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Architecture of Asterisk 13

Matt Jordan
@mattcjordan
Director of Technology, Digium

Why this talk?

- Asterisk 12
  - New SIP stack
  - New APIs
  - New Core

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  - 2014 - Asterisk's PJSIP stack
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- Asterisk 12
  - New SIP stack
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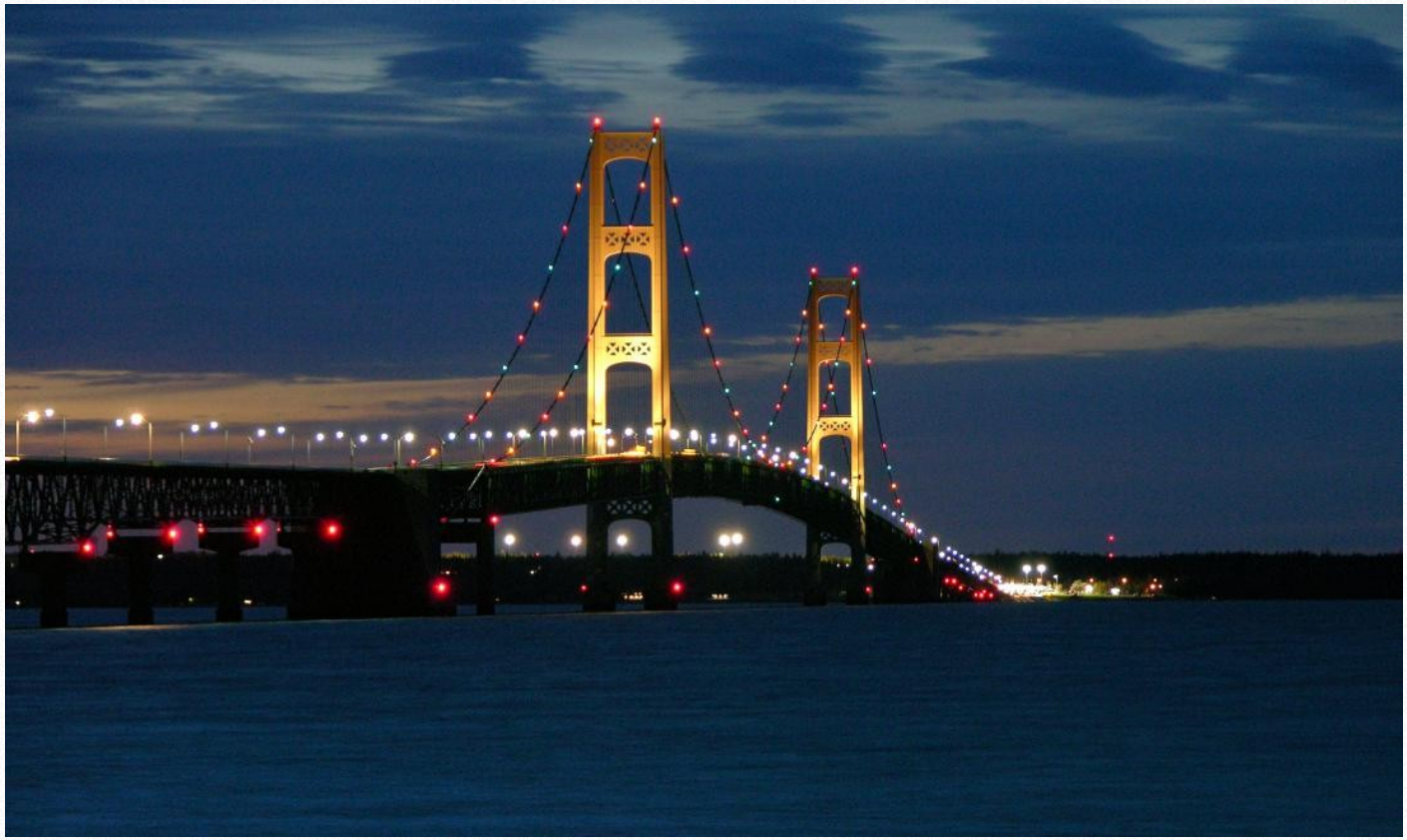
- Kamailio World:
  - 2014 - Asterisk's PJSIP stack
  - 2015 - Asterisk APIs/ARI
- Let's talk about C APIs!

Bridging!



The Problem

Or: How to justify to your employers spending 10 man years on something you hope your end users never notice

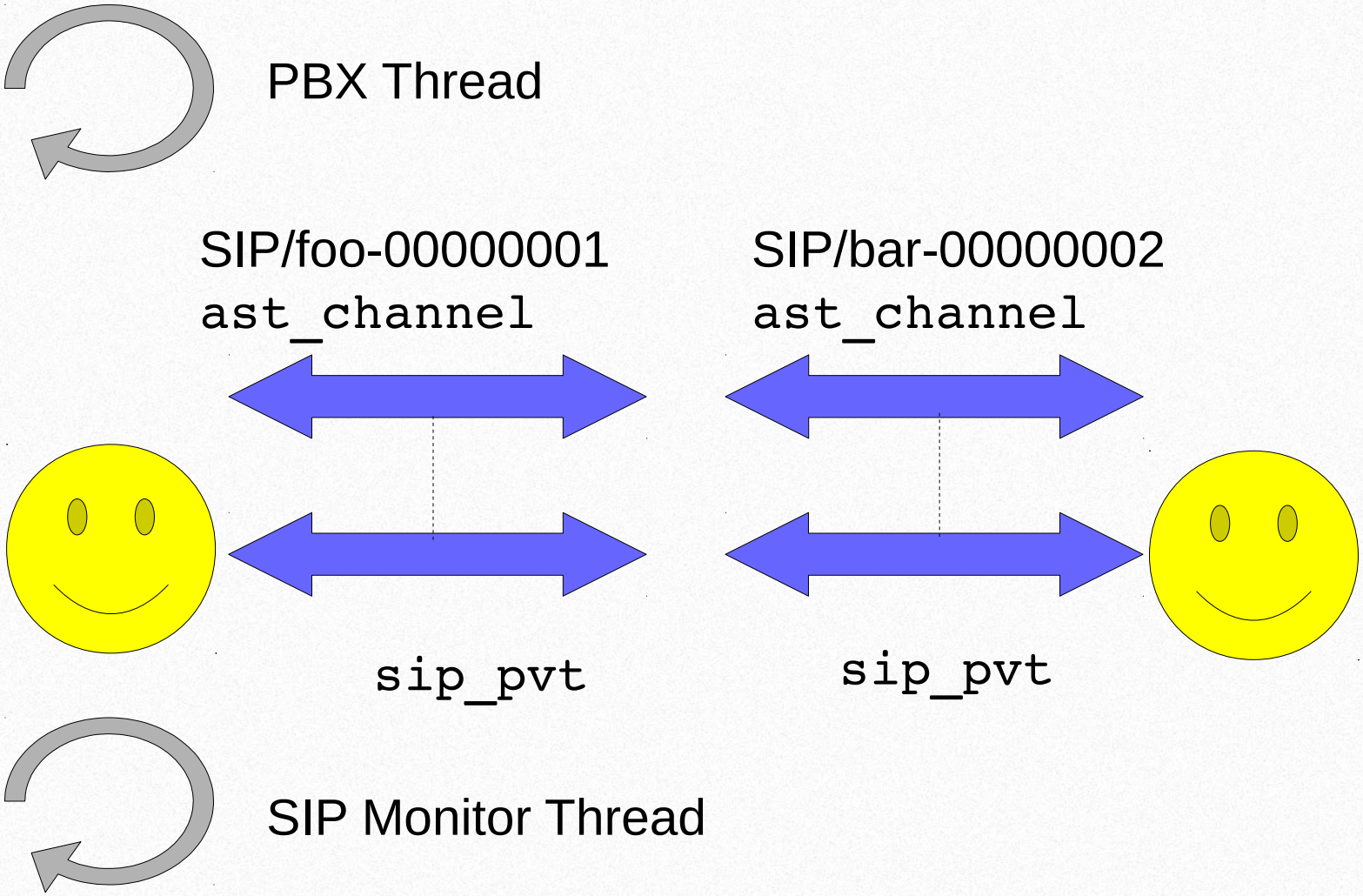
The Problem

- Asterisk
  - Parallelism achieved through multithreading
  - “Conservative” threading model
    - One thread per “call”
    - Thread services both inbound and outbound channels

The Problem

- Asterisk
  - Parallelism achieved through multithreading
  - “Conservative” threading model
    - One thread per “call”
    - Thread services both inbound and outbound channels
- Problem: How do you move channels out of a call?
  - Transfers
  - Externally initiated redirects
  - Parking
  - Call pickup

“Solution”: Masquerades!



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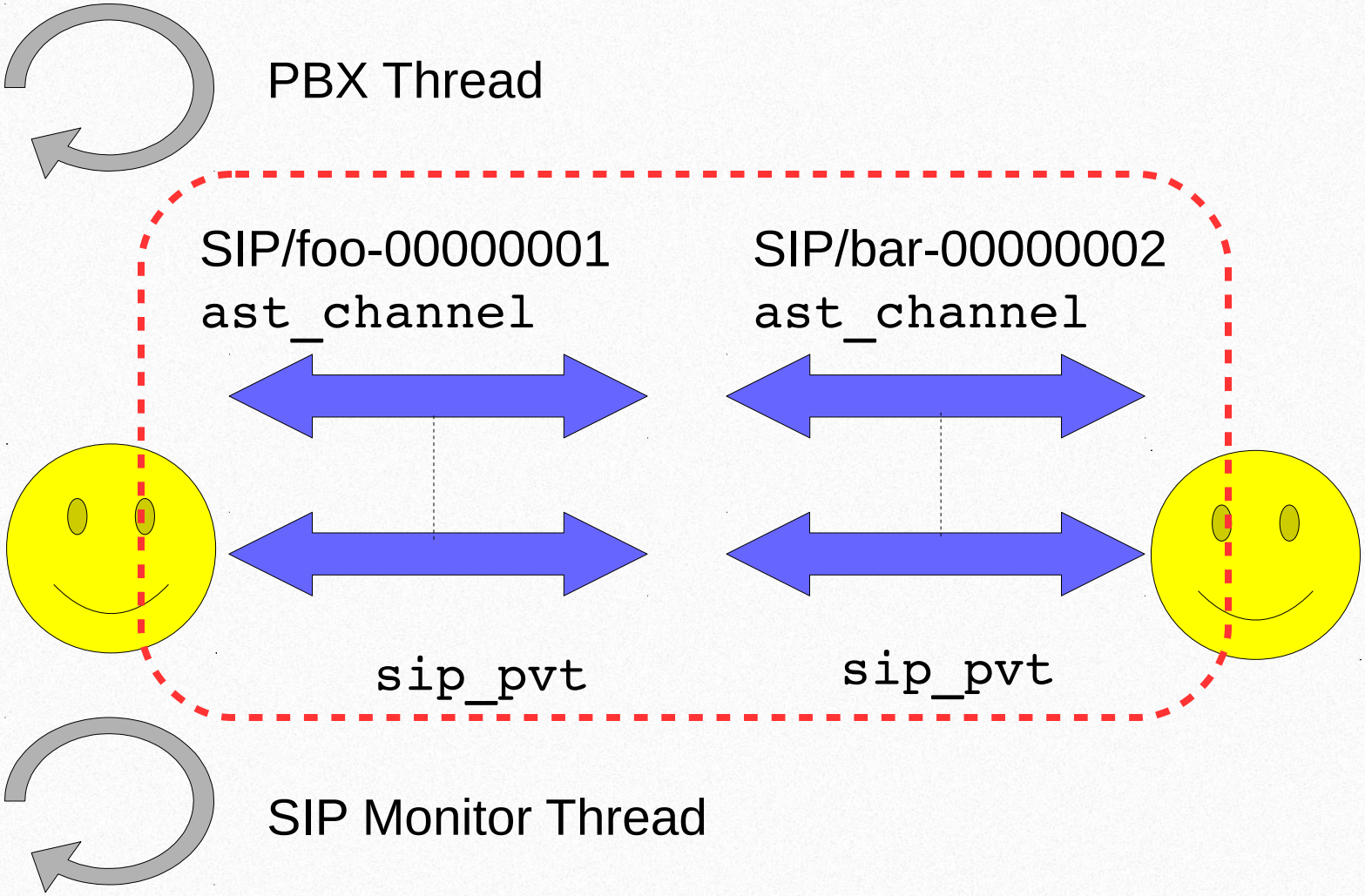

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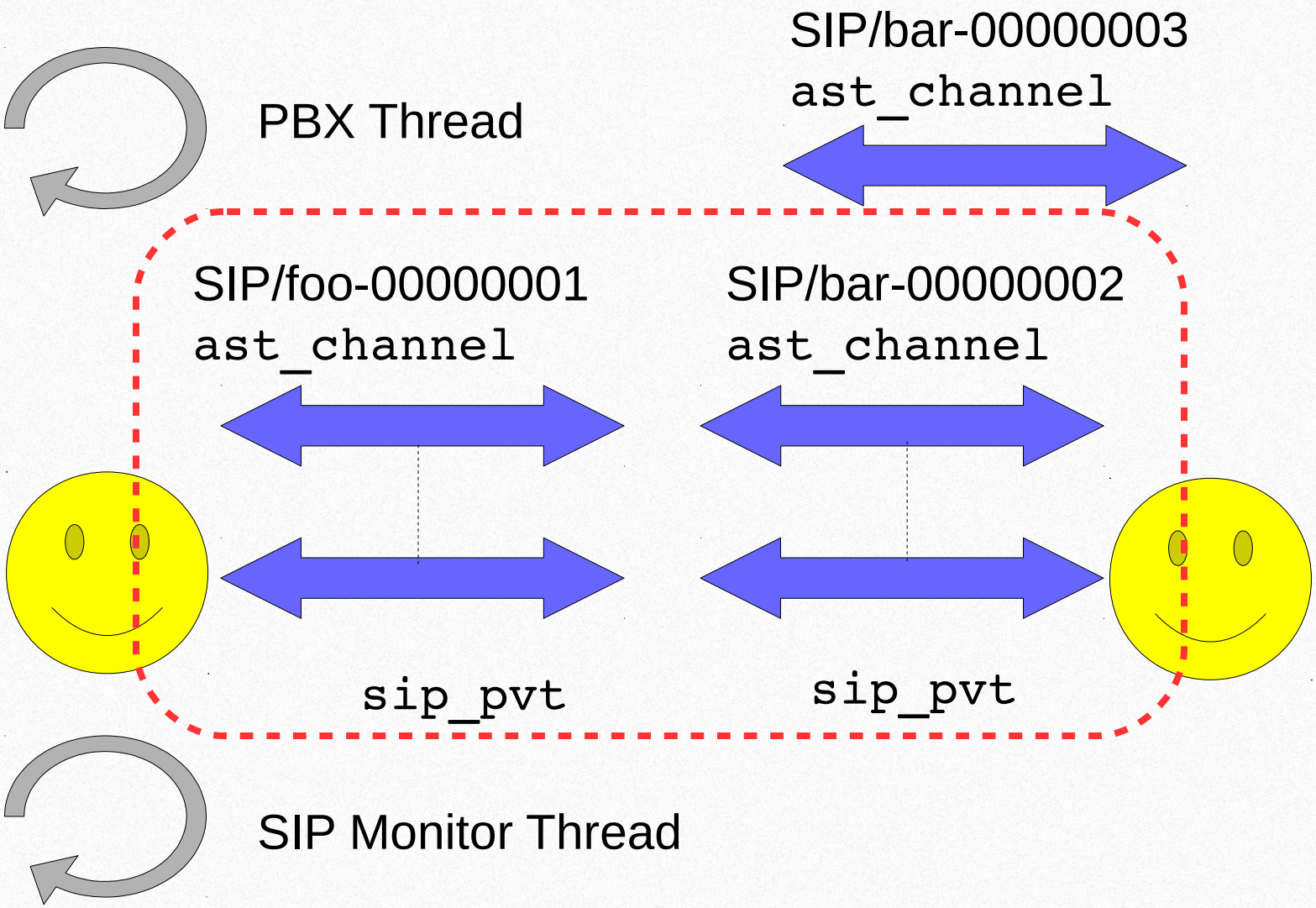

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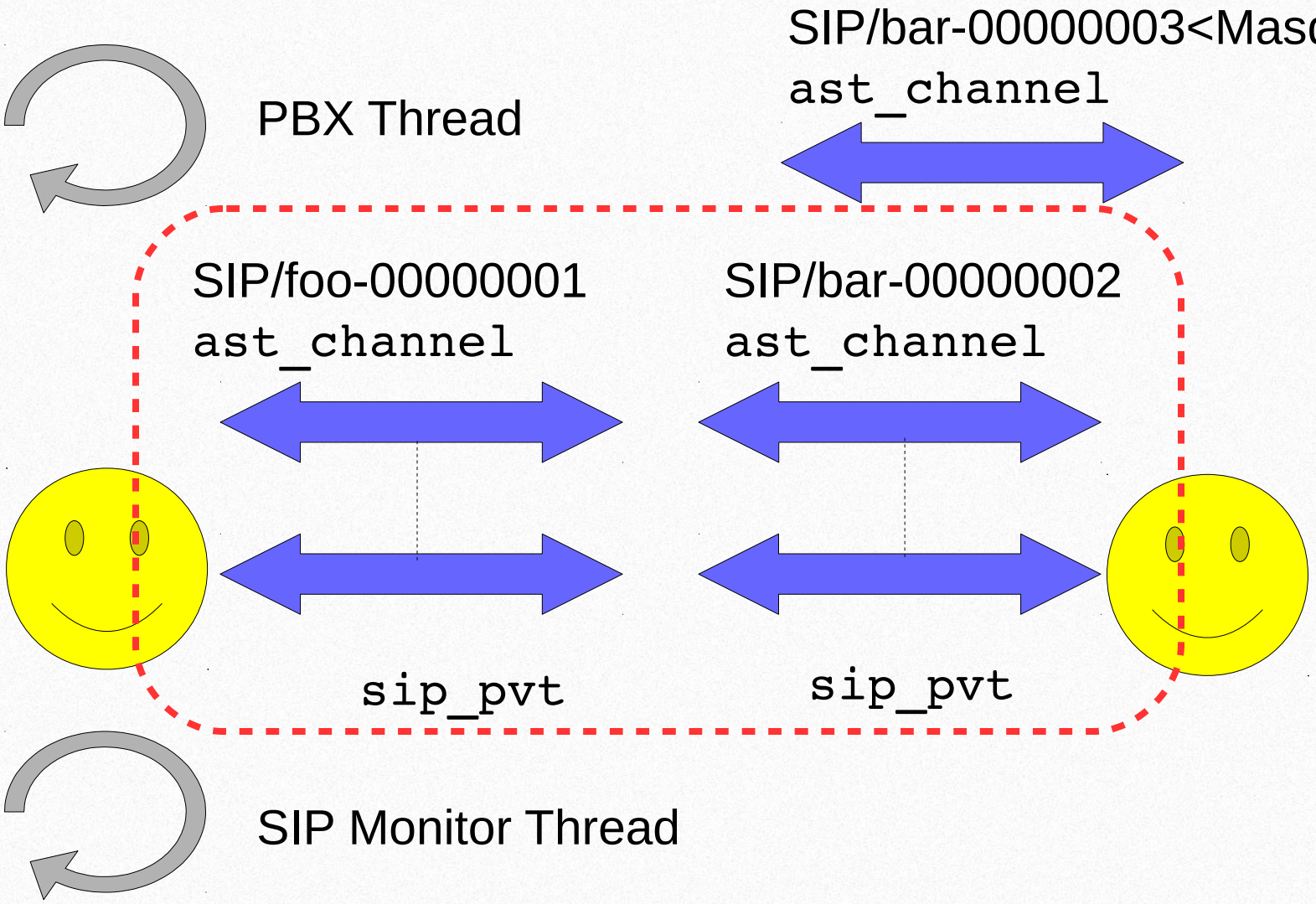

