The Slothful Ways of D-Bus

Will Thompson
Collabora

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Pre-emptive thanks:

Robin Bate Boerop
Alban Crequy

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“Slow”

- How slow?
- High latency?
  - …perhaps due to context switching?
- Low throughput?
- Scales poorly as traffic/number of clients increases?
- Something else?

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Preamble on methodology

- Benchmarks are benchmarks
- libdbus
- Statistics taken from various devices—not directly comparable

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Journey of a message

- Alice constructs a message, and gives it to the bus;
- The bus stamps the message header with Alice's unique name, and sends it out to its destination (maybe) and other interested recipients.

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Context switches?

- 1-byte ping-pong using UNIX sockets:
  - 10µs on a modern-ish laptop.
  - (40µs on a Nokia N900.)
- 1-byte (body) D-Bus message ping-pong:
  - 225µs

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Message throughput

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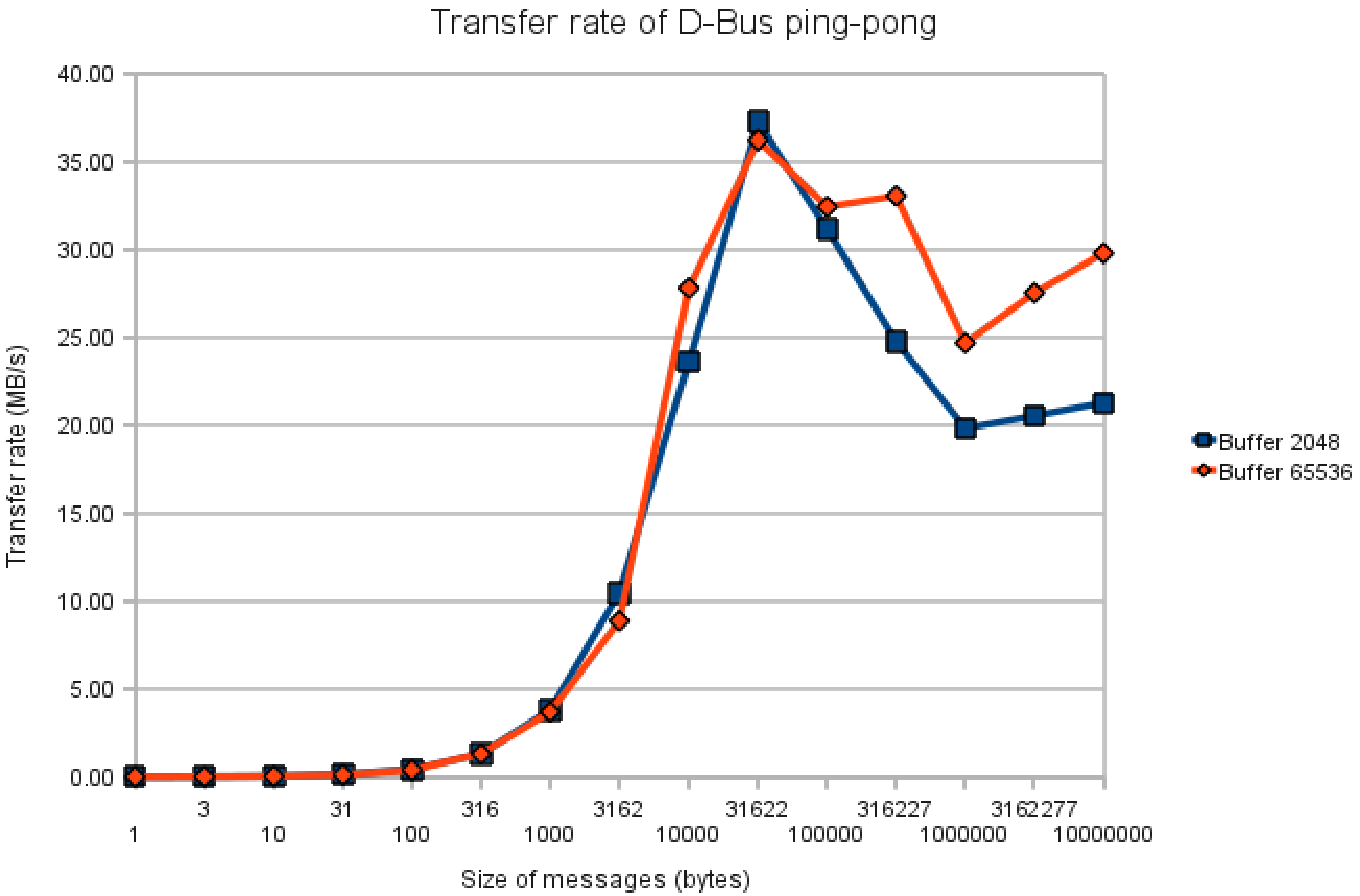
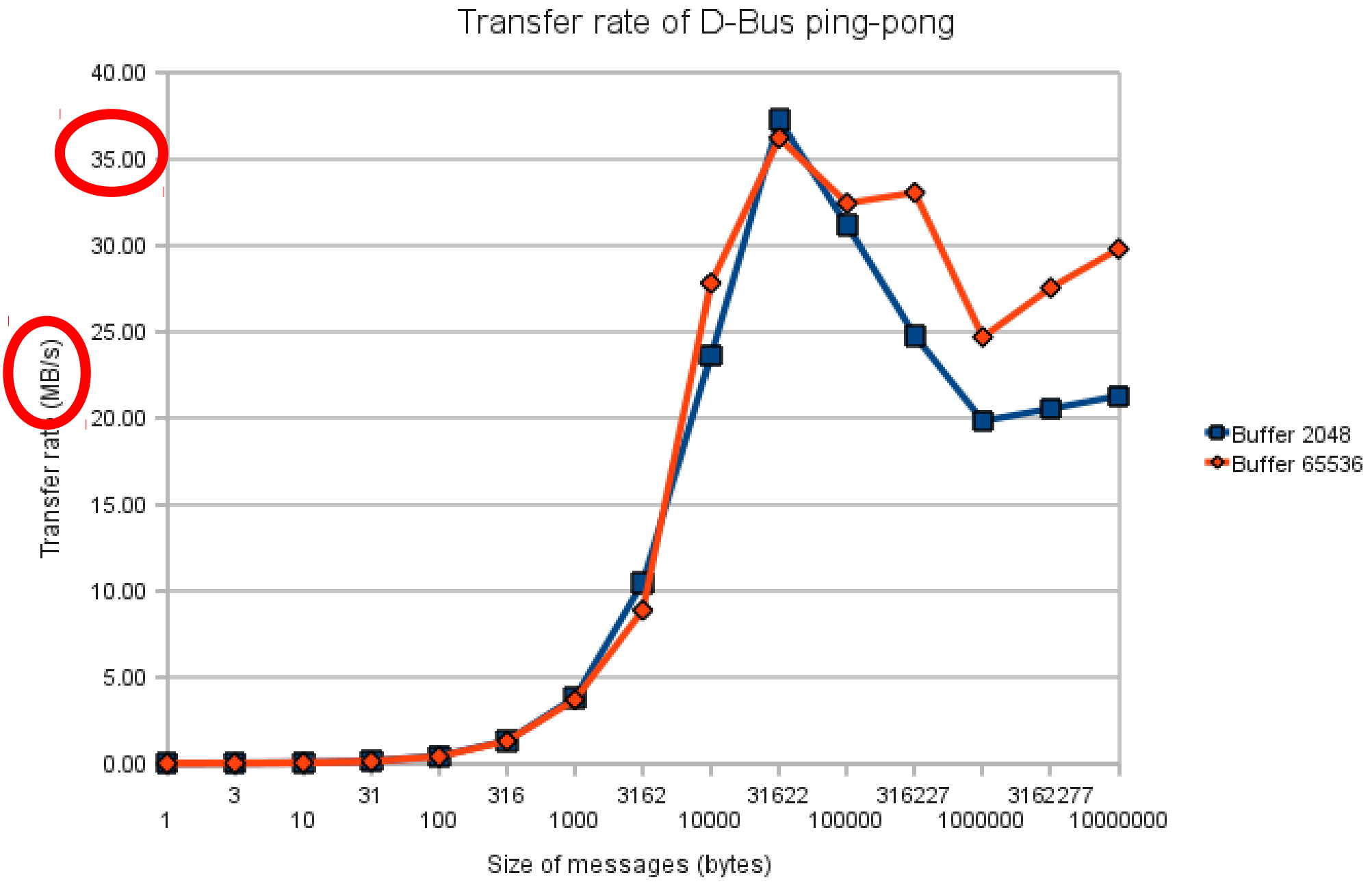

