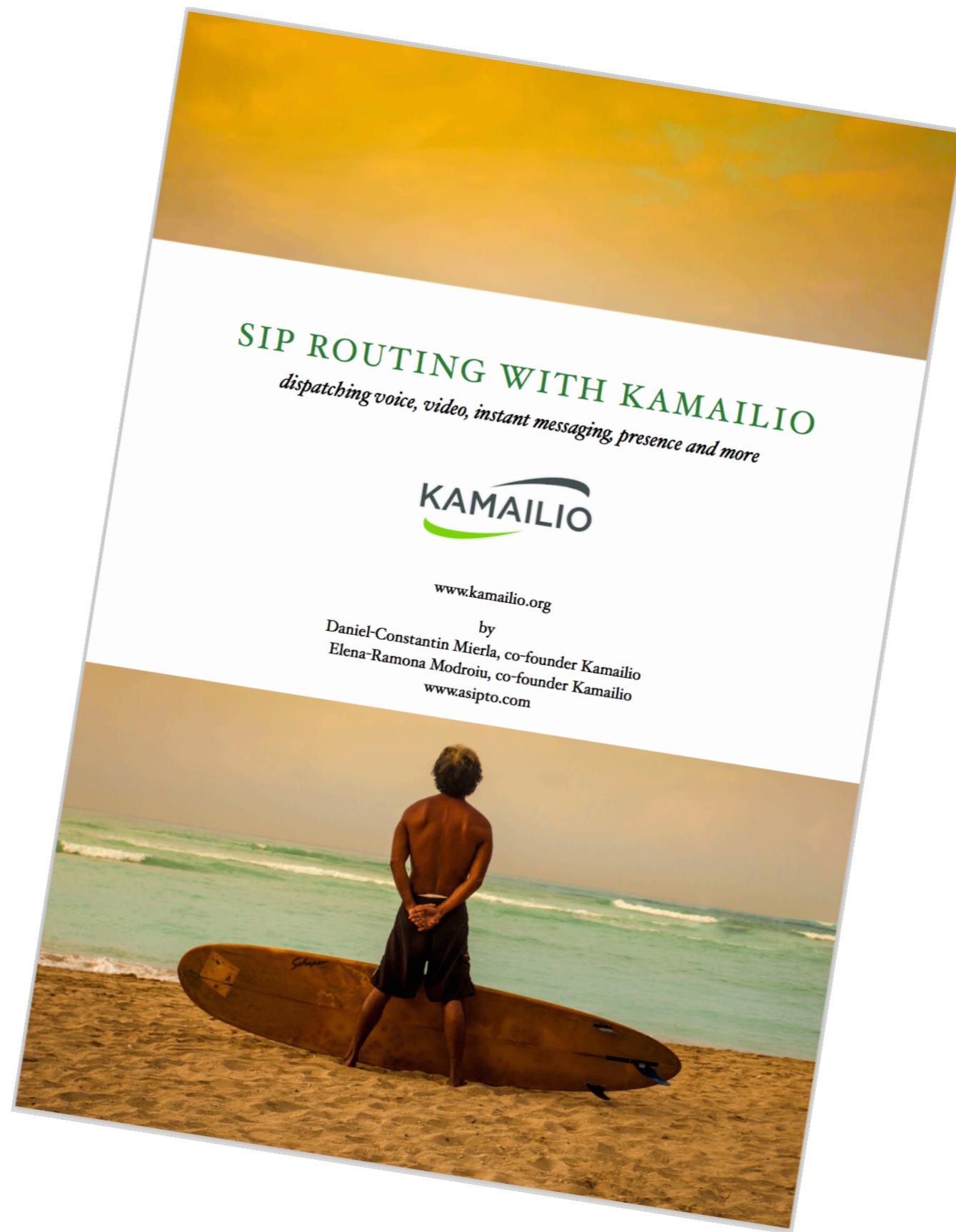
Squirrel
the programming language

<https://github.com/kamailio/kamailio/blob/master/misc/examples/kemi/kamailio-basic-kemi-sqlang.sql>

```
332 // Routing to foreign domains
333 function ksr_route_sipout()
334 {
335     if (KSR.is_myself(KSR.pv.get("$ru"))) { return; }
336
337     KSR.hdr.append_hf("P-Hint: outbound\r\n");
338     ksr_route_relay();
339     KSR.x.exit();
340 }
```



expo booth 22a



<http://www.asipto.com/sw/kamailio-admin-book/>



see you at
Kamailio World 2018
www.kamailioworld.com



Thank you!



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