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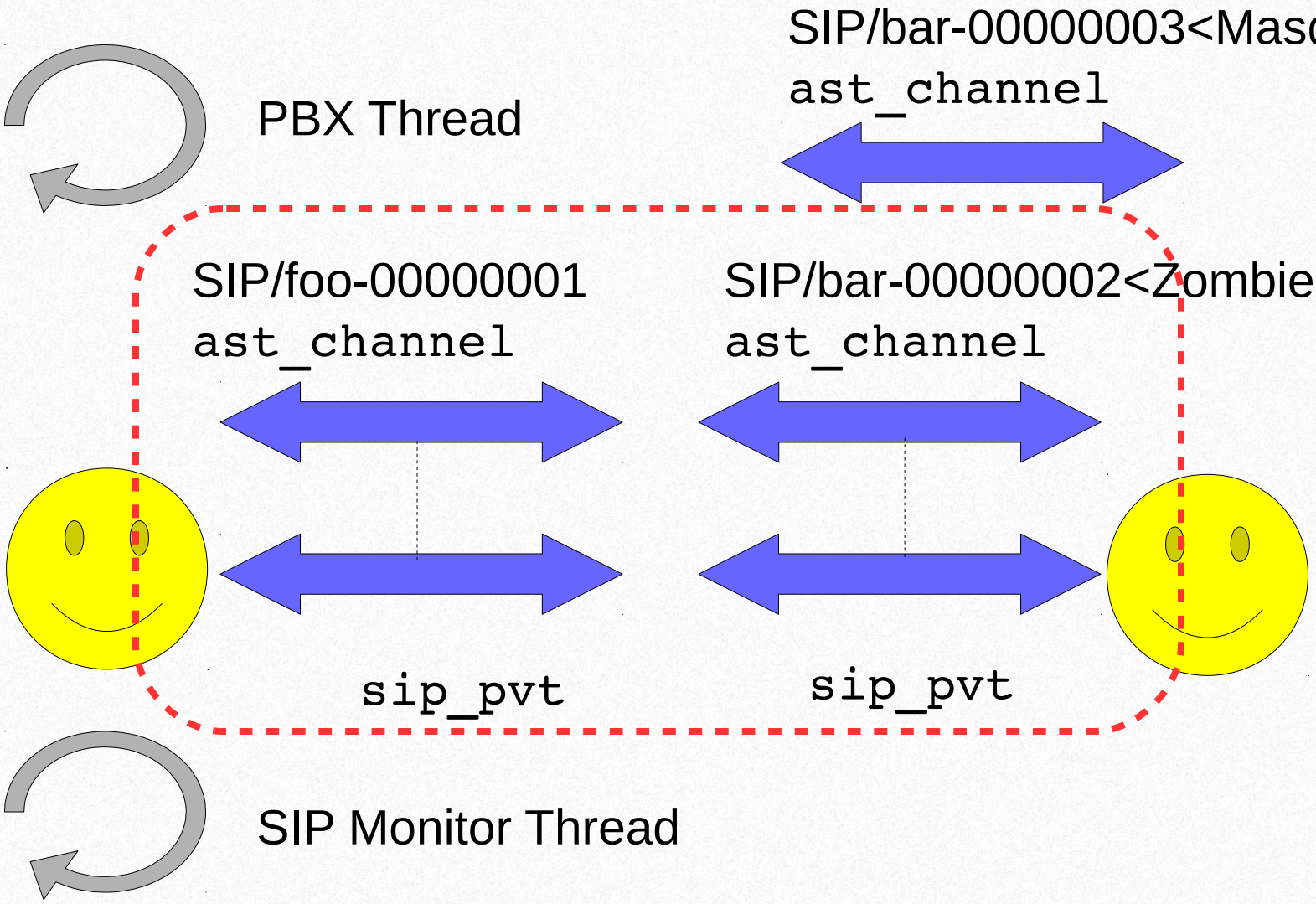

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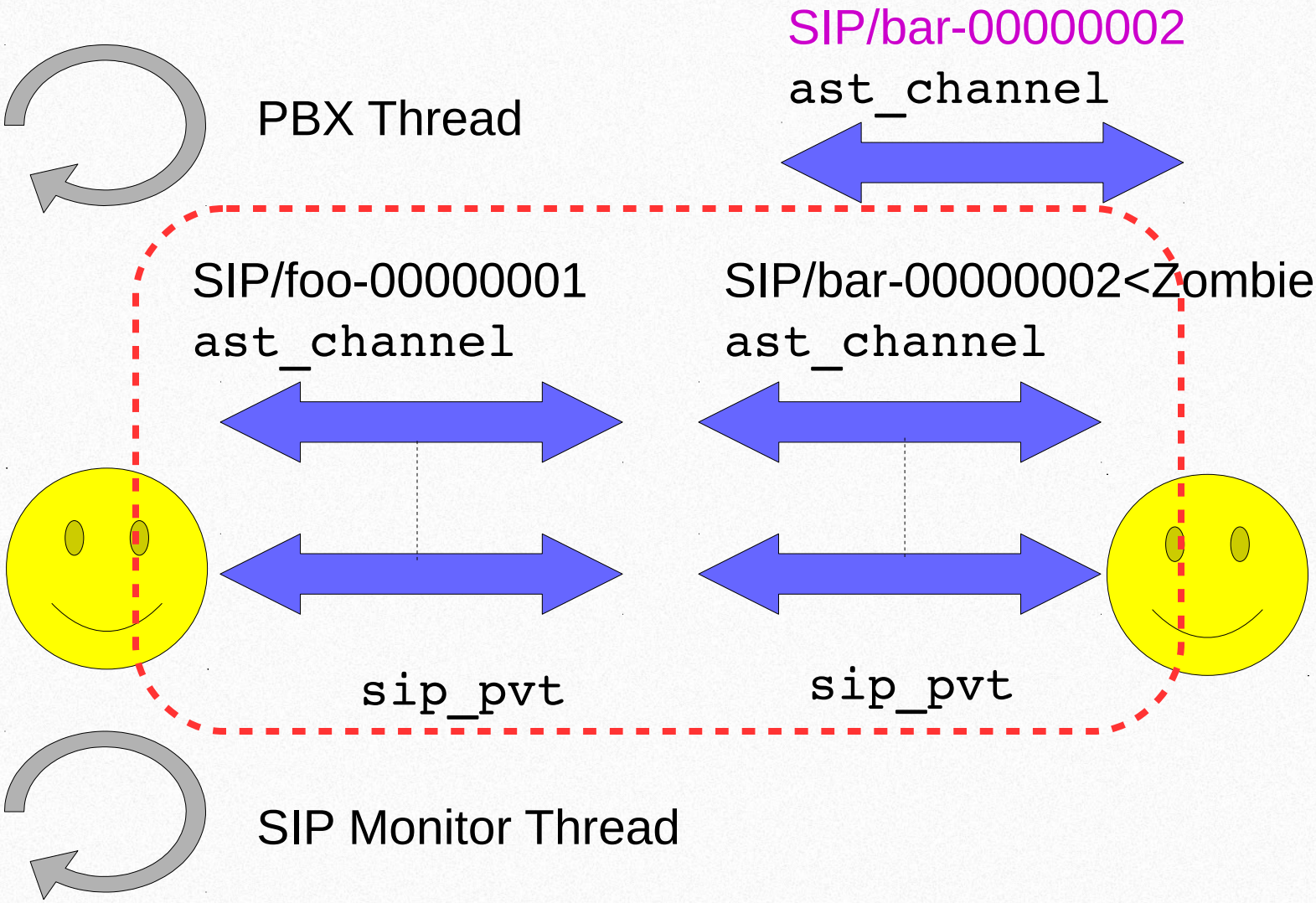

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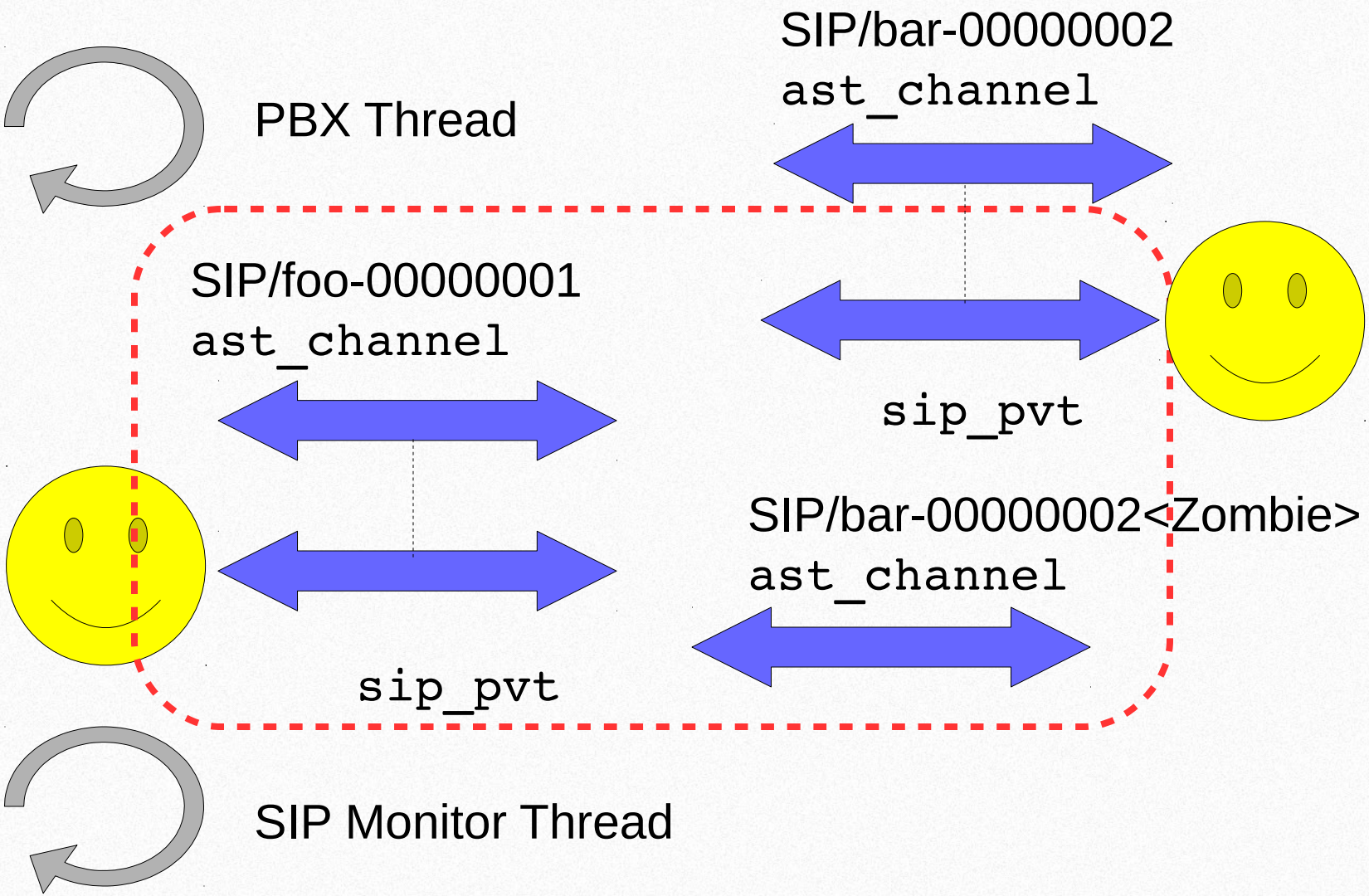

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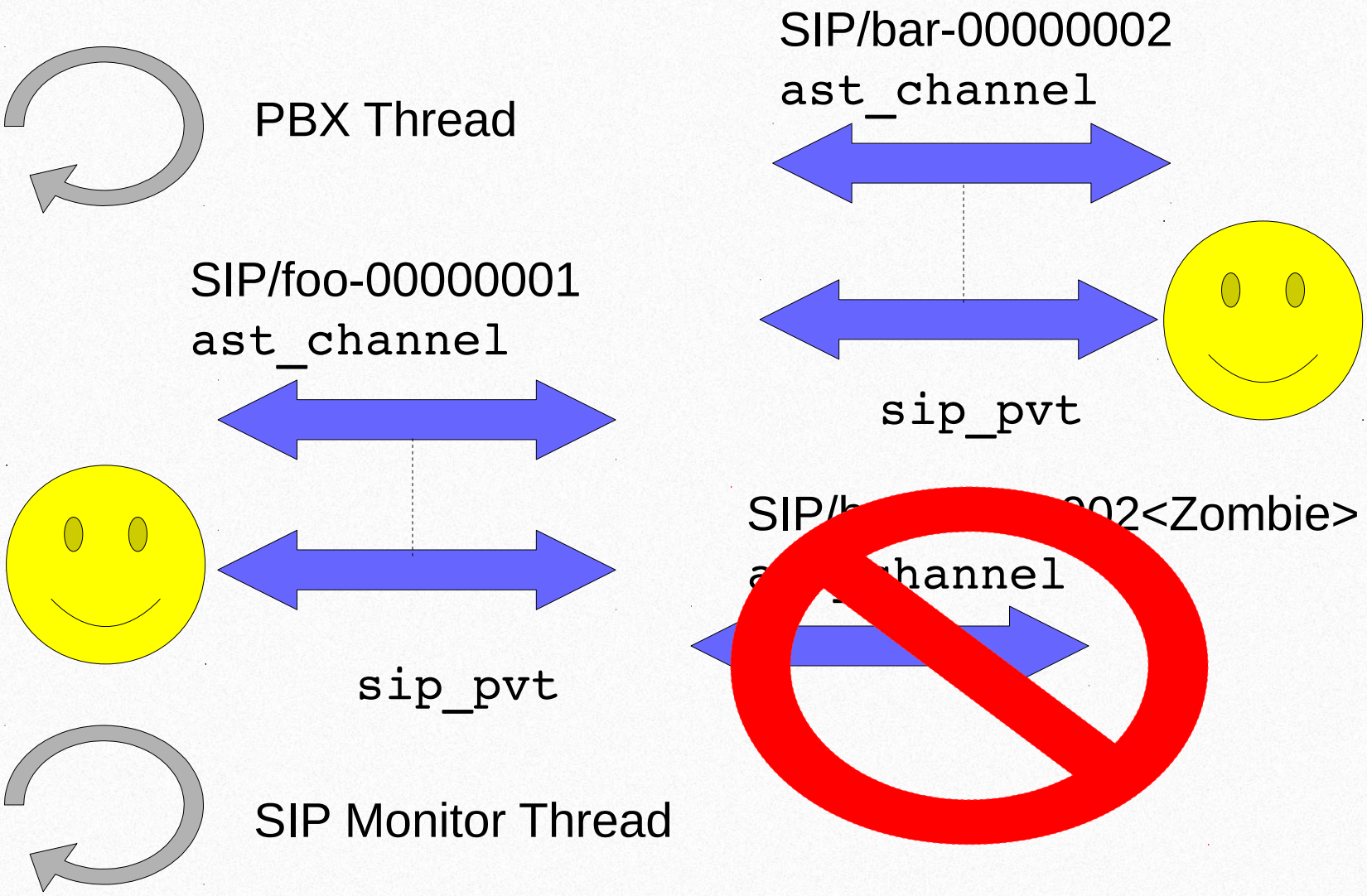

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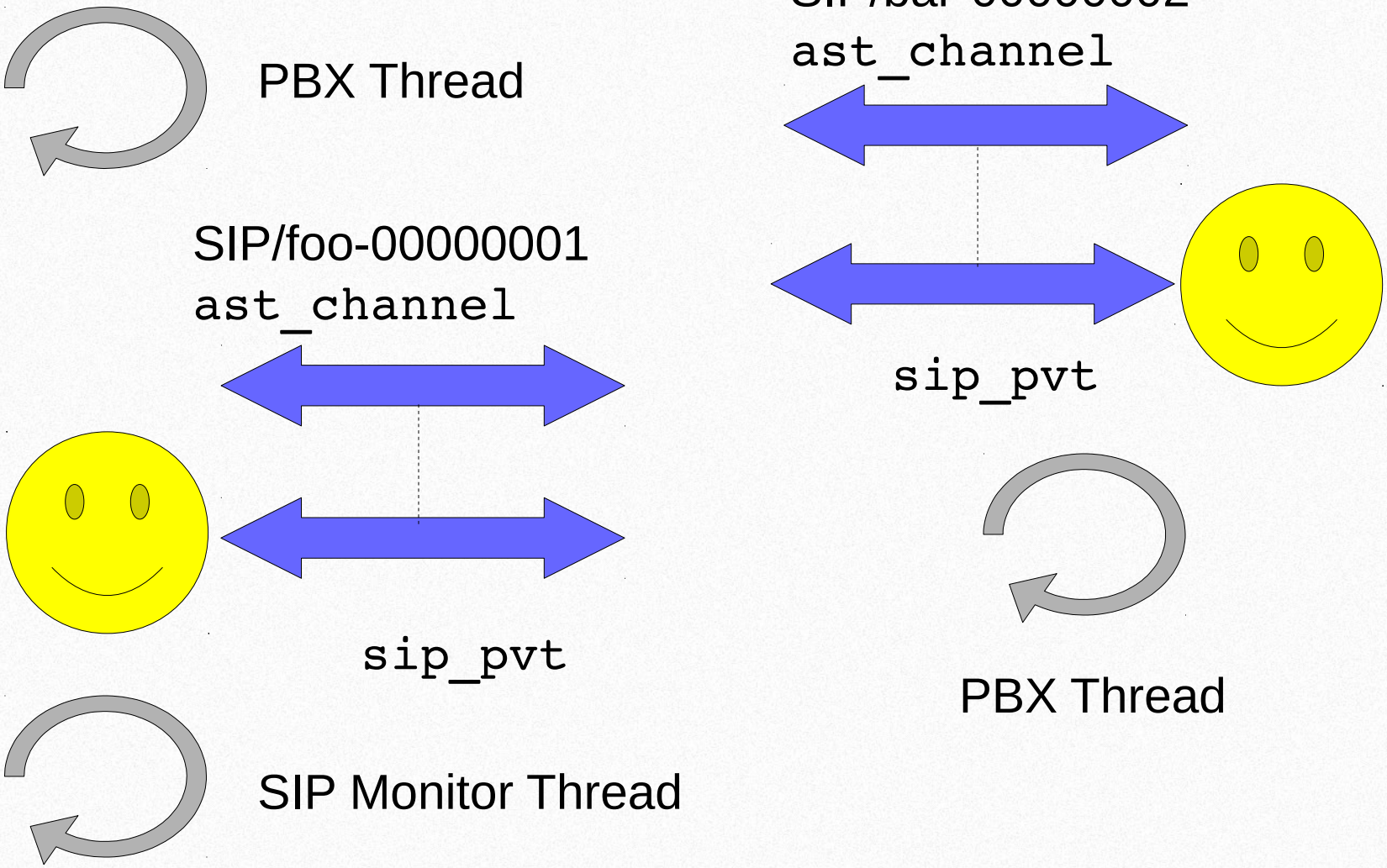


THIS IS FINE.