Transfer rate of D-Bus ping-pong
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Transfer rate (MB/s)
1
3
10
31
100
316
1000
3162
10000
31622
100000
316227
1000000
3162277
10000000
Size of messages (bytes)
Buffer 2048
Buffer 65536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Buffer 2048
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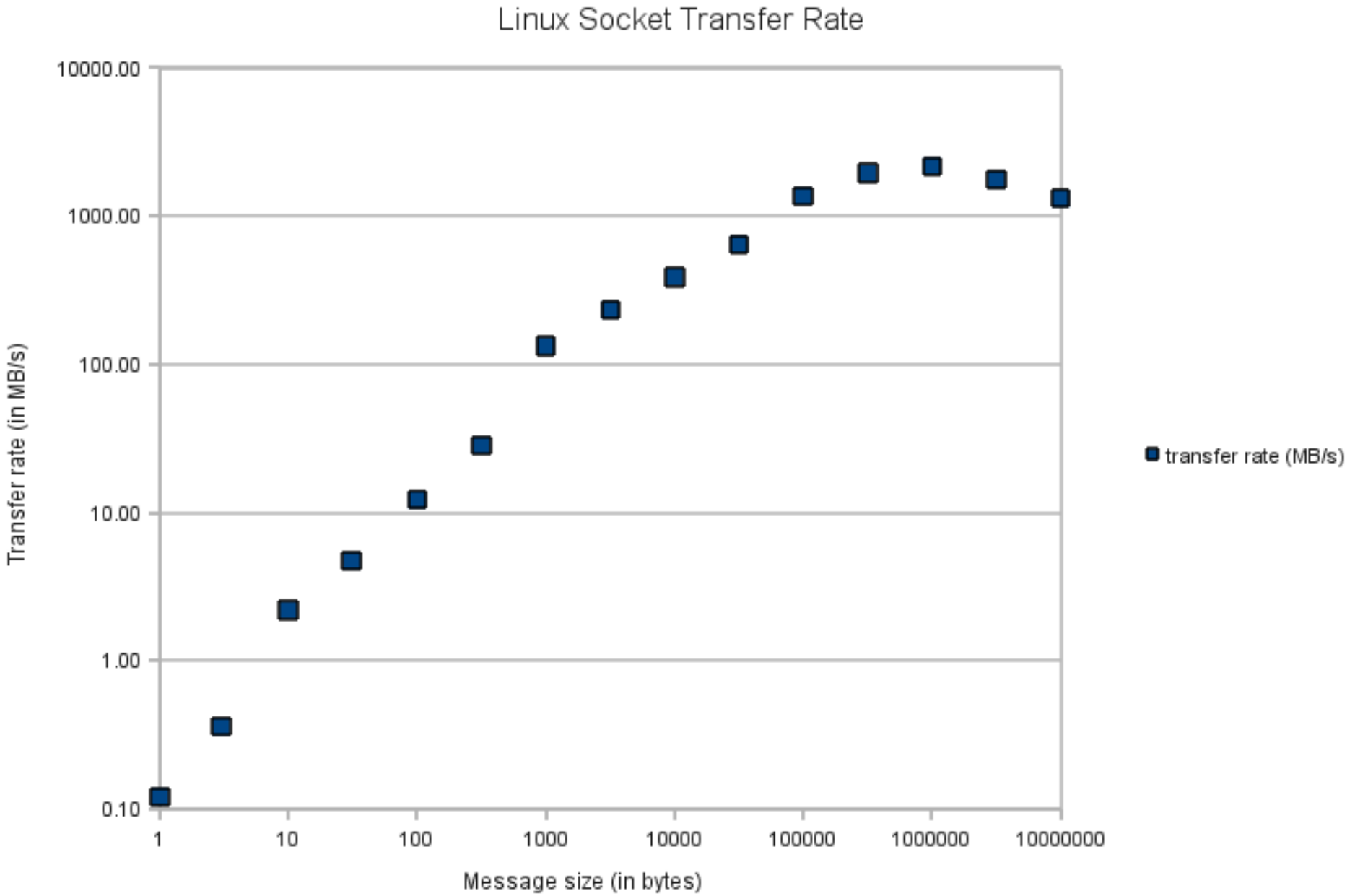
Linux Socket Transfer Rate
10000.00
1000.00
100.00
10.00
1.00
0.10
Transfer rate (in MB/s)
1
10
100
1000
10000
100000
1000000
10000000
Message size (in bytes)
transfer rate (MB/s)

For comparison

- Best D-Bus throughput: ~37MB/s (32KB messages)
- Best bare socket throughput: 2GB/s (1MB messages)
- Bare socket throughput with 32KB messages: 647MB/s

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…and furthermore

- Best D-Bus throughput: ~37MB/s (32KB messages)
- My desktop’s mediocre hard disk writes at 34MB/s and reads at 40MB/s

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U+1F63E POUTING CAT FACE

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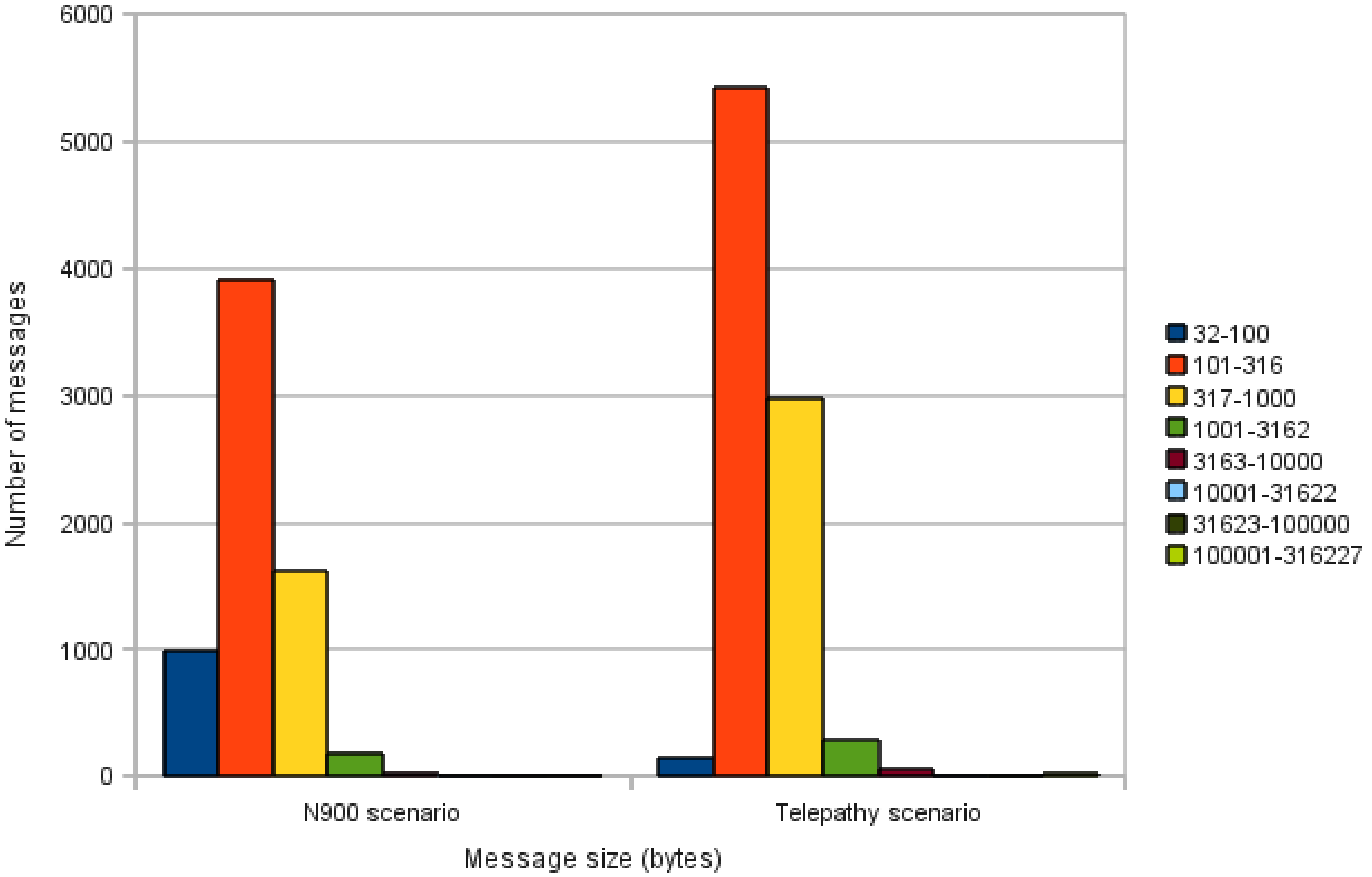
6000
5000
4000
3000
2000
1000
0
Number of messages
N900 scenario
Telepathy scenario
Message size (bytes)
32-100
101-316
317-1000
1001-3162
3163-10000
10001-31622
31623-100000
100001-316227

Copies and validations

- Sender marshals message
- Sender writes message to socket
- Daemon reads message from socket
- Daemon validates message
- Daemon writes message to *r* sockets
- *r* recipients read the message
- *r* recipients validate the message
- $4 + 2r$ copies, $1 + 2r$ validations

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@1990sLinuxUser

“AFAICT dbus is just a replacement for a directory tree with unix sockets under /tmp. Either is equally functional.”

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What does D-Bus give us?

- Flexible, widely-supported serialization format
- Name service
- Broadcast notifications
- Causal-order delivery among n processes
- Authentication and security policies
- Service activation
- De-facto standard desktop IPC

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What does D-Bus give us?