Masquerade Events

```
Event: NewChannel
Channel: SIP/bar-00000003

Event: Rename
Channel: SIP/bar-00000003
Newname: SIP/bar-00000003<Masq>

Event: Rename
Channel: SIP/bar-00000002
Newname: SIP/bar-00000002<Zombie>

Event: Rename
Channel: SIP/bar-00000003<Masq>
Newname: SIP/bar-00000002

Event: Masquerade
Original: SIP/bar-00000002
Clone: SIP/bar-00000002<Zombie>
```


I'M OKAY WITH THE EVENTS THAT ARE UNFOLDING CURRENTLY.

Problem: “Bridging”

```
features::
ast_do_bridge
```

Problem: “Bridging”

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```
channel::
ast_channel_bridge
```

```
features::
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```

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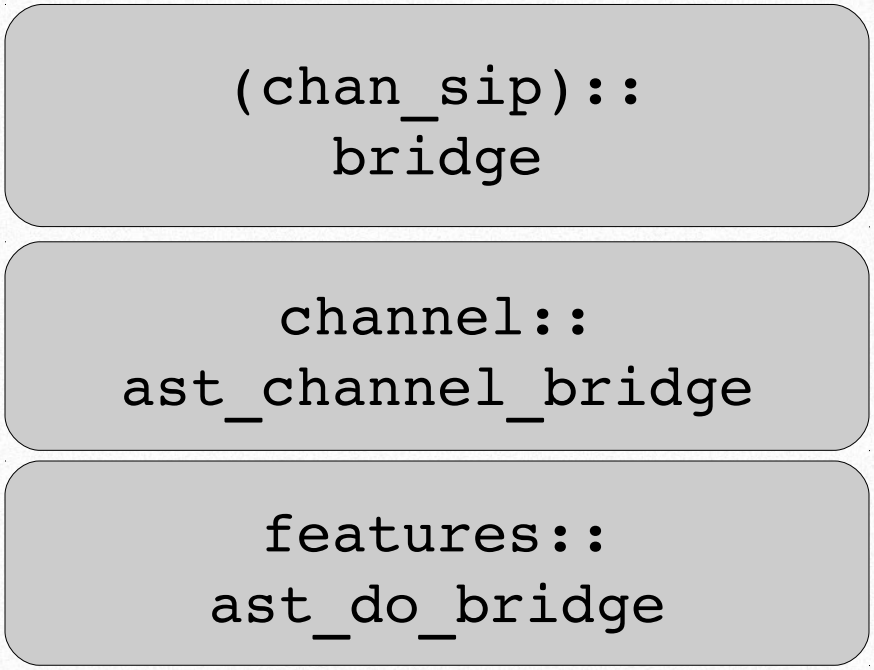

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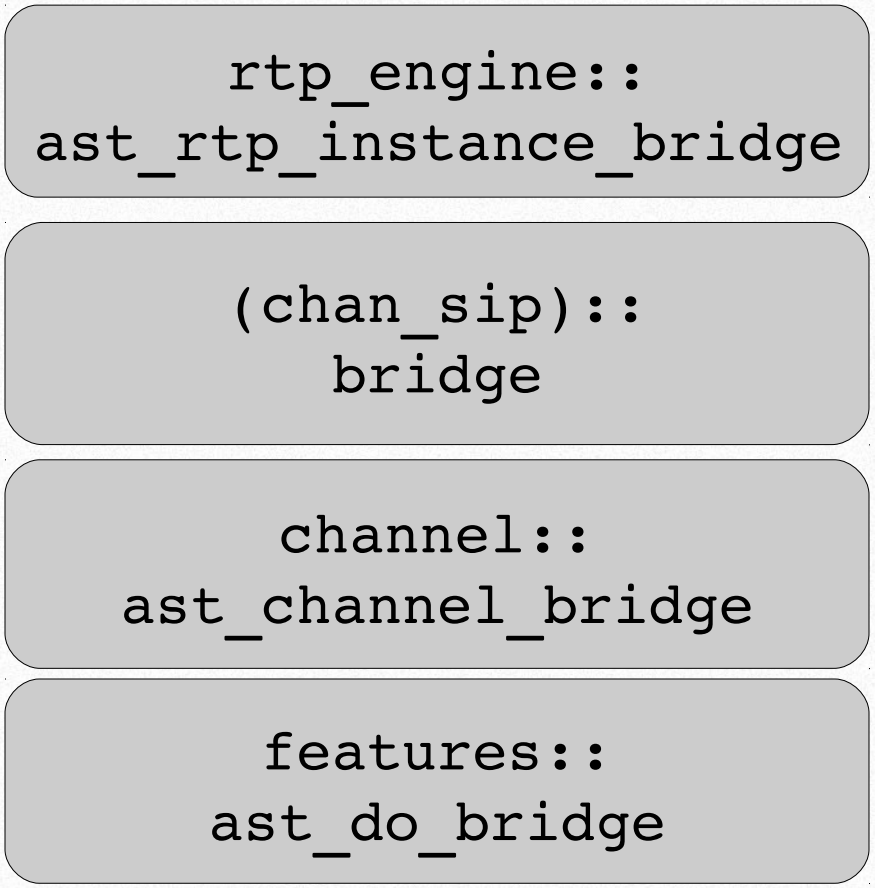

Problem: “Bridging”

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```
(res_rtp_asterisk)::
ast_rtp_local_bridge
```

```
rtp_engine::
ast_rtp_instance_bridge
```

```
(chan_sip)::
bridge
```

```
channel::
ast_channel_bridge
```

```
features::
ast_do_bridge
```

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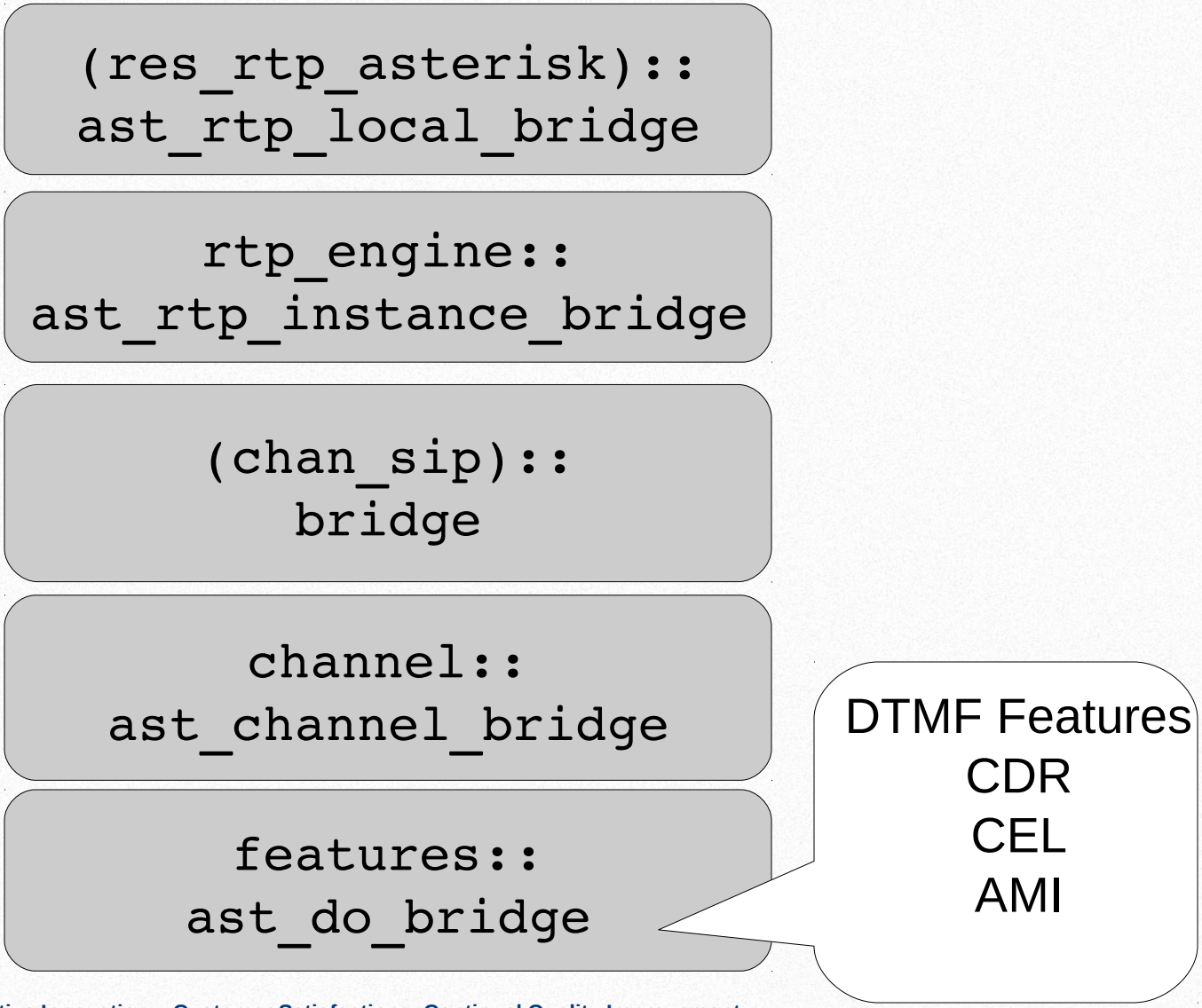

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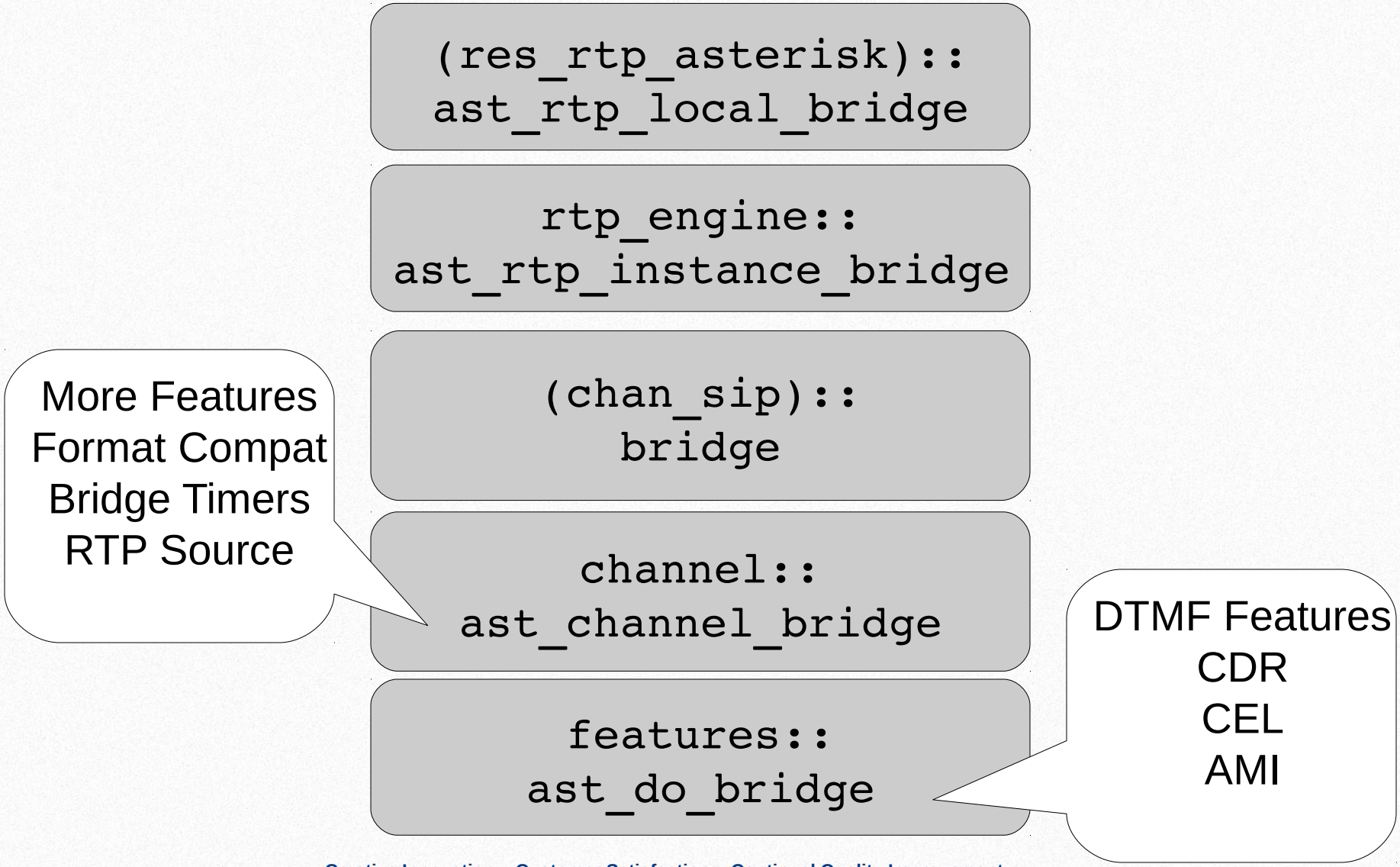

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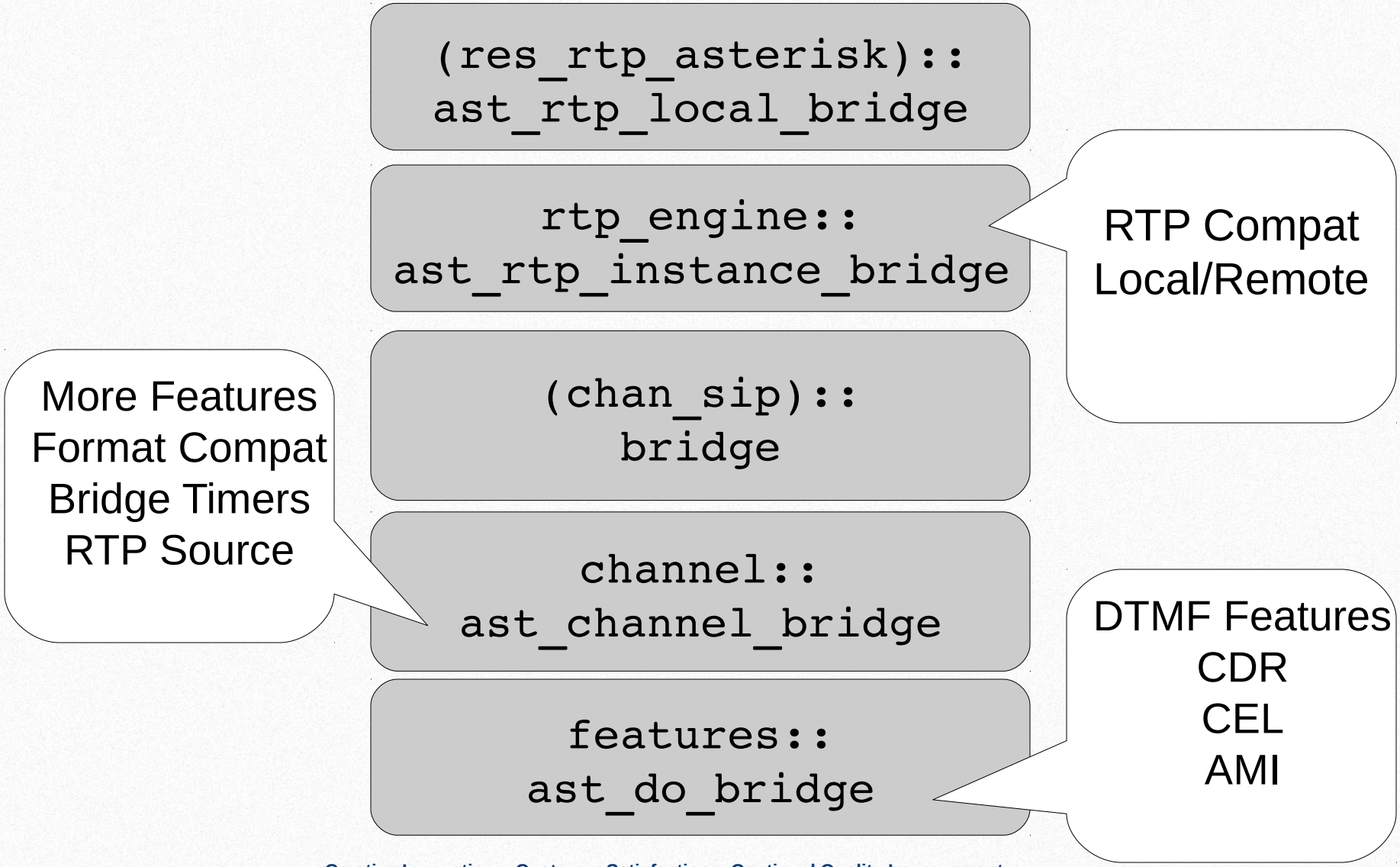


THAT'S OKAY, THINGS ARE GOING TO BE OKAY.

This Is Not Fine

Constraints

- Channels must be “stable”
  - No rename events
  - No masquerade events
  - Predictable lifetime

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  - The PBX Thread must still service an `ast_channel`

Constraints

- Channels must be “stable”
  - No rename events
  - No masquerade events
  - Predictable lifetime
- Can't fundamentally change Asterisk's threading model
  - Asterisk is multithreaded, not multiprocess
  - The PBX Thread must still service an `ast_channel`
- Use existing APIs to maximize chance of success
  - Bridging Framework (1.6.x)
  - Find places to *stop* expanding the scope

Version I: Bridging as an Object

Or: Let's try a novel approach and use some code we wrote five years ago

The Bridging Framework

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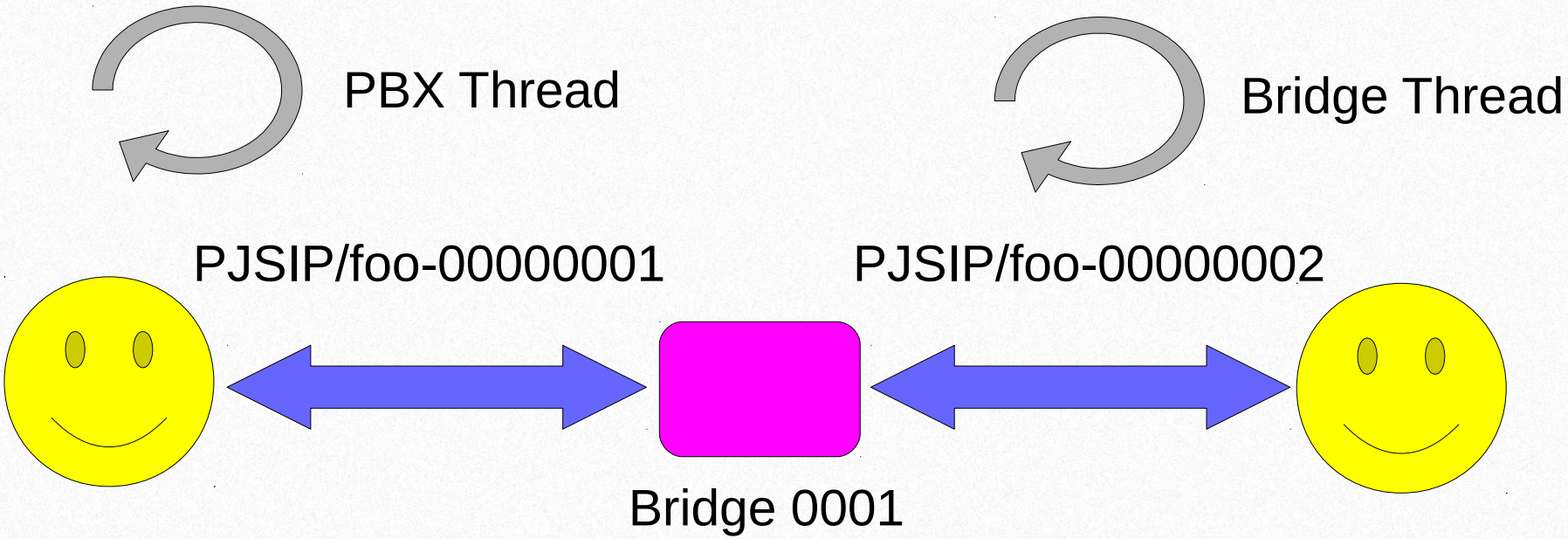
  - *Have* a mixing technology (strategy pattern)
- Mixing strategies
  - “Simple” - two party, media in the core
  - “Softmix” - multiparty
  - ~~“Multiplex” - multiple two party bridges~~
- Dedicated thread per channel
  - Allows channels to gracefully leave a bridge

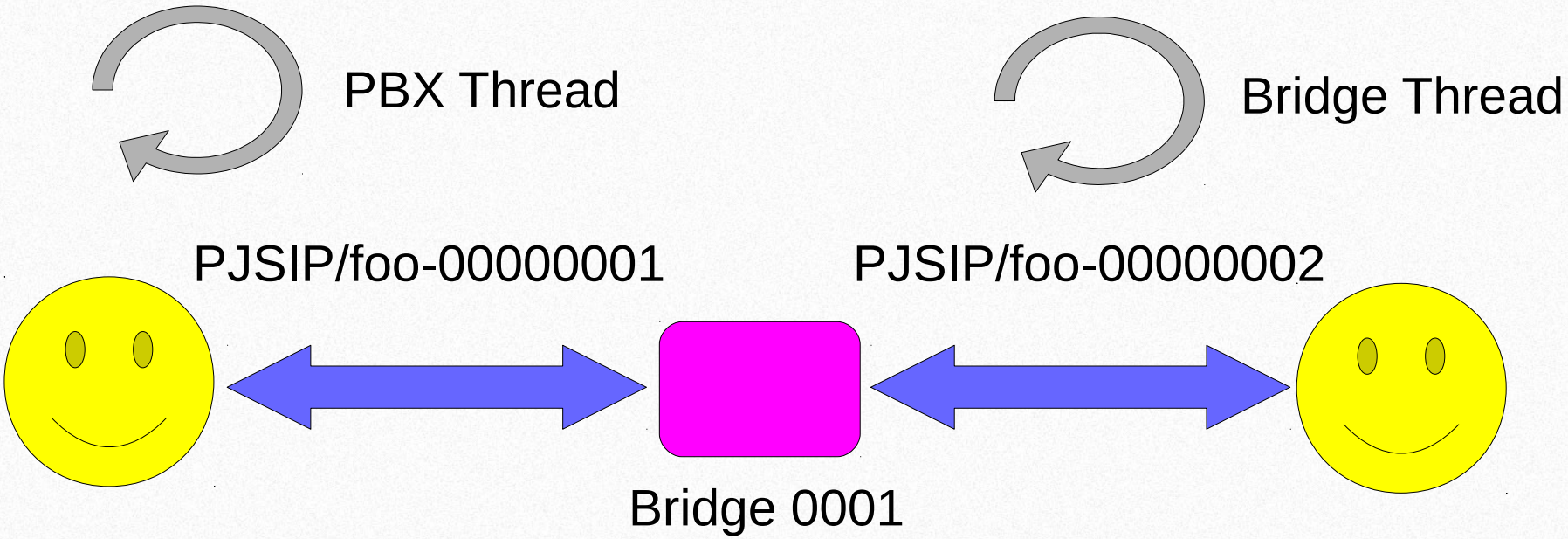
The Bridging Framework

- `ast_bridge_create` – make a new bridge
- `ast_bridge_join` – add a channel to a bridge (blocking)
- `ast_bridge_impart` – add a channel to a bridge (non-blocking)
- `ast_bridge_merge` – merge two bridges together
- `ast_bridge_move` – move a channel from one bridge to another
- `ast_bridge_transfer_blind` – blind transfer a channel to the dialplan
- `ast_bridge_transfer_attended` – perform an attended transfer between two channels

Releasing a Channel

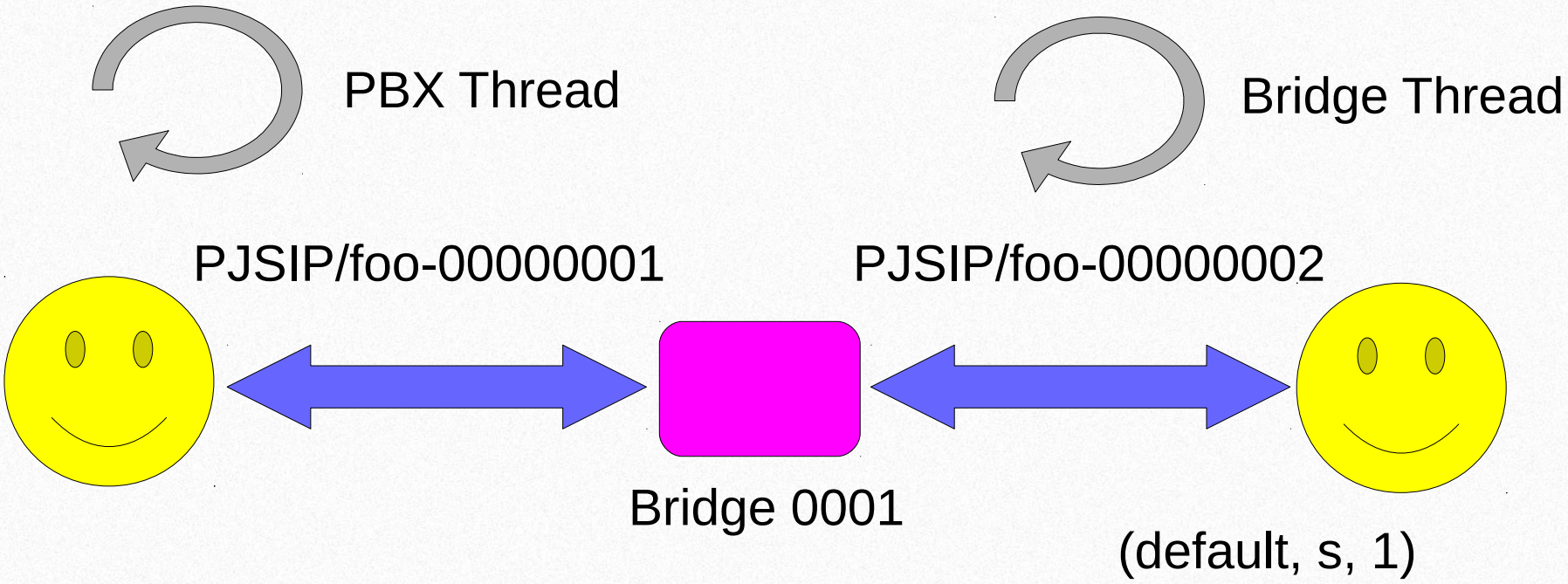


Releasing a Channel




```
ast_bridge_set_after_goto(pjsip_foo,
    “default”, “s”, 1);
```

Releasing a Channel




```
ast_bridge_set_after_goto(pjsip_foo,
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```
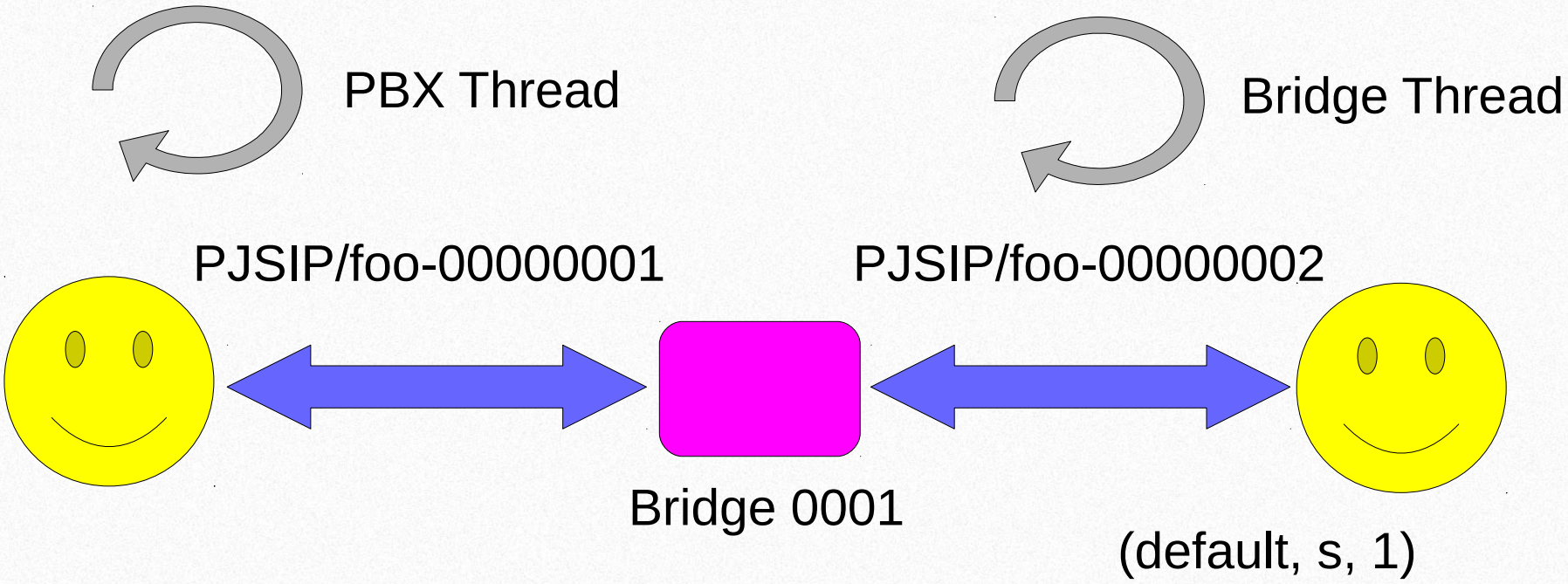

Releasing a Channel




```
ast_bridge_kick(b01, pjsip_foo);
```

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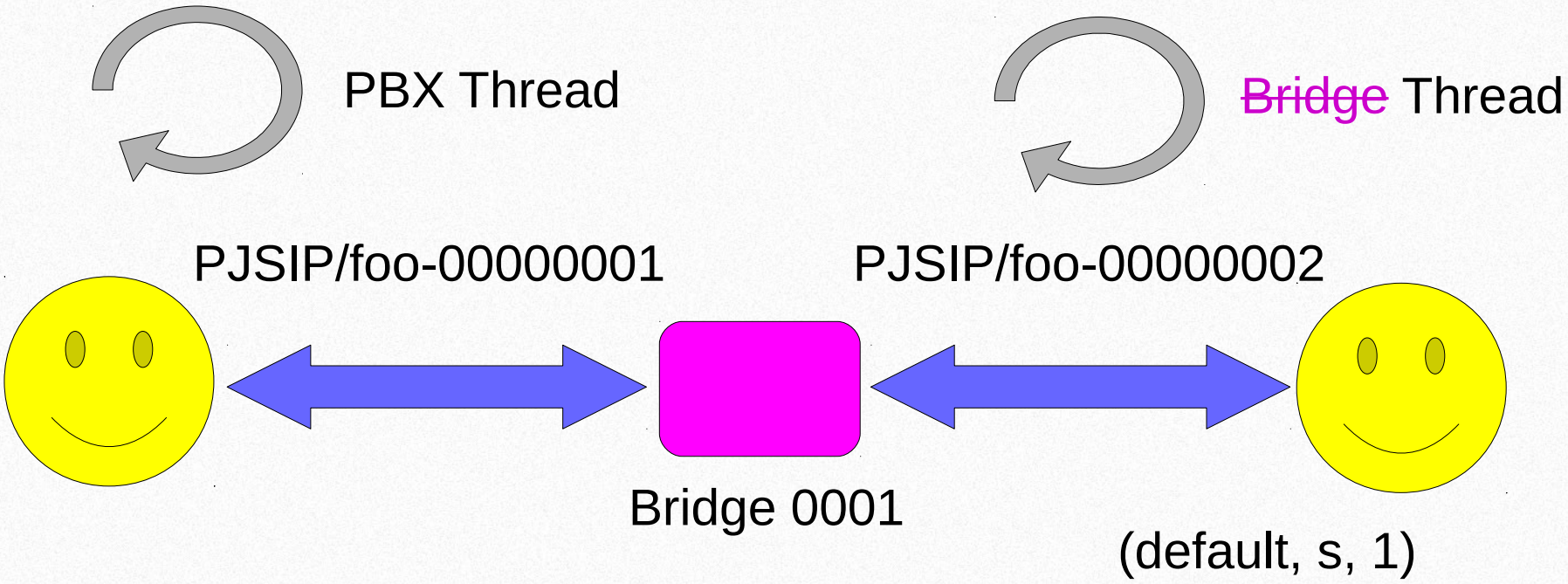


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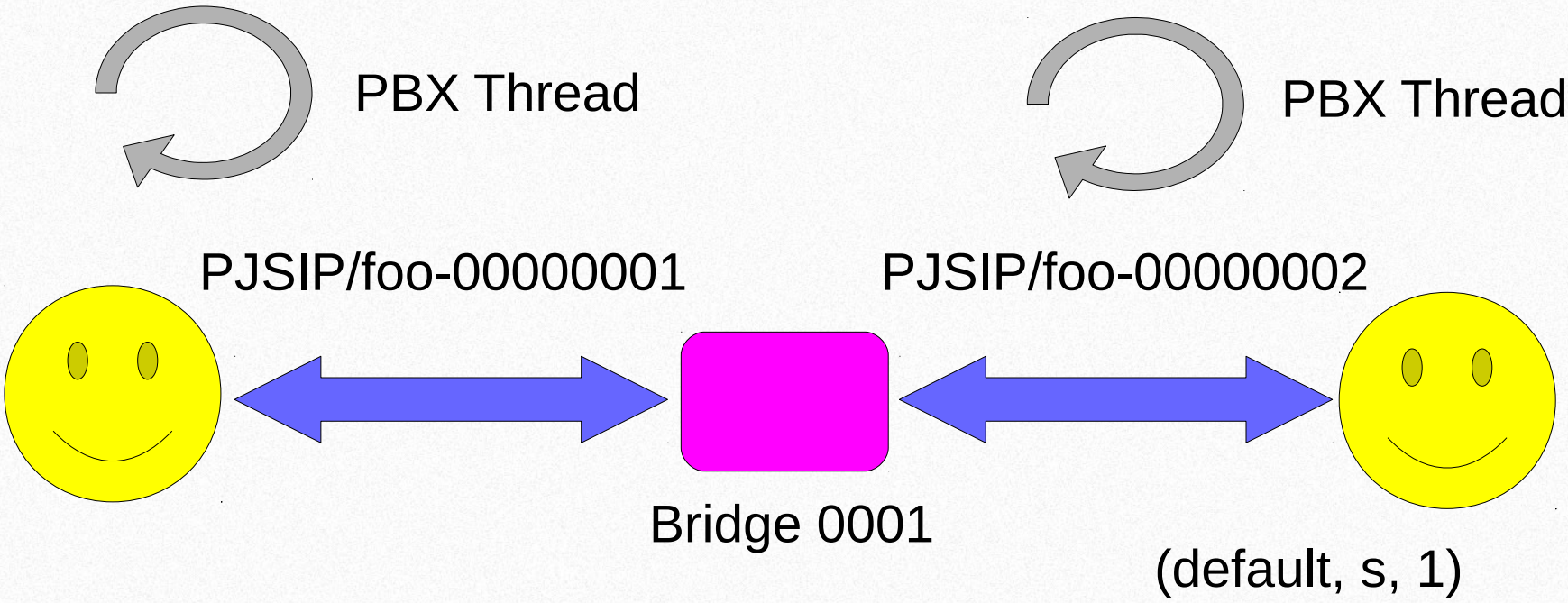