- Flexible, widely-supported serialization format

- Name service
- Broadcast notifications
- Causal-order delivery among n processes
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- De-facto standard desktop IPC

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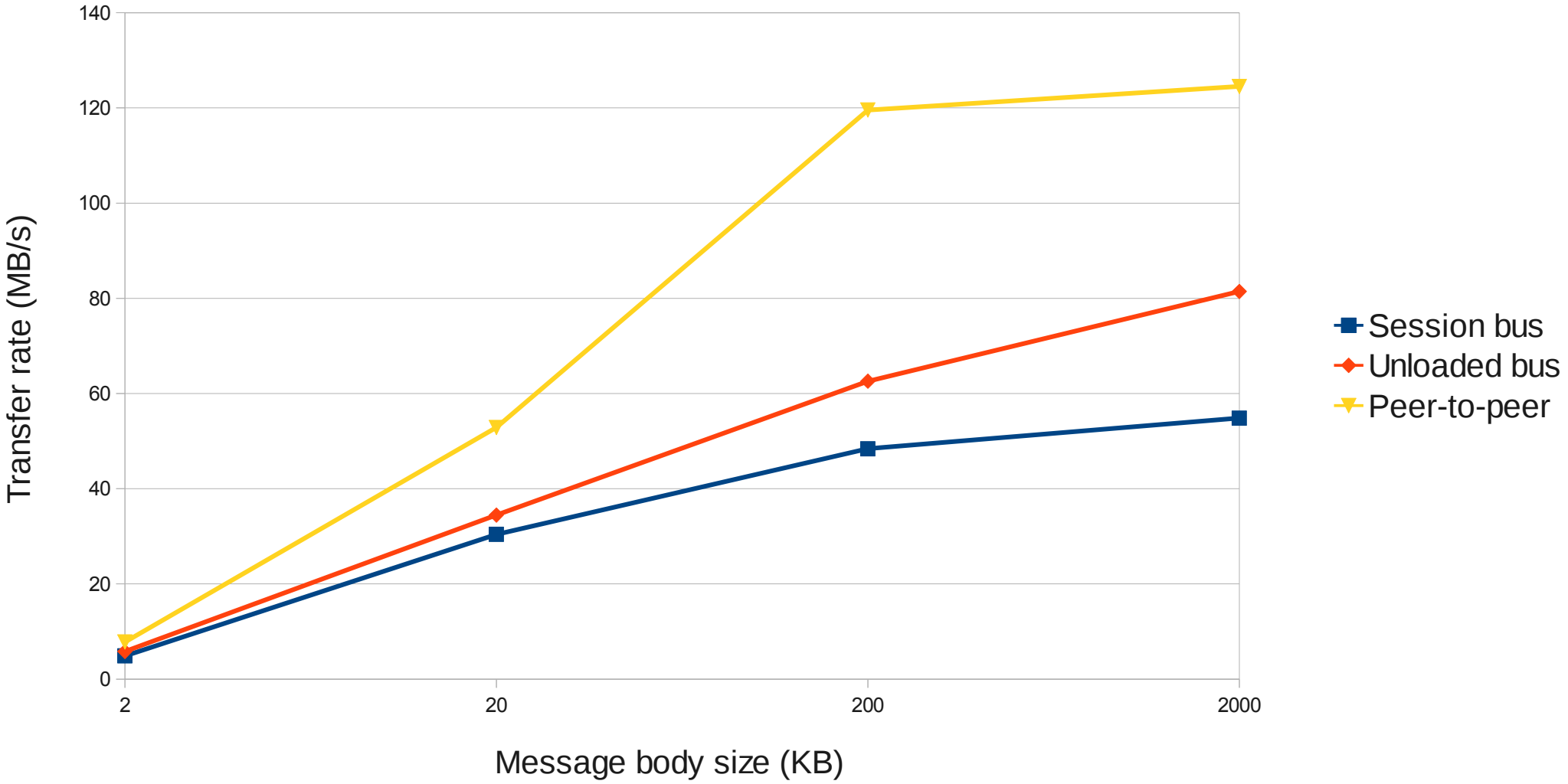
5000 method calls



How about epoll?

50000 ping-pongs on…	an empty bus	a bus with standard services, all idle
D-Bus 1.4 using poll	0:54	1:45
Branch using epoll	0:56	0:55

(The fine work of Simon McVittie.)

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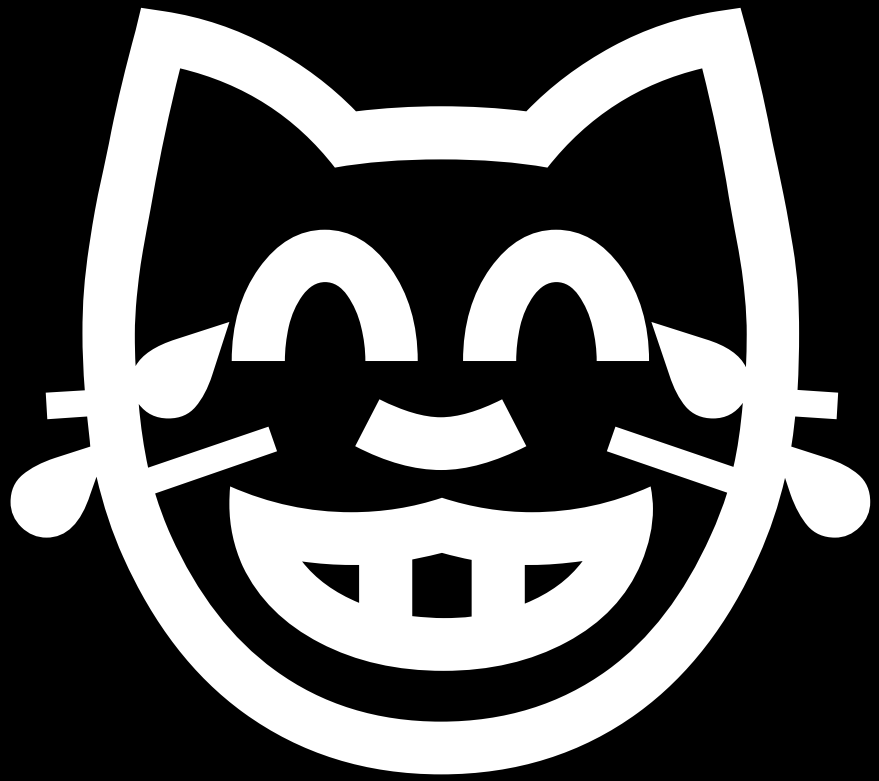
CAT FACE WITH TEARS OF JOY



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Revenge of the context switch

- A service emits 10 signals in immediate succession
- 10 other services have match rules matching them

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First message

- One context switch from sender to D-Bus daemon;
- Daemon writes the message into 10 sockets;
- A context switch to each recipient, in turn;
- One final switch back to the sender.
- Total: 12

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Subsequent messages

- One context switch from sender to D-Bus daemon;
- Daemon writes the message into one socket; gets descheduled;
- That recipient reads the message; daemon gets rescheduled;
- Repeat nine times;
- One final switch back to the sender.
- Total: 22

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Raise the daemon's priority?

- Can o' priority inversion worms!
- (But makes this case twice as fast.)

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Self-promotion time!

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Bustle now uses pcap files

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Bustle now uses pcap files

- A big stream of eavesdropped messages…
- …plus ListNames() and a bunch of GetNameOwners() to make the logs more usable.
- Possibly inaccurate timestamps.
- Service activation time invisible.
- Good enough for now!