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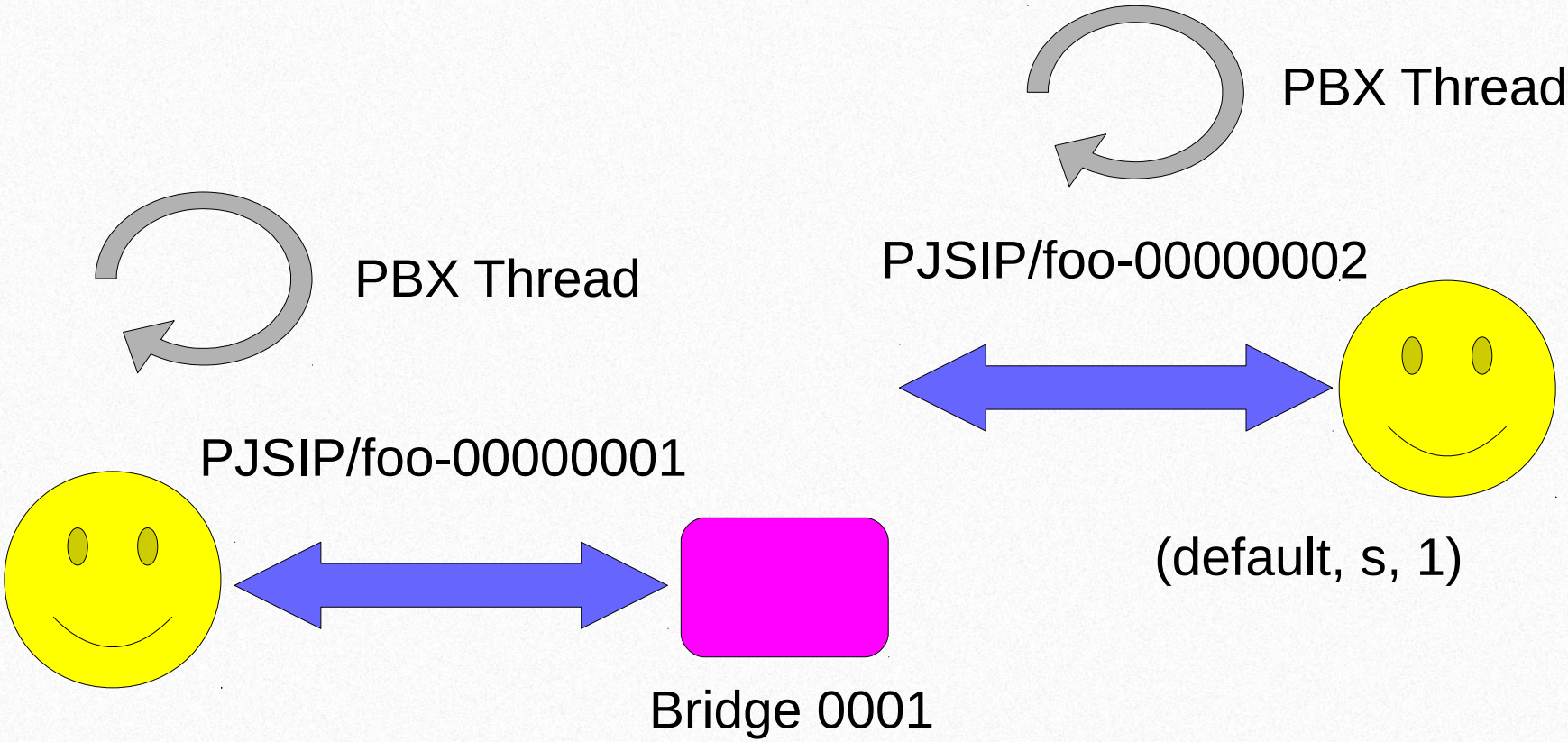



```
ast_bridge_kick(b01, pjsip_foo);
```

Bridging Events

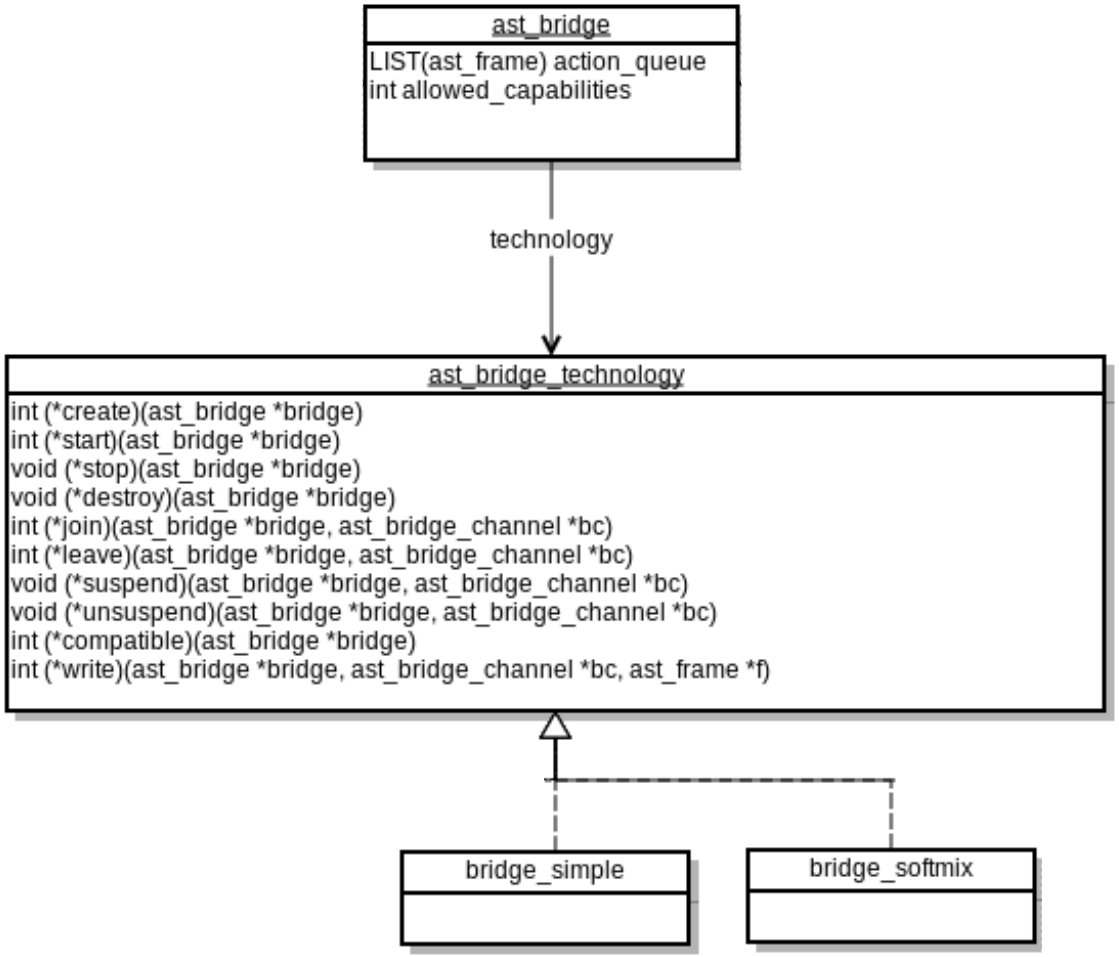
```
Event: BridgeEnter
Channel: PJSIP/foo-00000001
Bridge: 0001

Event: BridgeEnter
Channel: PJSIP/bar-00000002
Bridge: 0001

Event: BridgeLeave
Channel: PJSIP/bar-00000002
Bridge: 0001

Event: BridgeLeave
Channel: PJSIP/foo-00000001
Bridge: 0001
```

Version I


ast_bridge
LIST(ast_frame) action_queue
int allowed_capabilities
technology
ast_bridge_technology
int (*create)(ast_bridge *bridge)
int (*start)(ast_bridge *bridge)
void (*stop)(ast_bridge *bridge)
void (*destroy)(ast_bridge *bridge)
int (*join)(ast_bridge *bridge, ast_bridge_channel *bc)
int (*leave)(ast_bridge *bridge, ast_bridge_channel *bc)
void (*suspend)(ast_bridge *bridge, ast_bridge_channel *bc)
void (*unsuspend)(ast_bridge *bridge, ast_bridge_channel *bc)
int (*compatible)(ast_bridge *bridge)
int (*write)(ast_bridge *bridge, ast_bridge_channel *bc, ast_frame *f)
bridge_simple
bridge_softmix

What about Native Bridging?

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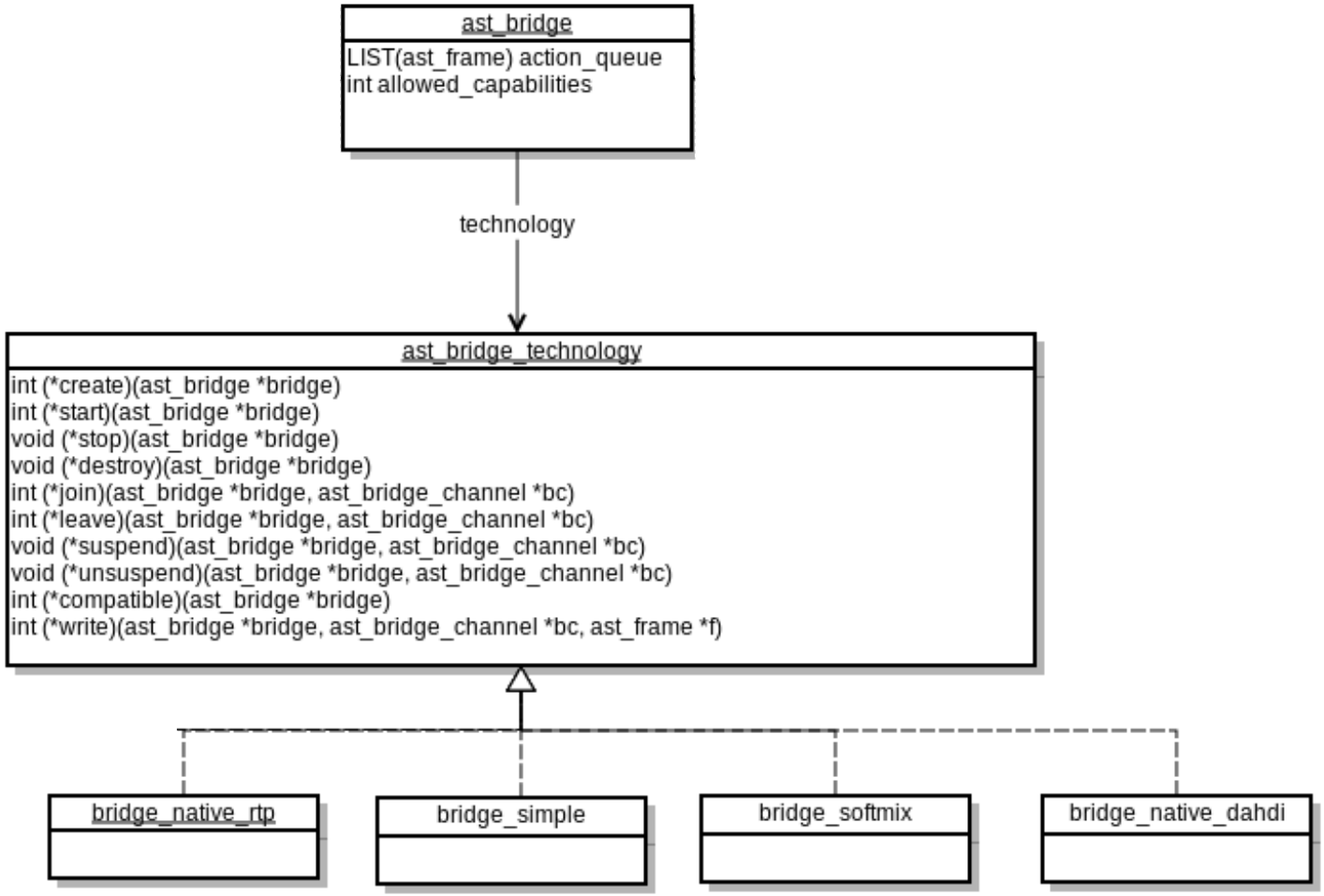
Version II: Native Bridging Modules

Or: Let's not rewrite res_rtp_asterisk just yet

Version II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ast_bridge_technology
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void (*suspend)(ast_bridge *bridge, ast_bridge_channel *bc)
void (*unsuspend)(ast_bridge *bridge, ast_bridge_channel *bc)
int (*compatible)(ast_bridge *bridge)
int (*write)(ast_bridge *bridge, ast_bridge_channel *bc, ast_frame *f)
bridge_native_rtp
bridge_simple
bridge_softmix
bridge_native_dahdi

Mixing Strategies

- PJSIP-foo joins
- Simple – 1 channel

Mixing Strategies

- PJSIP-foo joins
- DAHDI-i1 joins
- Simple – 1 channel
- Simple – 2 channels

Mixing Strategies

- PJSIP-foo joins
- DAHDI-i1 joins
- PJSIP-yack joins

- Simple – 1 channel
- Simple – 2 channels
- Softmix – 3 channels

Mixing Strategies

- PJSIP-foo joins
- DAHDI-i1 joins
- PJSIP-yack joins
- DAHDI-i1 leaves

- Simple – 1 channel
- Simple – 2 channels
- Softmix – 3 channels
- Native RTP (local) – 2 channels

Mixing Strategies

- PJSIP-foo joins
- DAHDI-i1 joins
- PJSIP-yack joins
- DAHDI-i1 leaves
- PJSIP-bar joins

- Simple – 1 channel
- Simple – 2 channels
- Softmix – 3 channels
- Native RTP (local) – 2 channels
- Softmix – 3 channels

Mixing Strategies

- PJSIP-foo joins
- DAHDI-i1 joins
- PJSIP-yack joins
- DAHDI-i1 leaves
- PJSIP-bar joins
- PJSIP-yack leaves

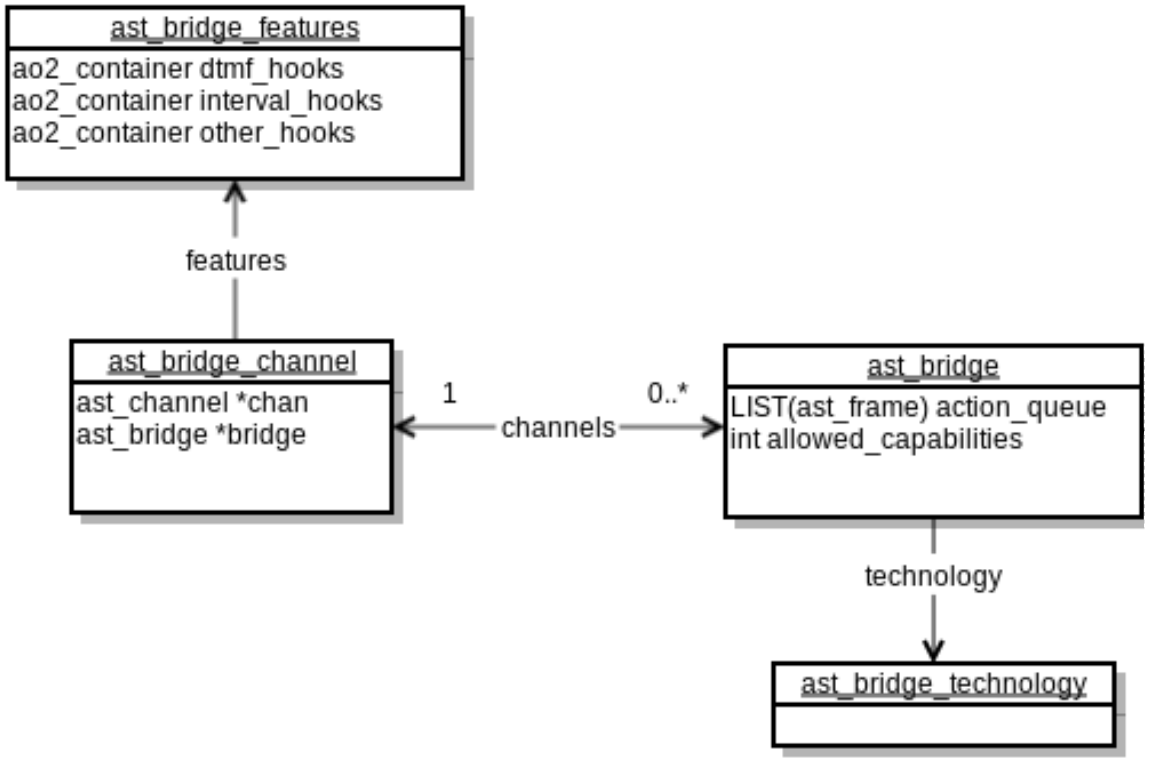
- Simple – 1 channel
- Simple – 2 channels
- Softmix – 3 channels
- Native RTP (local) – 2 channels
- Softmix – 3 channels
- Native RTP (rmt) – 2 channels

What about Features?

Version III: Features

Or: Users like buttons

Version III


ast_bridge_features
ao2_container dtmf_hooks
ao2_container interval_hooks
ao2_container other_hooks
features
ast_bridge_channel
ast_channel *chan
ast_bridge *bridge
1
channels
0..*
ast_bridge
LIST(ast_frame) action_queue
int allowed_capabilities
technology
ast_bridge_technology

What about Parking?

Version IV: Parking as a Bridge

Or: Hold All the Things

Parking

- Create a new bridge mixing technology, 'holding'
  - Drops all media read from channels
  - Entertains channels with music, ringing, or white noise

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- Announcements
  - Channels join either as participant or announcer
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Parking

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- Announcements
  - Channels join either as participant or announcer
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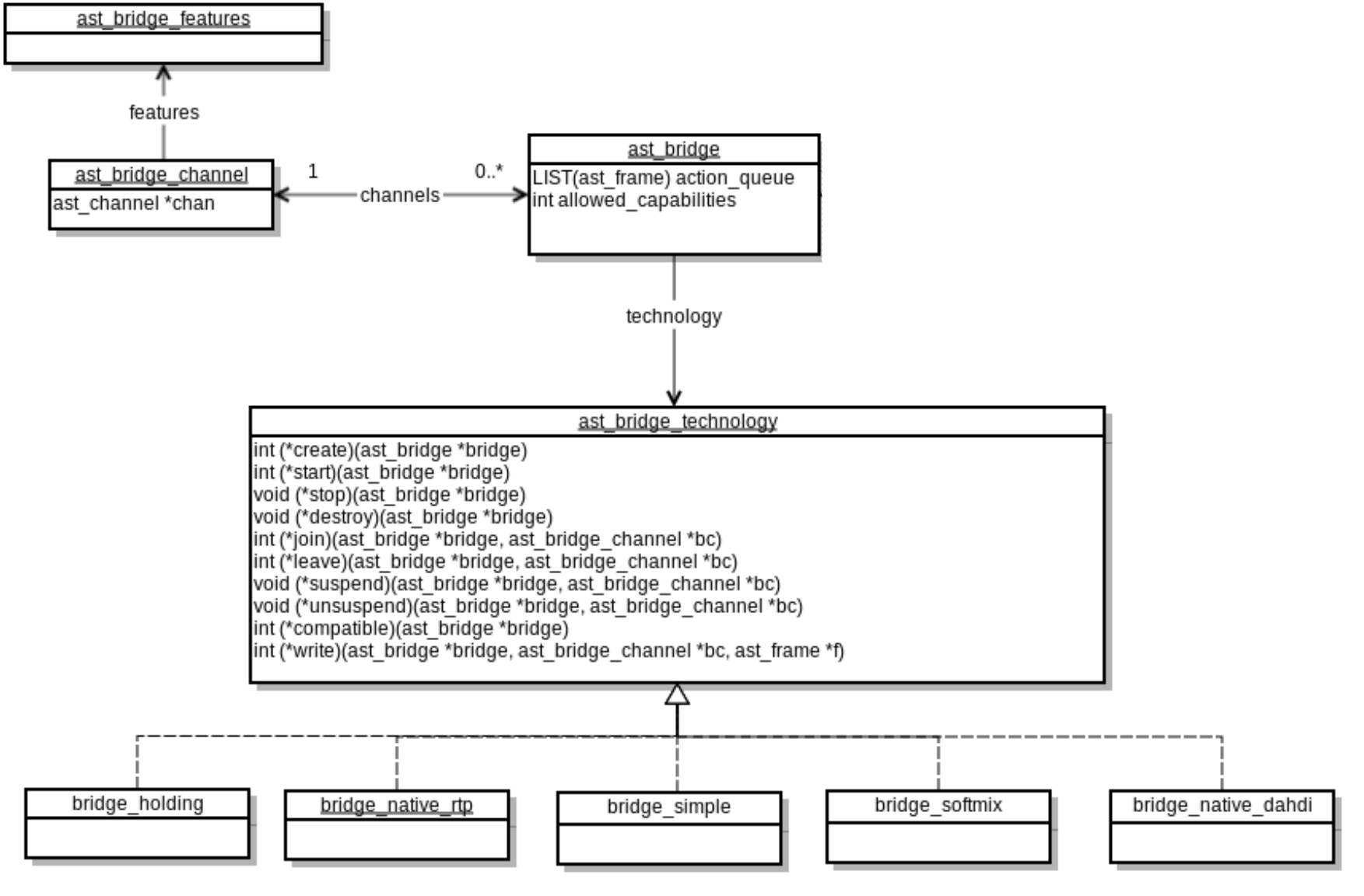
- Parking
  - Park puts channel into holding bridge
  - Pickup pulls channel from bridge and puts it into a standard 'mixing' bridge with the pickup-ee

Version IV


ast_bridge_features
features
ast_bridge_channel
ast_channel *chan
1
channels
0..*
ast_bridge
LIST(ast_frame) action_queue
int allowed_capabilities
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ast_bridge_technology
int (*create)(ast_bridge *bridge)
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bridge_holding
bridge_native_rtp
bridge_simple
bridge_softmix
bridge_native_dahdi

What about CDRs/CEL/AMI?

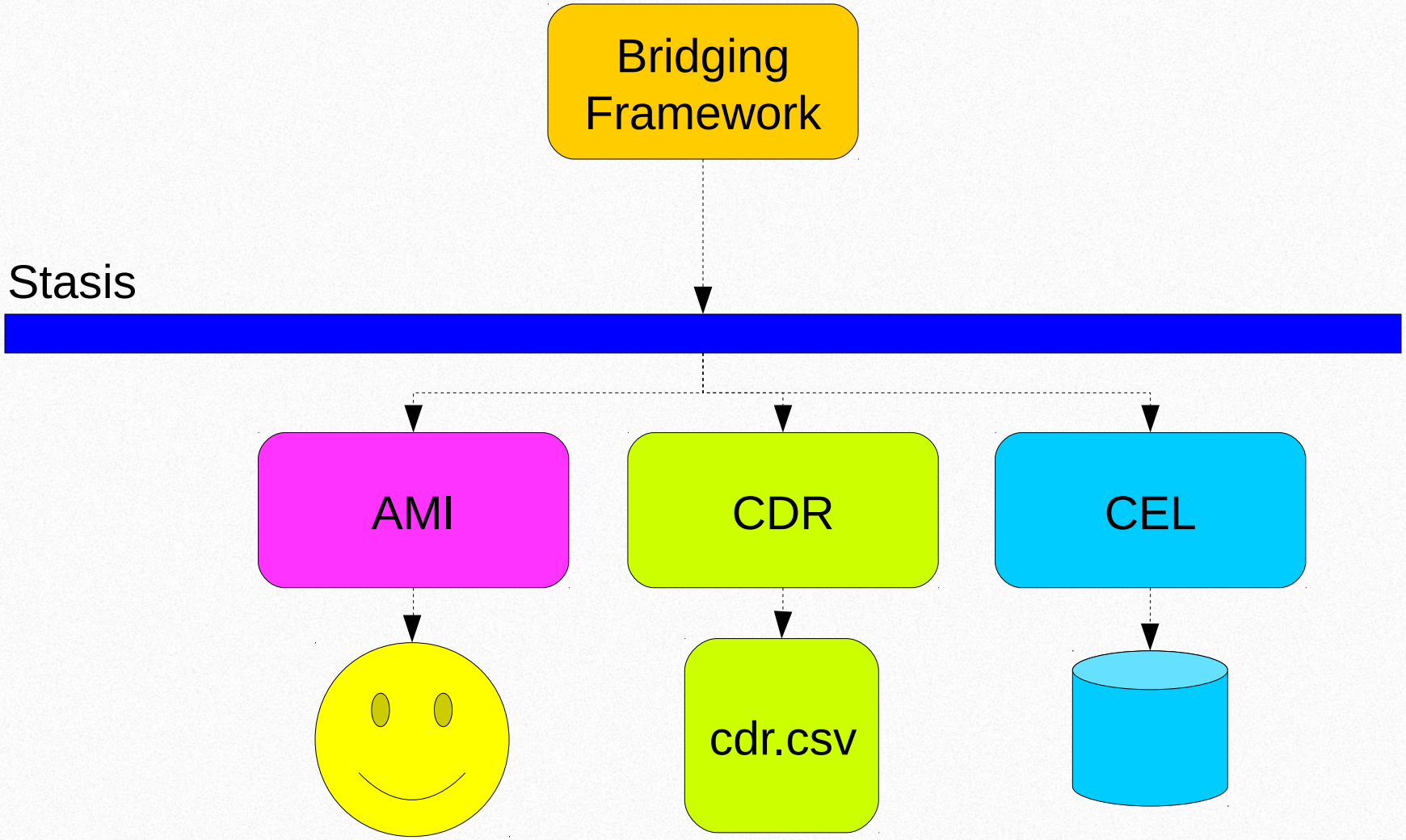
Version V: Stasis

Or: If we never charged people money this would be much easier

Consuming Bridge State

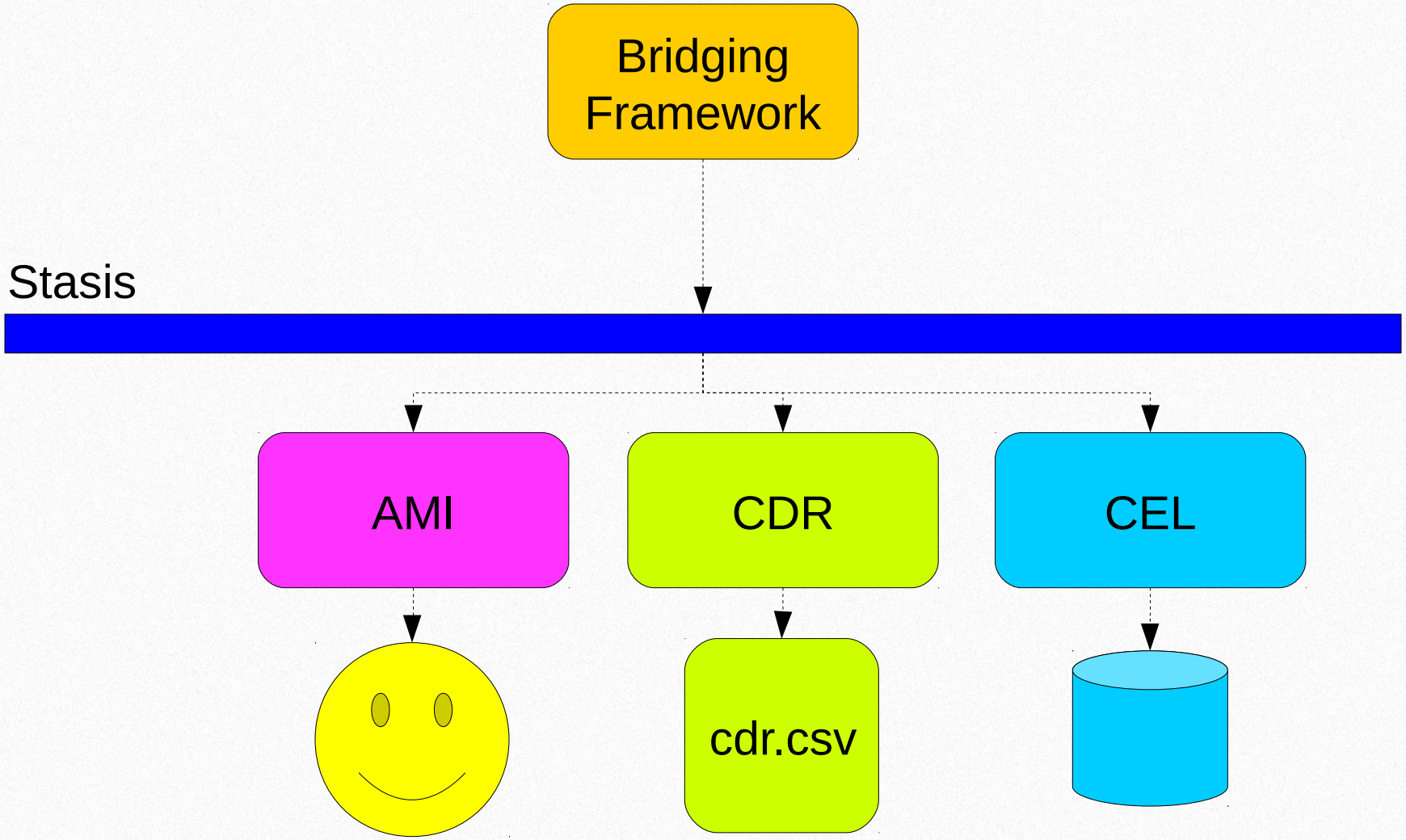
- Do *not* put CDR, CEL, AMI logic back into Bridging Framework
- Stasis: Internal pub/sub message bus
  - Bridge state is published onto bus
  - AMI, CDR, CEL become consumers of that state

Consuming Bridge State



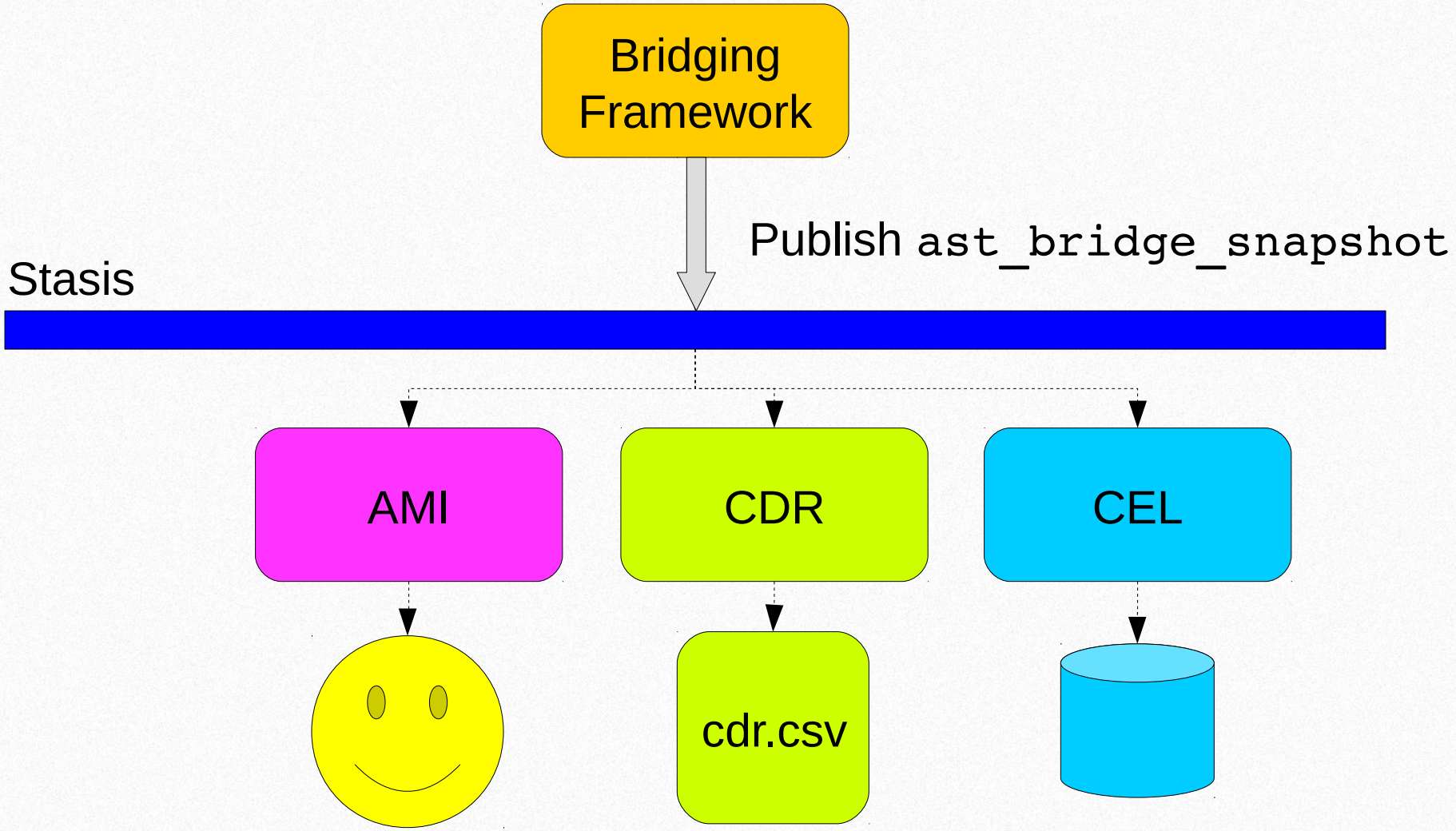
Consuming Bridge State

Channel pulled from bridge



Consuming Bridge State

Channel pulled from bridge



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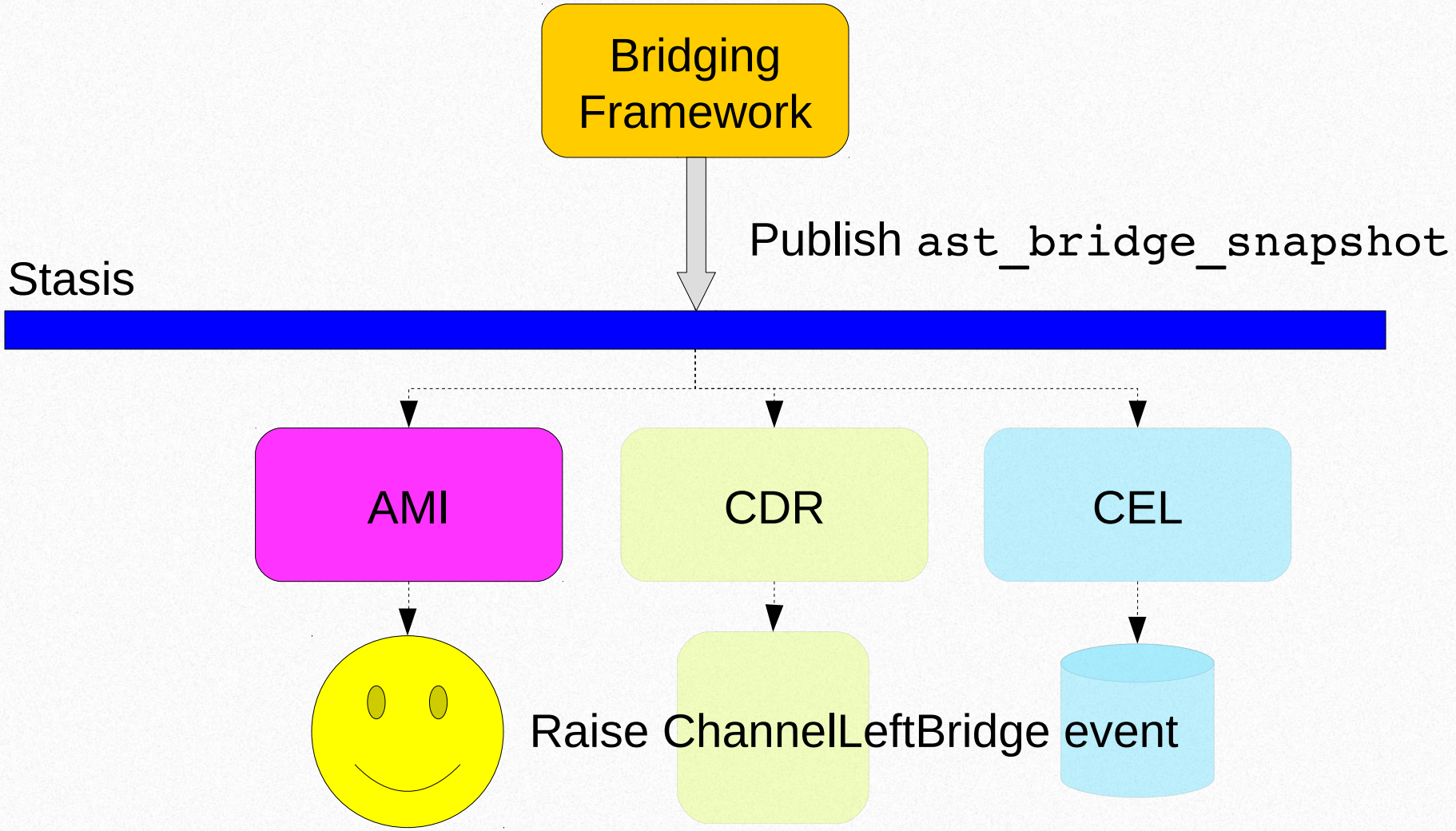