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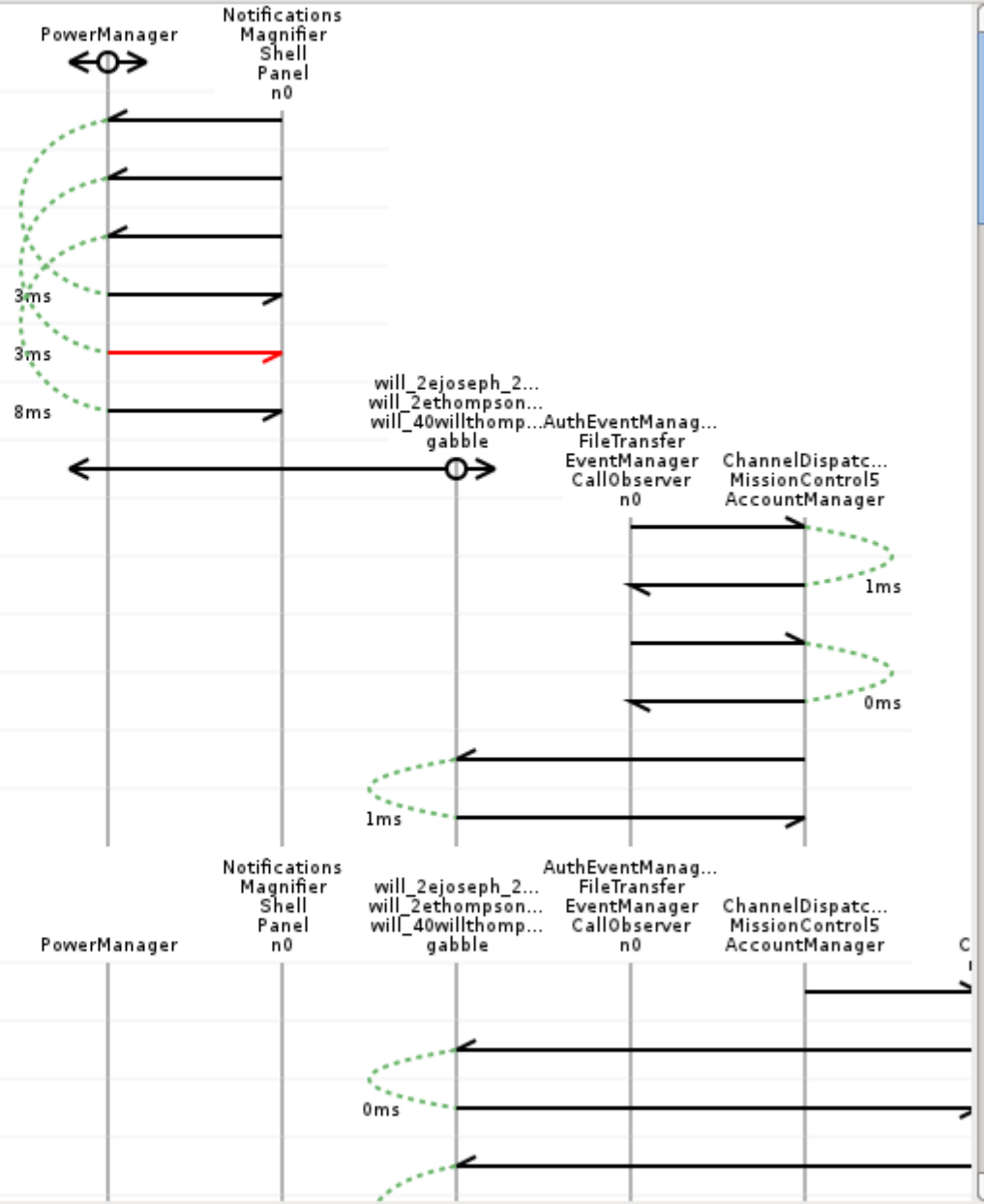
Some Telepathy stuff — Bustle

File View Help



611ms **/org/gnome/PowerManager**
org.gnome.PowerManager.**Changed**

613ms **/org/gnome/PowerManager**
org.freedesktop.DBus.Properties.**Get**

614ms **/org/gnome/PowerManager**
org.gnome.PowerManager.**GetPrimaryDevice**

614ms **/org/gnome/PowerManager**
org.gnome.PowerManager.**GetDevices**

616ms /org/gnome/PowerManager
*org.freedesktop.DBus.Properties.**Get***

617ms /org/gnome/PowerManager
*org.gnome.PowerManager.**GetPrimaryDevice***

623ms /org/gnome/PowerManager
*org.gnome.PowerManager.**GetDevices***

977ms **...n/gabble/jabber/will_2ethompson_40collabora_2eco_2euk_2fQueeg**
...nection.Interface.ContactCapabilities.**ContactCapabilitiesChanged**

2986ms **/org/freedesktop/Telepathy/ChannelDispatcher**
org.freedesktop.Telepathy.ChannelDispatcher.**EnsureChannel**

2988ms /org/freedesktop/Telepathy/ChannelDispatcher
*org.freedesktop.Telepathy.ChannelDispatcher.**EnsureChannel***

2993ms **/com/nokia/MissionControl/requests/r18**
org.freedesktop.Telepathy.ChannelRequest.**Proceed**

2994ms /com/nokia/MissionControl/requests/r18
*org.freedesktop.Telepathy.ChannelRequest.**Proceed***

2994ms **...n/gabble/jabber/will_2ethompson_40collabora_2eco_2euk_2fQueeg**
...reedesktop.Telepathy.Connection.Interface.Requests.**EnsureChannel**

2996ms ...on/gabble/jabber/will_2ethompson_40collabora_2eco_2euk_2fQueeg
*...reedesktop.Telepathy.Connection.Interface.Requests.**EnsureChannel***

2997ms **/org/freedesktop/Telepathy/Client/Empathy/Chat**
org.freedesktop.Telepathy.Client.Handler.**HandleChannels**

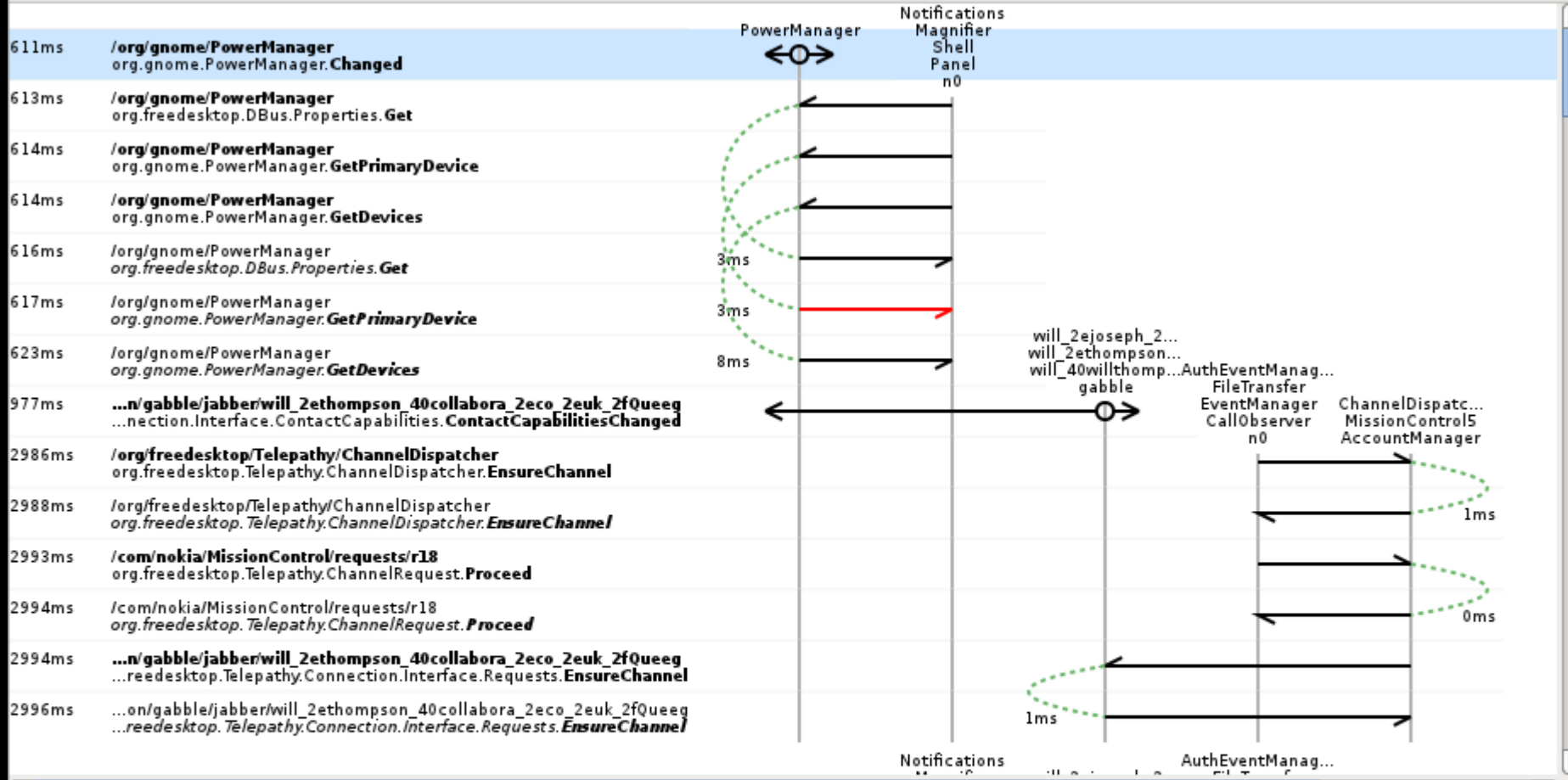
2998ms **...ber/will_2ethompson_40collabora_2eco_2euk_2fQueeg/ImChannel2**
org.freedesktop.Telepathy.Channel.**GetInterfaces**

2999ms ...ber/will_2ethompson_40collabora_2eco_2euk_2fQueeg/ImChannel2
*org.freedesktop.Telepathy.Channel.**GetInterfaces***

3000ms **...ber/will_2ethompson_40collabora_2eco_2euk_2fQueeg/ImChannel2**
org.freedesktop.DBus.Properties.**Get**

Some Telepathy stuff — Bustle

File View Help



Signal

Path: /org/gnome/PowerManager

Member: org.gnome.PowerManager.**Changed**

Arguments:

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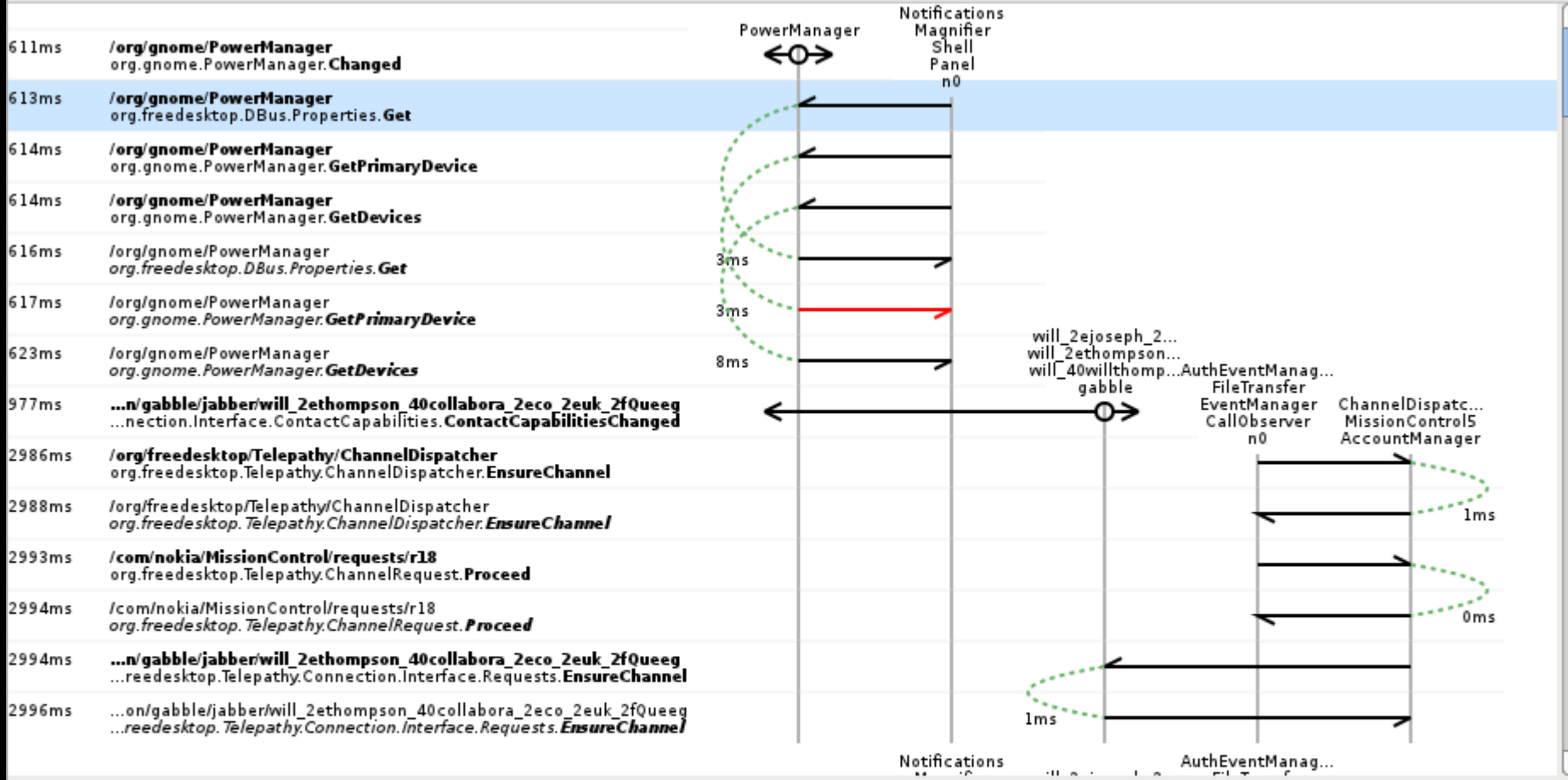
File View Help



Method call

Path: /org/gnome/PowerManager

Member: org.freedesktop.DBus.Properties.**Get**

Arguments:
- "s" "org.gnome.PowerManager"
- "s" "Icon"

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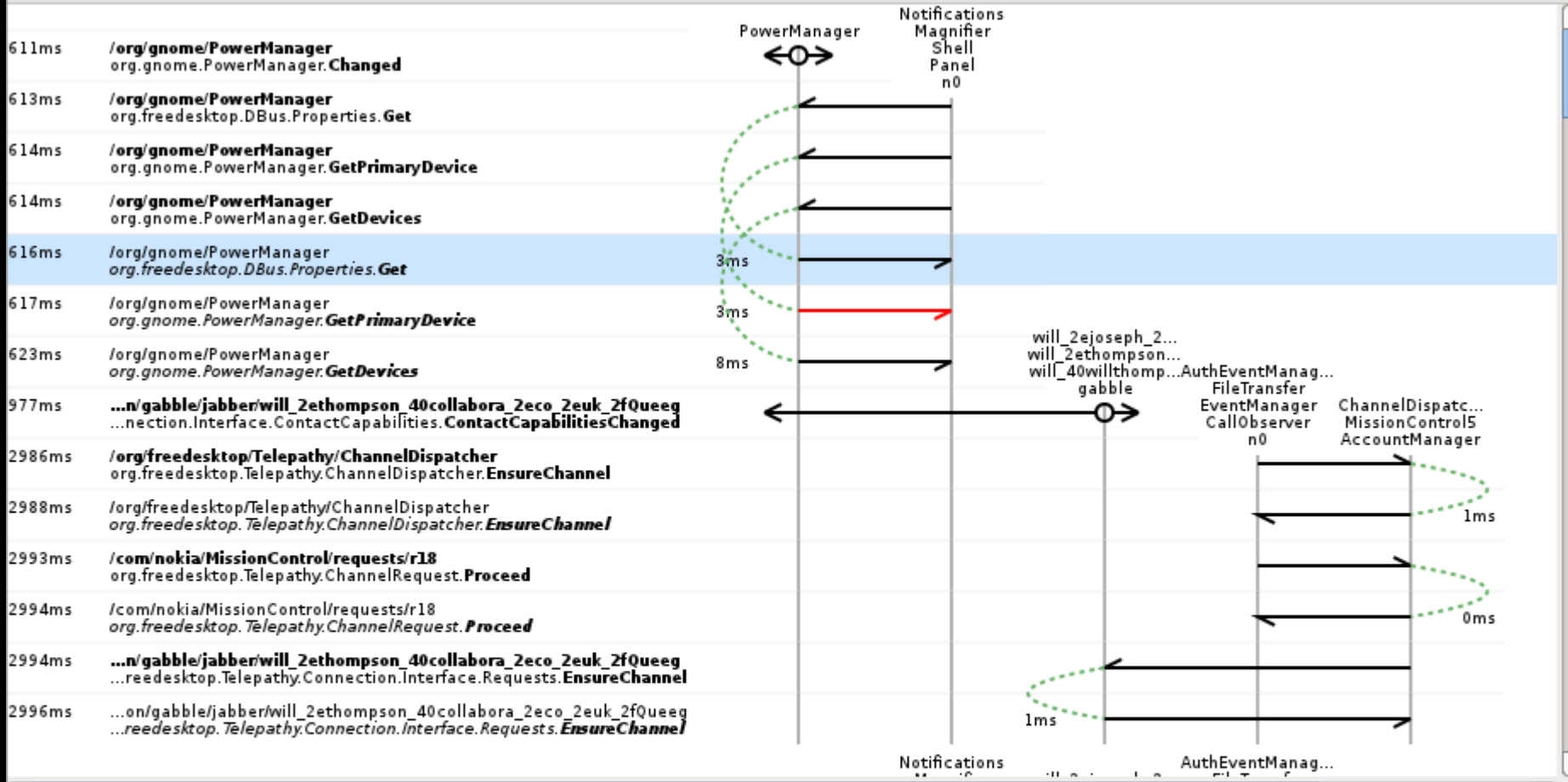
File View Help