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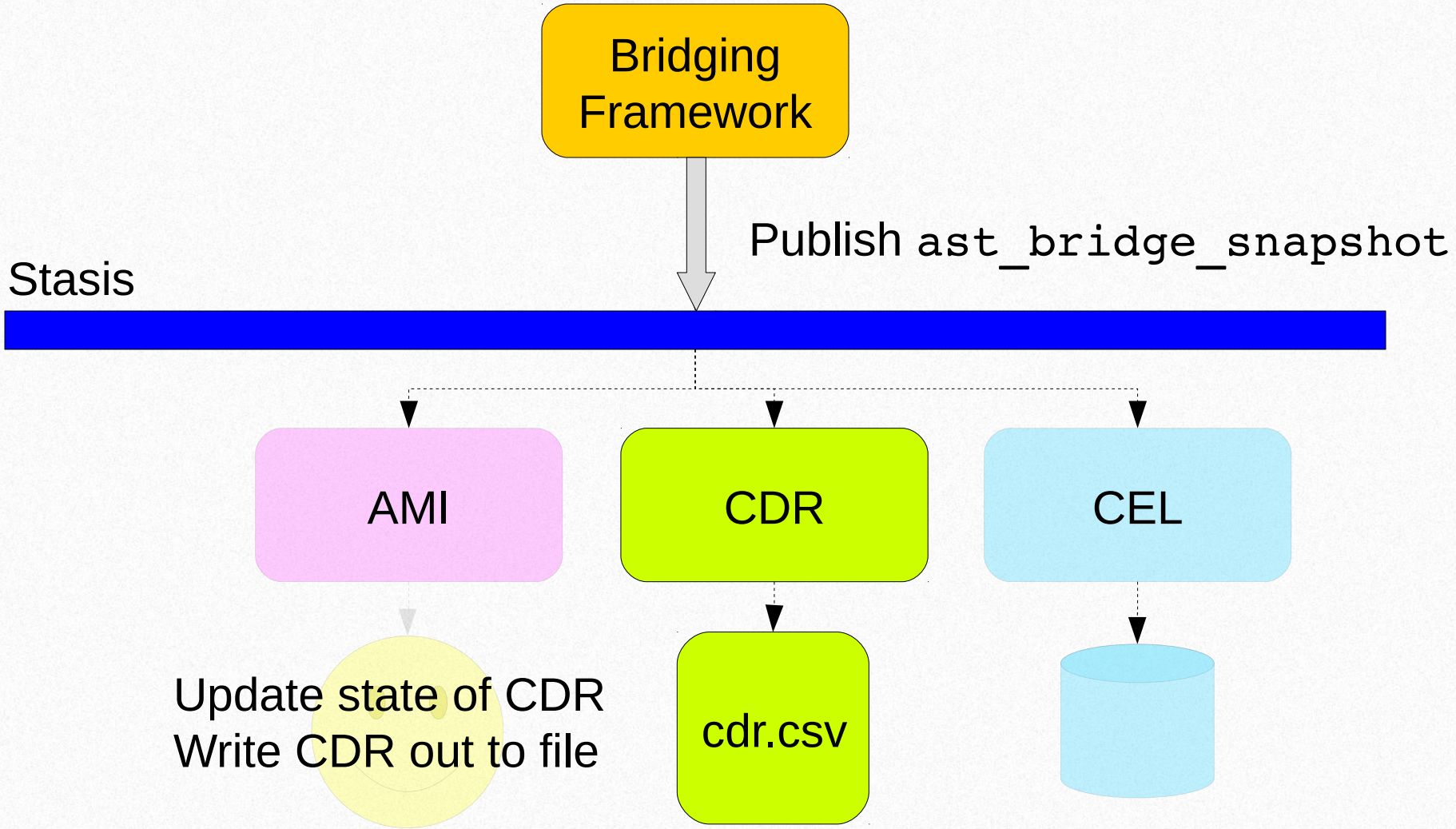
Channel pulled from bridge



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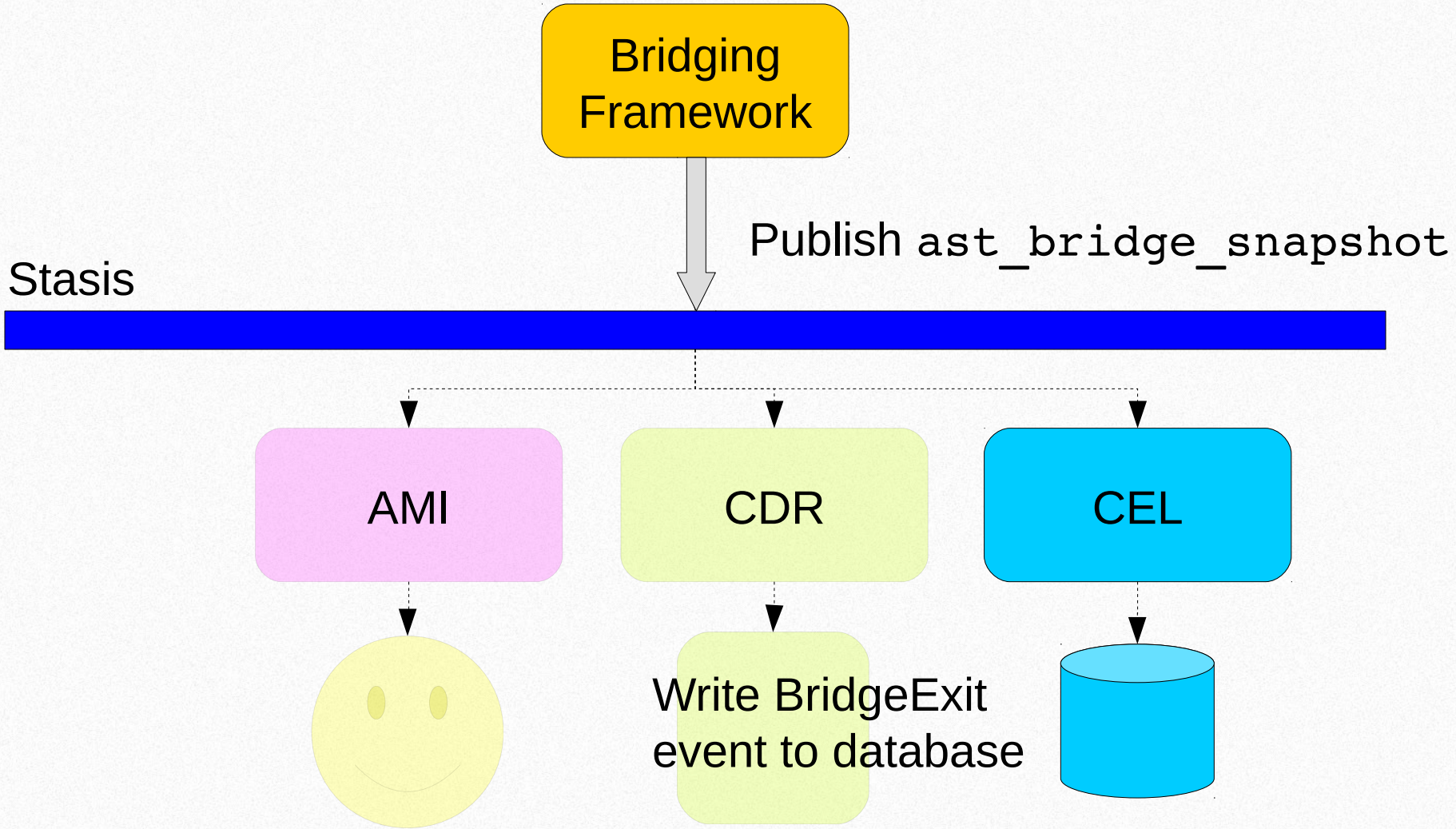
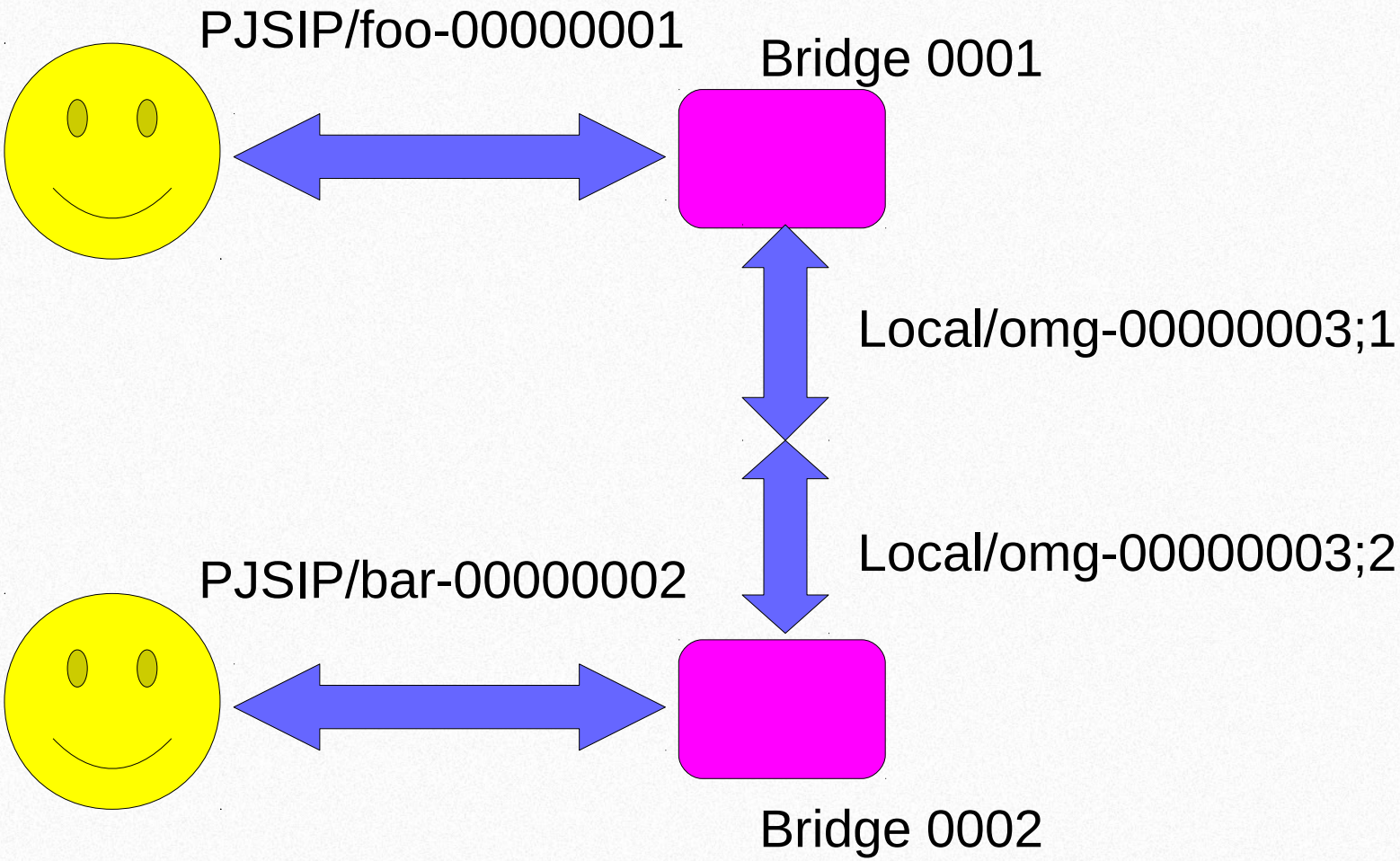


What about Local Channel Optimization?

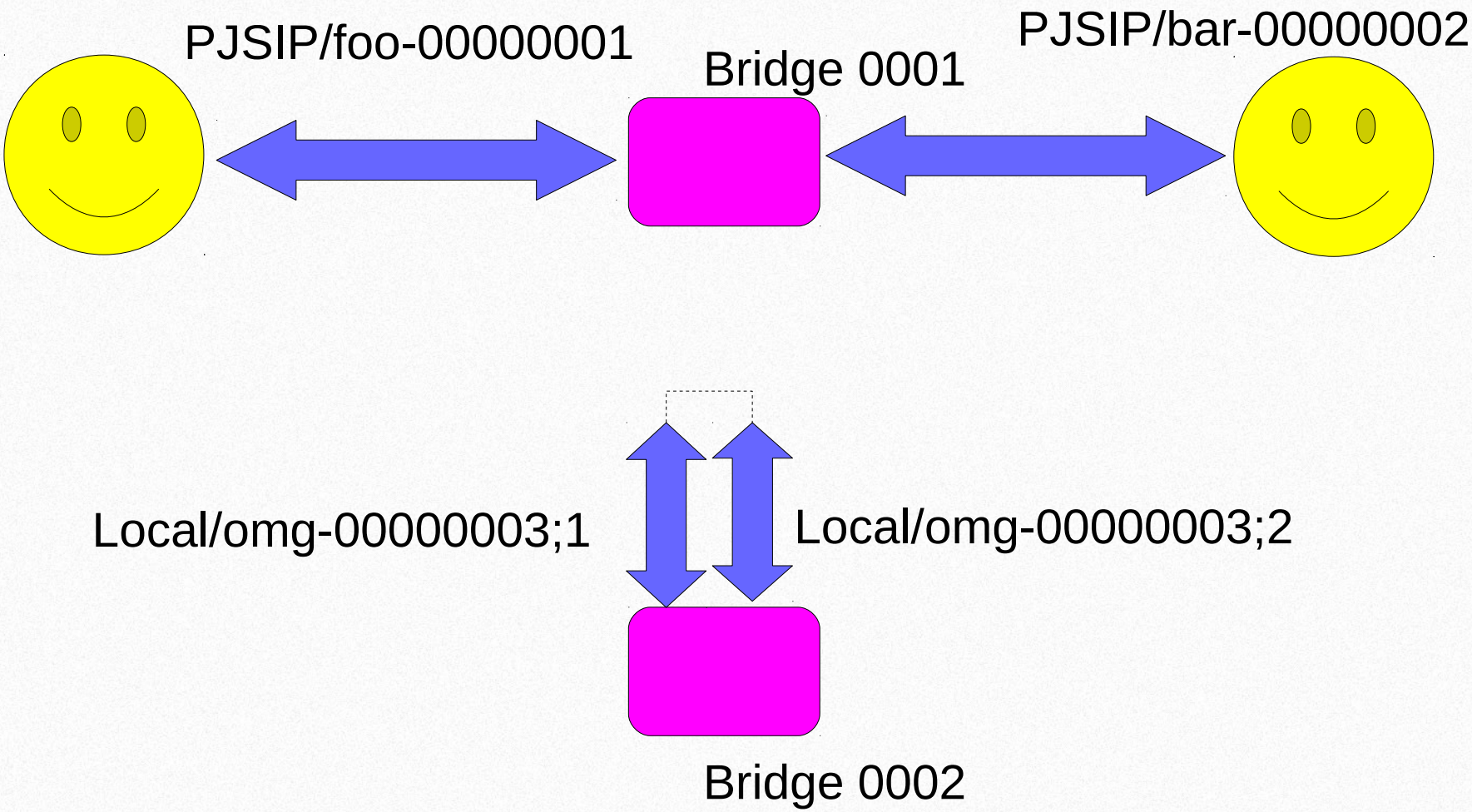
Version VI: Local Channels

Or: Oh Snap.