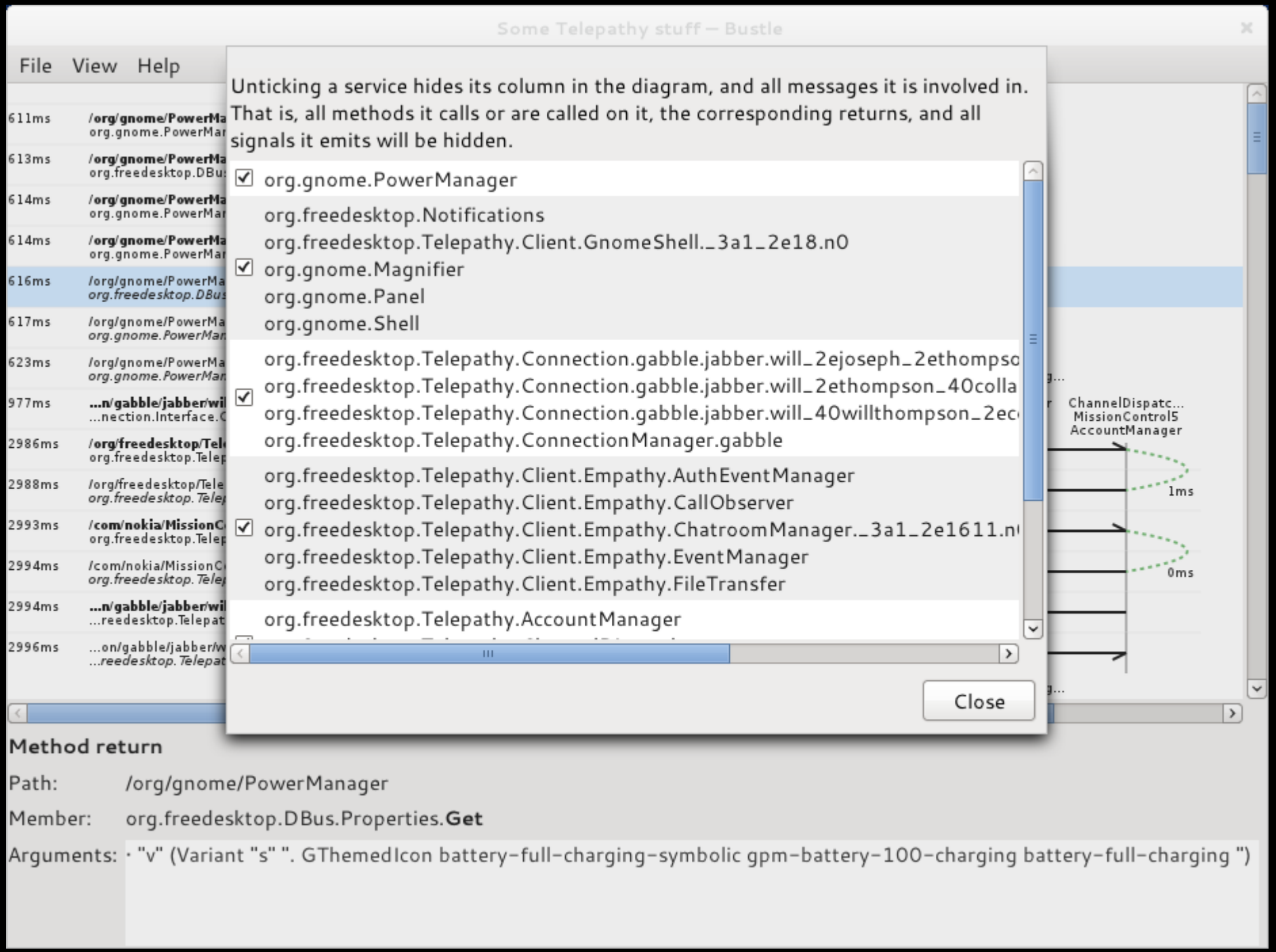


Method return

Path: /org/gnome/PowerManager

Member: org.freedesktop.DBus.Properties.**Get**

Arguments: · "v" (Variant "s" ". GThemedIcon battery-full-charging-symbolic gpm-battery-100-charging battery-full-charging ")


Some Telepathy stuff — Bustle
File View Help
Unticking a service hides its column in the diagram, and all messages it is involved in. That is, all methods it calls or are called on it, the corresponding returns, and all signals it emits will be hidden.
org.gnome.PowerManager
org.freedesktop.Notifications
org.freedesktop.Telepathy.Client.GnomeShell._3a1_2e18.n0
org.gnome.Magnifier
org.gnome.Panel
org.gnome.Shell
org.freedesktop.Telepathy.Connection.gabble.jabber.will_2ejoseph_2ethompso
org.freedesktop.Telepathy.Connection.gabble.jabber.will_2ethompson_40colla
org.freedesktop.Telepathy.Connection.gabble.jabber.will_40willthompson_2ec
org.freedesktop.Telepathy.ConnectionManager.gabble
org.freedesktop.Telepathy.Client.Empathy.AuthEventManager
org.freedesktop.Telepathy.Client.Empathy.CallObserver
org.freedesktop.Telepathy.Client.Empathy.ChatroomManager._3a1_2e1611.n
org.freedesktop.Telepathy.Client.Empathy.EventManager
org.freedesktop.Telepathy.Client.Empathy.FileTransfer
org.freedesktop.Telepathy.AccountManager
Close
ChannelDispatc...
MissionControl5
AccountManager
1ms
0ms
Method return
Path: /org/gnome/PowerManager
Member: org.freedesktop.DBus.Properties.Get
Arguments: · "v" (Variant "s" ". GThemedIcon battery-full-charging-symbolic gpm-battery-100-charging battery-full-charging ")