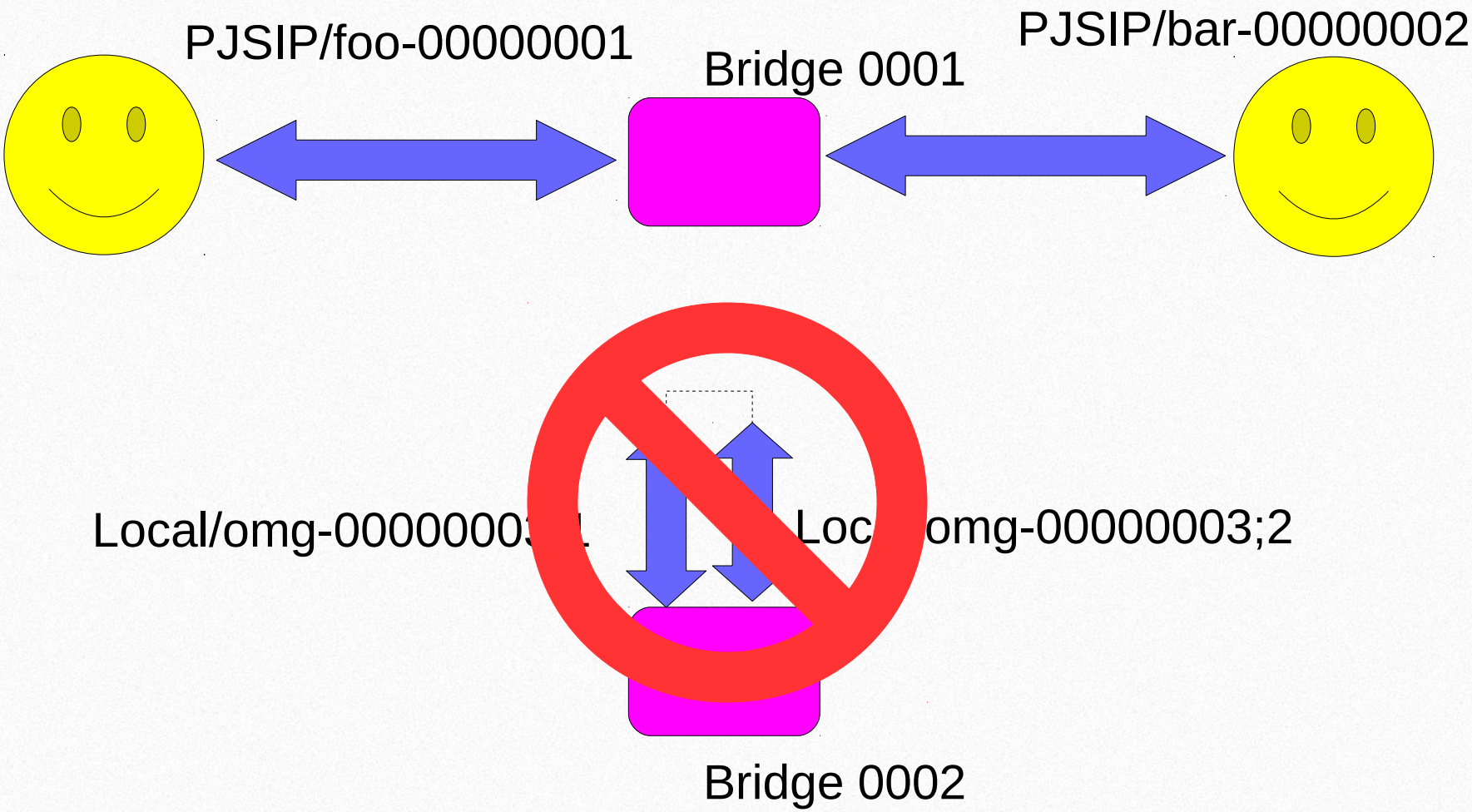
Optimization: Bridge Swap



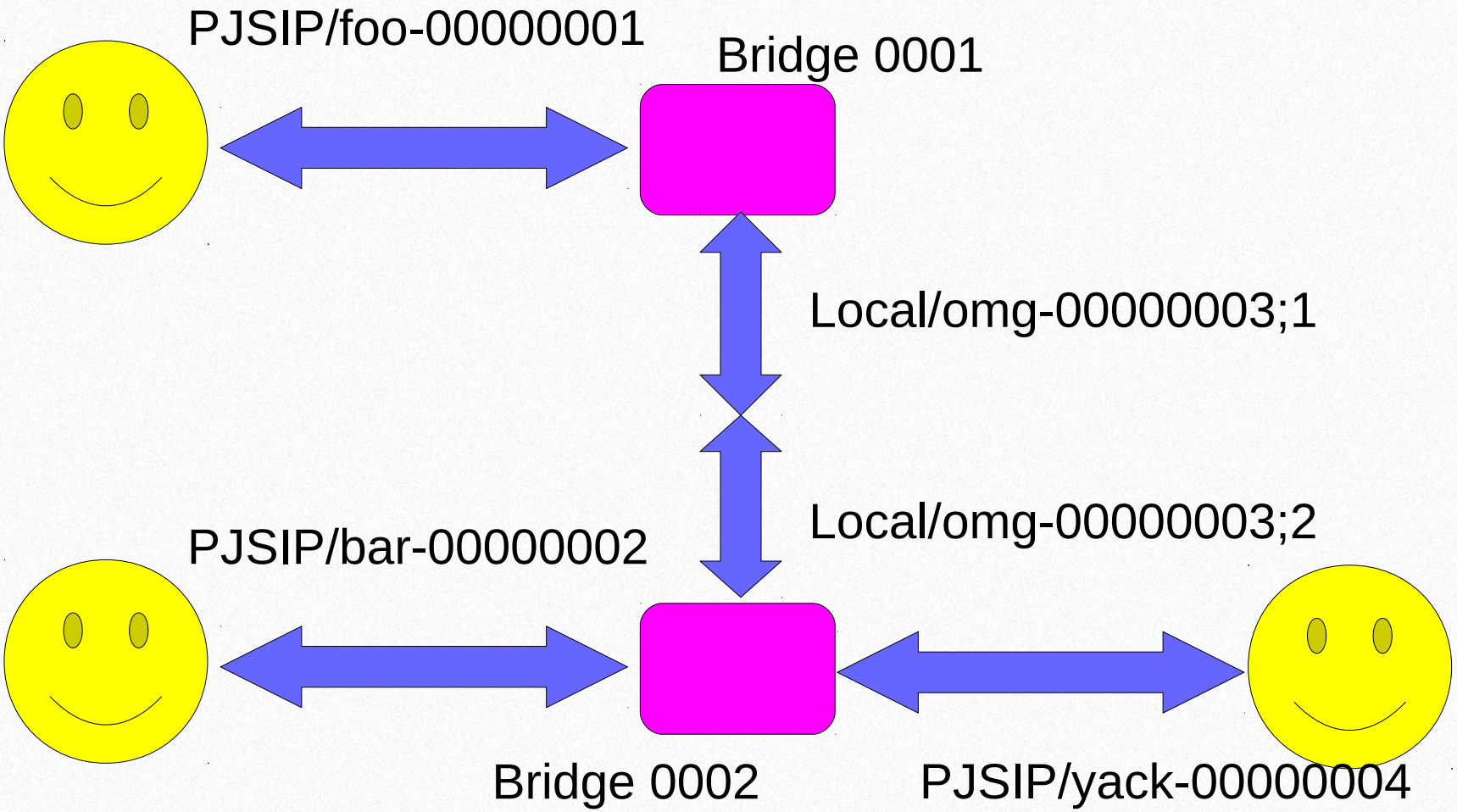
Optimization: Bridge Swap



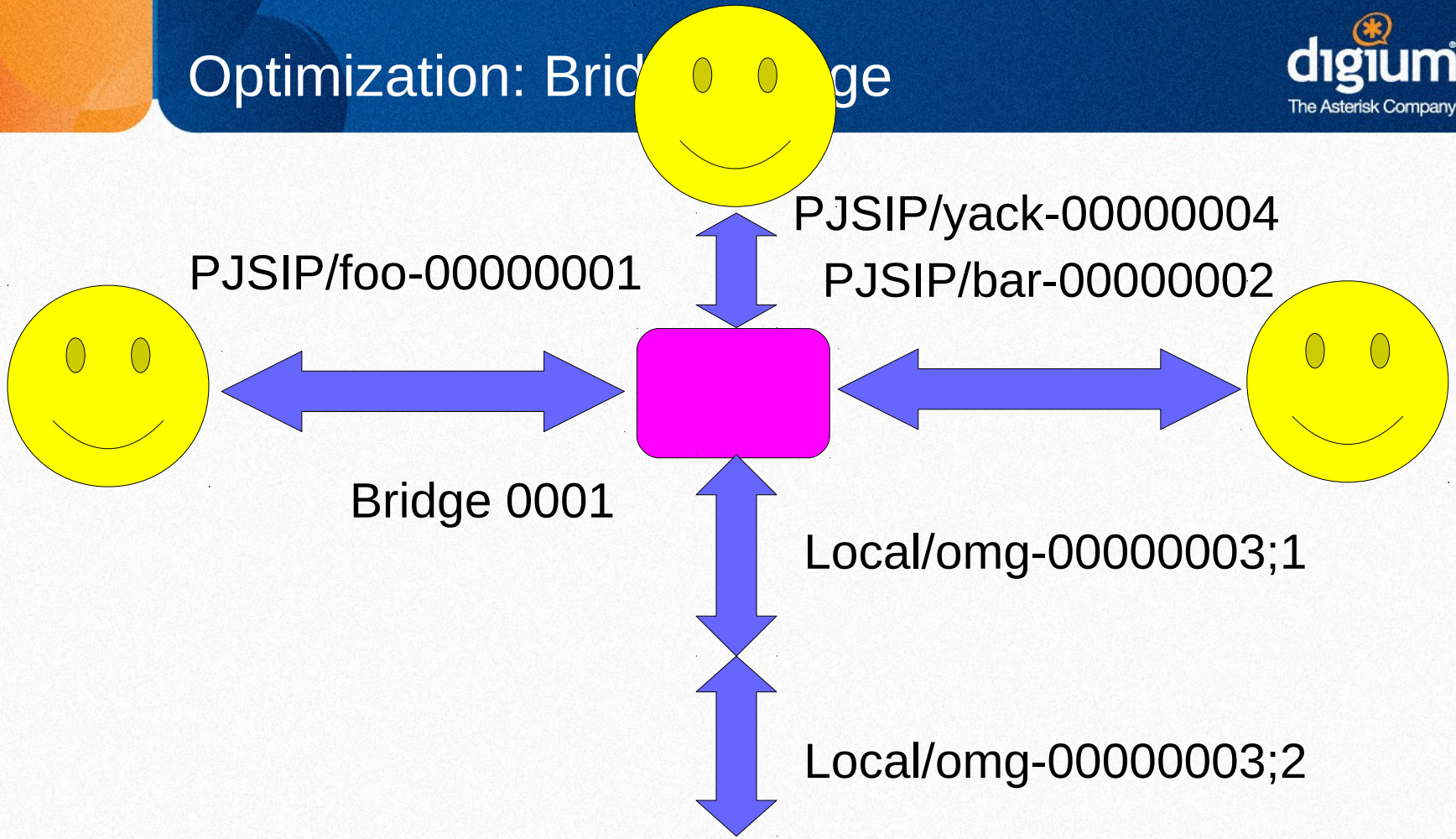
Optimization: Bridge Swap



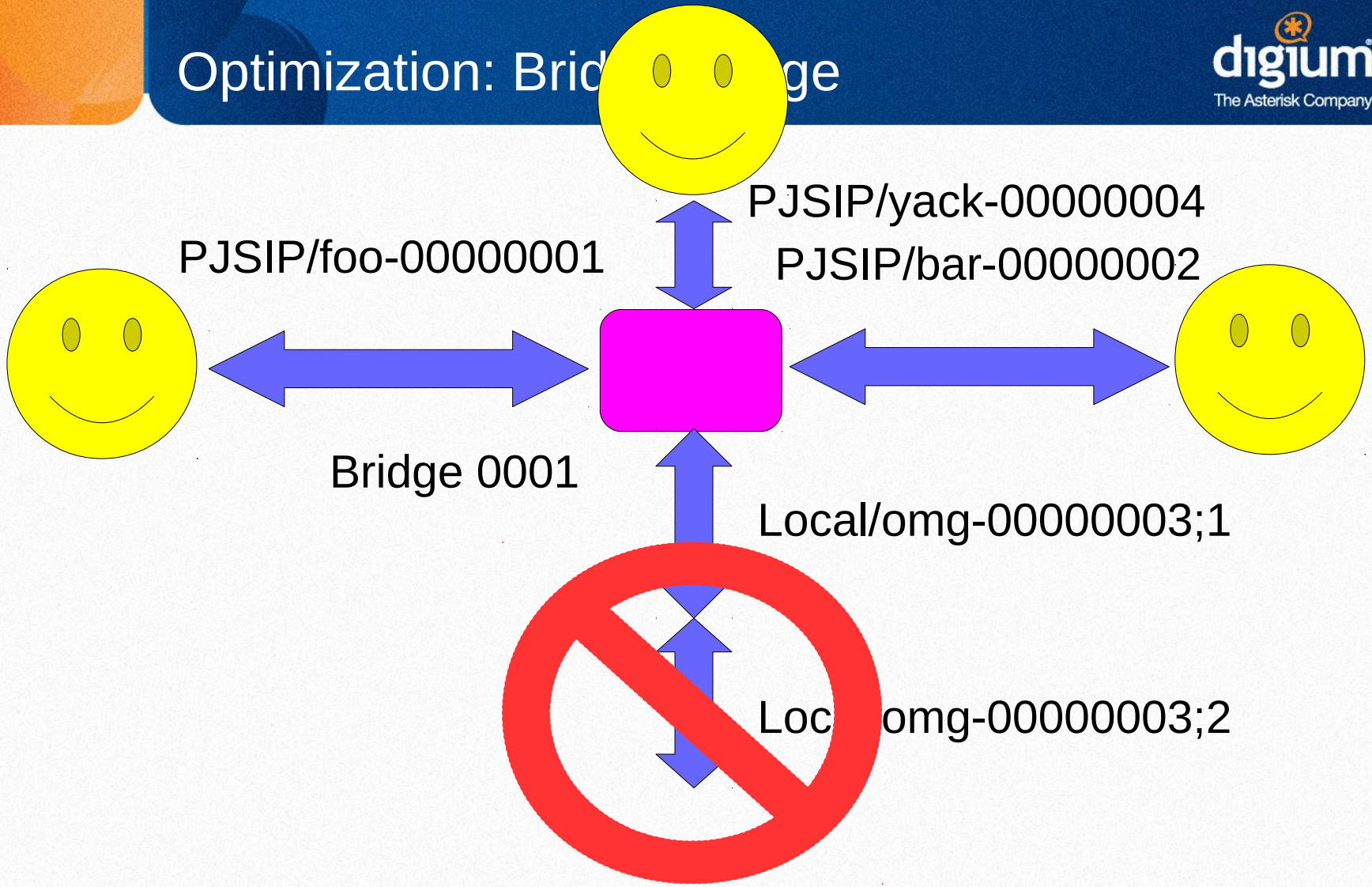
Optimization: Bridge Merge



Optimization: Brid ge



Optimization: Bridge



What happens when a Local channel merges into ConfBridge?

Version VII: Class Bridges

Or: That's it, I'm taking my ball and going home now.

Class Bridges

- Some bridges have application state in addition to their mixing strategy
  - ConfBridge: marked users, admins, etc.
  - Parking: which parking lot am I in
  - Stasis: ARI specific logic to know who controls a channel
  - Agent waiting pools: how long has a Queue agent been waiting for a call

Class Bridges

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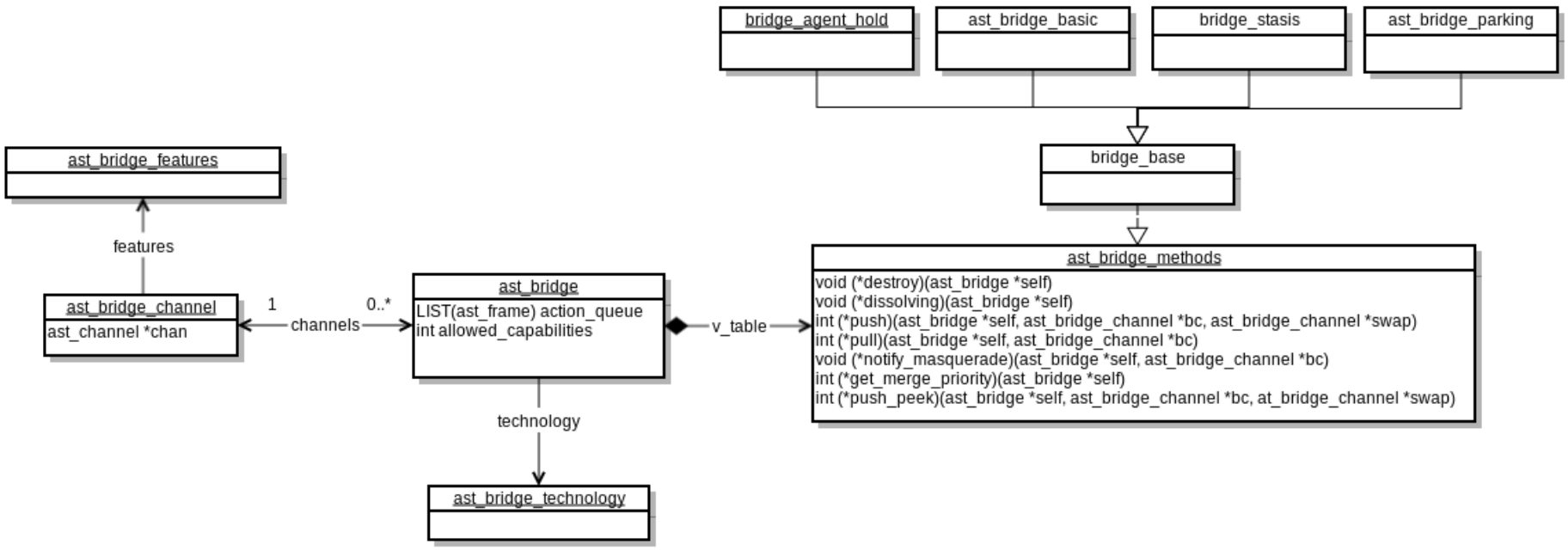
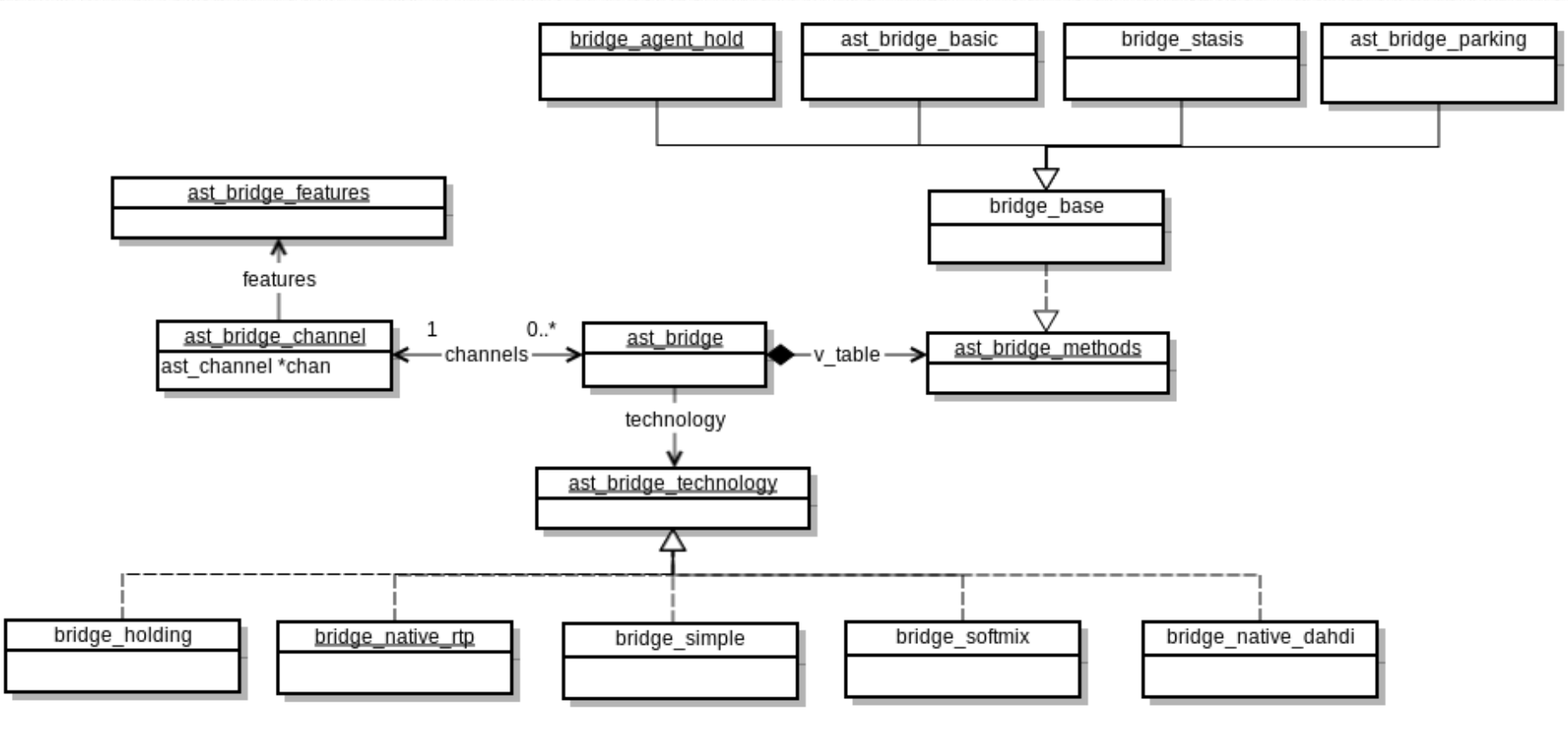
  - Agent waiting pools: how long has a Queue agent been waiting for a call
- Solution: give a bridge a 'class' with callbacks to update their application state
- ConfBridge: still prohibited


bridge_agent_hold
ast_bridge_basic
bridge_stasis
ast_bridge_parking
bridge_base
ast_bridge_features
features
ast_bridge_channel
ast_channel *chan
1
channels
0..*
ast_bridge
LIST(ast_frame) action_queue
int allowed_capabilities
v_table
ast_bridge_methods
void (*destroy)(ast_bridge *self)
void (*dissolving)(ast_bridge *self)
int (*push)(ast_bridge *self, ast_bridge_channel *bc, ast_bridge_channel *swap)
int (*pull)(ast_bridge *self, ast_bridge_channel *bc)
void (*notify_masquerade)(ast_bridge *self, ast_bridge_channel *bc)
int (*get_merge_priority)(ast_bridge *self)
int (*push_peek)(ast_bridge *self, ast_bridge_channel *bc, at_bridge_channel *swap)
technology
ast_bridge_technology

The Big Picture

The Current* Bridging Framework



Questions?