Some Telepathy stuff — Bustle

File View Help

977ms	**...n/gabble/jabber/will_2ethompson_40collabora_2eco_2euk_2fQueeg** ...nection.Interface.ContactCapabilities.**ContactCapabilitiesChanged**
2986ms	**/org/freedesktop/Telepathy/ChannelDispatcher** org.freedesktop.Telepathy.ChannelDispatcher.**EnsureChannel**
2988ms	/org/freedesktop/Telepathy/ChannelDispatcher *org.freedesktop.Telepathy.ChannelDispatcher.**EnsureChannel***
2993ms	**/com/nokia/MissionControl/requests/r18** org.freedesktop.Telepathy.ChannelRequest.**Proceed**
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2994ms	**...n/gabble/jabber/will_2ethompson_40collabora_2eco_2euk_2fQueeg** ...reedesktop.Telepathy.Connection.Interface.Requests.**EnsureChannel**
2996ms	...on/gabble/jabber/will_2ethompson_40collabora_2eco_2euk_2fQueeg *...reedesktop.Telepathy.Connection.Interface.Requests.**EnsureChannel***
2997ms	**/org/freedesktop/Telepathy/Client/Empathy/Chat** org.freedesktop.Telepathy.Client.Handler.**HandleChannels**
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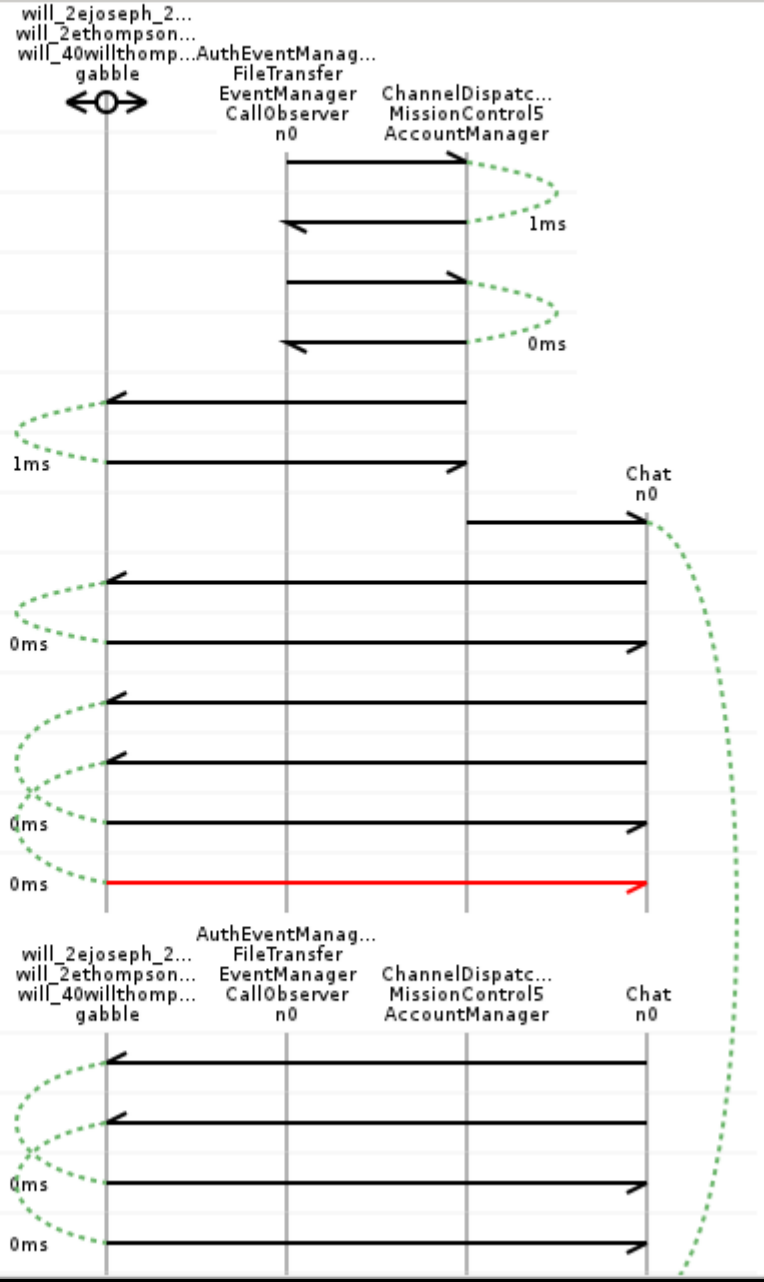
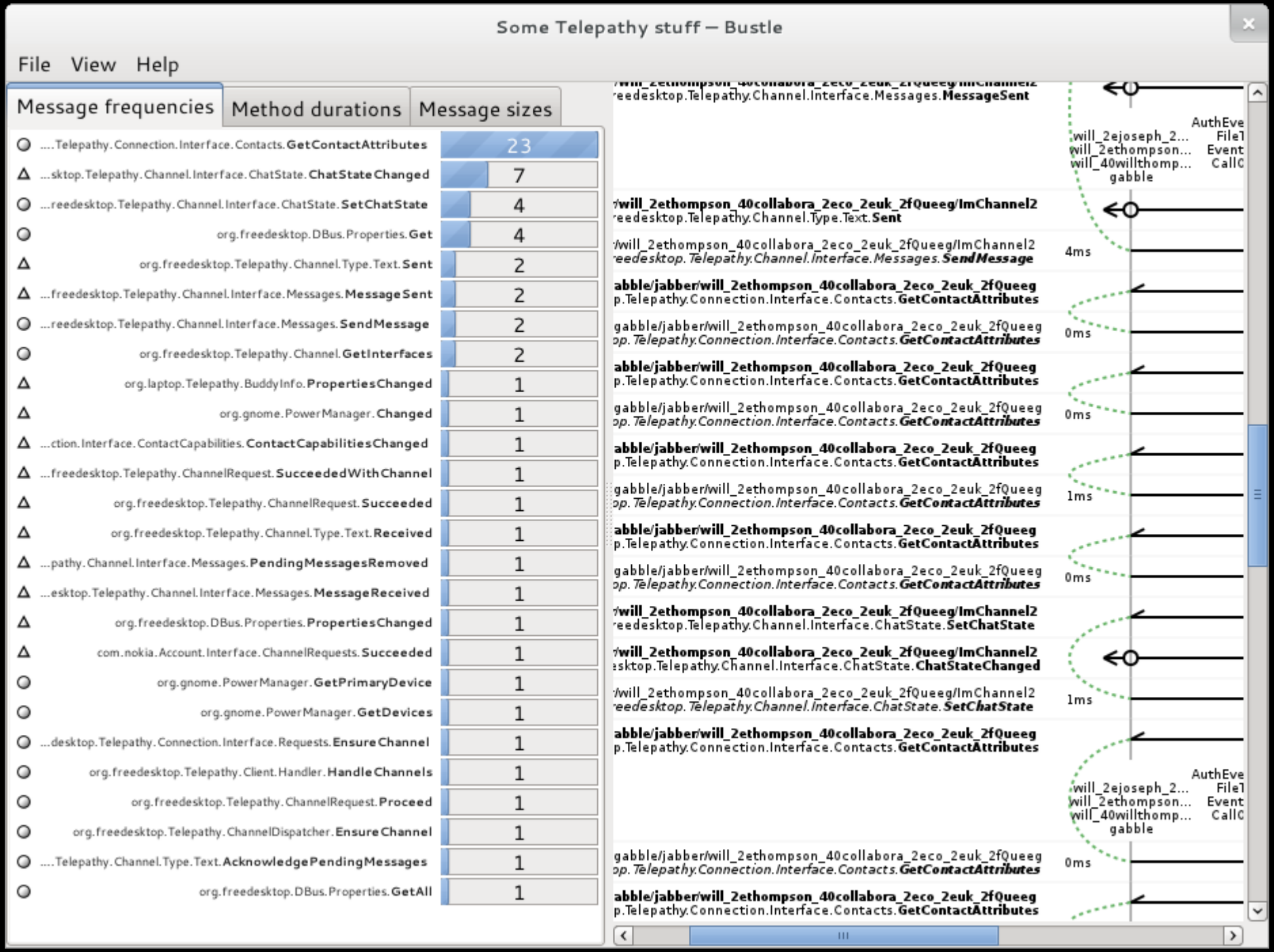
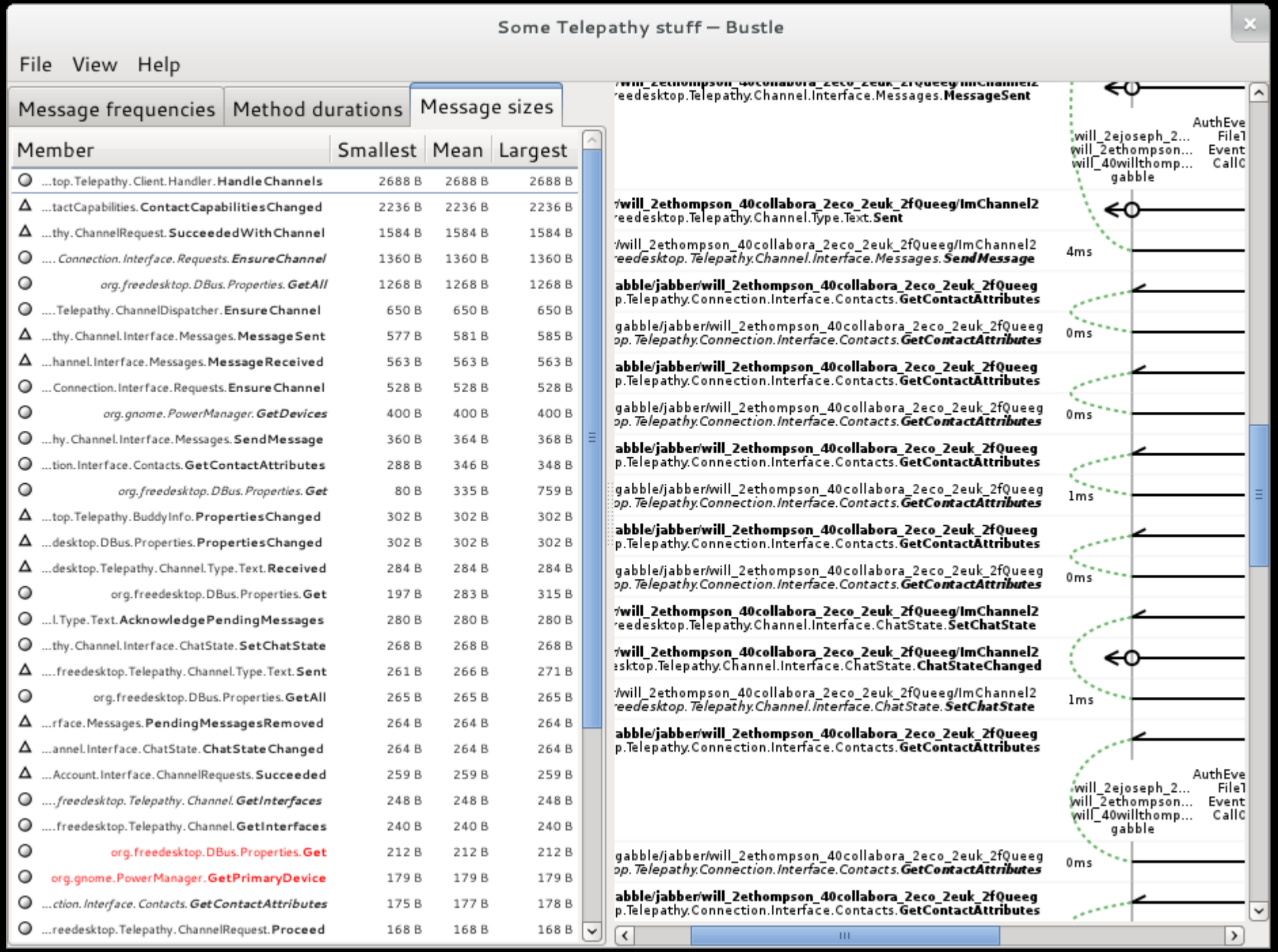
2999ms	...ber/will_2ethompson_40collabora_2eco_2euk_2fQueeg/ImChannel2 *org.freedesktop.Telepathy.Channel.**GetInterfaces***
3000ms	**...ber/will_2ethompson_40collabora_2eco_2euk_2fQueeg/ImChannel2** org.freedesktop.DBus.Properties.**Get**
3001ms	**...ber/will_2ethompson_40collabora_2eco_2euk_2fQueeg/ImChannel2** org.freedesktop.DBus.Properties.**Get**
3001ms	...ber/will_2ethompson_40collabora_2eco_2euk_2fQueeg/ImChannel2 *org.freedesktop.DBus.Properties.**Get***
3001ms	...ber/will_2ethompson_40collabora_2eco_2euk_2fQueeg/ImChannel2 *org.freedesktop.DBus.Properties.**Get***
3002ms	**...n/gabble/jabber/will_2ethompson_40collabora_2eco_2euk_2fQueeg** ...ktop.Telepathy.Connection.Interface.Contacts.**GetContactAttributes**
3002ms	**...n/gabble/jabber/will_2ethompson_40collabora_2eco_2euk_2fQueeg** ...ktop.Telepathy.Connection.Interface.Contacts.**GetContactAttributes**
3003ms	...on/gabble/jabber/will_2ethompson_40collabora_2eco_2euk_2fQueeg *...sktop.Telepathy.Connection.Interface.Contacts.**GetContactAttributes***
3003ms	...on/gabble/jabber/will_2ethompson_40collabora_2eco_2euk_2fQueeg *...sktop.Telepathy.Connection.Interface.Contacts.**GetContactAttributes***




Some Telepathy stuff — Bustle
File View Help
Message frequencies
Method durations
Message sizes
....Telepathy.Connection.Interface.Contacts.GetContactAttributes 23
...sktop.Telepathy.Channel.Interface.ChatState.ChatStateChanged 7
...reedesktop.Telepathy.Channel.Interface.ChatState.SetChatState 4
org.freedesktop.DBus.Properties.Get 4
org.freedesktop.Telepathy.Channel.Type.Text.Sent 2
...freedesktop.Telepathy.Channel.Interface.Messages.MessageSent 2
...reedesktop.Telepathy.Channel.Interface.Messages.SendMessage 2
org.freedesktop.Telepathy.Channel.GetInterfaces 2
org.laptop.Telepathy.BuddyInfo.PropertiesChanged 1
org.gnome.PowerManager.Changed 1
...ction.Interface.ContactCapabilities.ContactCapabilitiesChanged 1
...freedesktop.Telepathy.ChannelRequest.SucceededWithChannel 1
org.freedesktop.Telepathy.ChannelRequest.Succeeded 1
org.freedesktop.Telepathy.Channel.Type.Text.Received 1
...pathy.Channel.Interface.Messages.PendingMessagesRemoved 1
...esktop.Telepathy.Channel.Interface.Messages.MessageReceived 1
org.freedesktop.DBus.Properties.PropertiesChanged 1
com.nokia.Account.Interface.ChannelRequests.Succeeded 1
org.gnome.PowerManager.GetPrimaryDevice 1
org.gnome.PowerManager.GetDevices 1
...desktop.Telepathy.Connection.Interface.Requests.EnsureChannel 1
org.freedesktop.Telepathy.Client.Handler.HandleChannels 1
org.freedesktop.Telepathy.ChannelRequest.Proceed 1
org.freedesktop.Telepathy.ChannelDispatcher.EnsureChannel 1
....Telepathy.Channel.Type.Text.AcknowledgePendingMessages 1
org.freedesktop.DBus.Properties.GetAll 1
reedesktop.Telepathy.Channel.Interface.Messages.MessageSent
AuthEve
will_2ejoseph_2... File1
will_2ethompson... Event
will_40willthomp... Call0
gabble
/will_2ethompson_40collabora_2eco_2euk_2fQueeg/ImChannel2
reedesktop.Telepathy.Channel.Type.Text.Sent
/will_2ethompson_40collabora_2eco_2euk_2fQueeg/ImChannel2
reedesktop.Telepathy.Channel.Interface.Messages.SendMessage
4ms
abble/jabber/will_2ethompson_40collabora_2eco_2euk_2fQueeg
p.Telepathy.Connection.Interface.Contacts.GetContactAttributes
gabble/jabber/will_2ethompson_40collabora_2eco_2euk_2fQueeg
op.Telepathy.Connection.Interface.Contacts.GetContactAttributes
0ms
abble/jabber/will_2ethompson_40collabora_2eco_2euk_2fQueeg
p.Telepathy.Connection.Interface.Contacts.GetContactAttributes
gabble/jabber/will_2ethompson_40collabora_2eco_2euk_2fQueeg
op.Telepathy.Connection.Interface.Contacts.GetContactAttributes
0ms
abble/jabber/will_2ethompson_40collabora_2eco_2euk_2fQueeg
p.Telepathy.Connection.Interface.Contacts.GetContactAttributes
gabble/jabber/will_2ethompson_40collabora_2eco_2euk_2fQueeg
op.Telepathy.Connection.Interface.Contacts.GetContactAttributes
1ms
abble/jabber/will_2ethompson_40collabora_2eco_2euk_2fQueeg
p.Telepathy.Connection.Interface.Contacts.GetContactAttributes
gabble/jabber/will_2ethompson_40collabora_2eco_2euk_2fQueeg
op.Telepathy.Connection.Interface.Contacts.GetContactAttributes
0ms
/will_2ethompson_40collabora_2eco_2euk_2fQueeg/ImChannel2
reedesktop.Telepathy.Channel.Interface.ChatState.SetChatState
/will_2ethompson_40collabora_2eco_2euk_2fQueeg/ImChannel2
esktop.Telepathy.Channel.Interface.ChatState.ChatStateChanged
/will_2ethompson_40collabora_2eco_2euk_2fQueeg/ImChannel2
reedesktop.Telepathy.Channel.Interface.ChatState.SetChatState
1ms
abble/jabber/will_2ethompson_40collabora_2eco_2euk_2fQueeg
p.Telepathy.Connection.Interface.Contacts.GetContactAttributes
AuthEve
will_2ejoseph_2... File1
will_2ethompson... Event
will_40willthomp... Call0
gabble
gabble/jabber/will_2ethompson_40collabora_2eco_2euk_2fQueeg
op.Telepathy.Connection.Interface.Contacts.GetContactAttributes
0ms
abble/jabber/will_2ethompson_40collabora_2eco_2euk_2fQueeg
p.Telepathy.Connection.Interface.Contacts.GetContactAttributes


Some Telepathy stuff — Bustle
File View Help
Message frequencies
Method durations
Message sizes
Member
Smallest
Mean
Largest
...top.Telepathy.Client.Handler.HandleChannels 2688 B 2688 B 2688 B
...tactCapabilities.ContactCapabilitiesChanged 2236 B 2236 B 2236 B
...thy.ChannelRequest.SucceededWithChannel 1584 B 1584 B 1584 B
....Connection.Interface.Requests.EnsureChannel 1360 B 1360 B 1360 B
org.freedesktop.DBus.Properties.GetAll 1268 B 1268 B 1268 B
....Telepathy.ChannelDispatcher.EnsureChannel 650 B 650 B 650 B
...thy.Channel.Interface.Messages.MessageSent 577 B 581 B 585 B
...hannel.Interface.Messages.MessageReceived 563 B 563 B 563 B
...Connection.Interface.Requests.EnsureChannel 528 B 528 B 528 B
org.gnome.PowerManager.GetDevices 400 B 400 B 400 B
...hy.Channel.Interface.Messages.SendMessage 360 B 364 B 368 B
...tion.Interface.Contacts.GetContactAttributes 288 B 346 B 348 B
org.freedesktop.DBus.Properties.Get 80 B 335 B 759 B
...top.Telepathy.BuddyInfo.PropertiesChanged 302 B 302 B 302 B
...desktop.DBus.Properties.PropertiesChanged 302 B 302 B 302 B
...desktop.Telepathy.Channel.Type.Text.Received 284 B 284 B 284 B
org.freedesktop.DBus.Properties.Get 197 B 283 B 315 B
...l.Type.Text.AcknowledgePendingMessages 280 B 280 B 280 B
...thy.Channel.Interface.ChatState.SetChatState 268 B 268 B 268 B
....freedesktop.Telepathy.Channel.Type.Text.Sent 261 B 266 B 271 B
org.freedesktop.DBus.Properties.GetAll 265 B 265 B 265 B
...rface.Messages.PendingMessagesRemoved 264 B 264 B 264 B
...annel.Interface.ChatState.ChatStateChanged 264 B 264 B 264 B
...Account.Interface.ChannelRequests.Succeeded 259 B 259 B 259 B
....freedesktop.Telepathy.Channel.GetInterfaces 248 B 248 B 248 B
....freedesktop.Telepathy.Channel.GetInterfaces 240 B 240 B 240 B
org.freedesktop.DBus.Properties.Get 212 B 212 B 212 B
org.gnome.PowerManager.GetPrimaryDevice 179 B 179 B 179 B
...ction.Interface.Contacts.GetContactAttributes 175 B 177 B 178 B
...reedesktop.Telepathy.ChannelRequest.Proceed 168 B 168 B 168 B
reedesktop.Telepathy.Channel.Interface.Messages.MessageSent
AuthEve
will_2ejoseph_2... File1
will_2ethompson... Event
will_40willthomp... Call0
gabble
/will_2ethompson_40collabora_2eco_2euk_2fQueeg/ImChannel2
reedesktop.Telepathy.Channel.Type.Text.Sent
/will_2ethompson_40collabora_2eco_2euk_2fQueeg/ImChannel2
reedesktop.Telepathy.Channel.Interface.Messages.SendMessage
4ms
abble/jabber/will_2ethompson_40collabora_2eco_2euk_2fQueeg
p.Telepathy.Connection.Interface.Contacts.GetContactAttributes
gabble/jabber/will_2ethompson_40collabora_2eco_2euk_2fQueeg
op.Telepathy.Connection.Interface.Contacts.GetContactAttributes
0ms
abble/jabber/will_2ethompson_40collabora_2eco_2euk_2fQueeg
p.Telepathy.Connection.Interface.Contacts.GetContactAttributes
gabble/jabber/will_2ethompson_40collabora_2eco_2euk_2fQueeg
op.Telepathy.Connection.Interface.Contacts.GetContactAttributes
0ms
abble/jabber/will_2ethompson_40collabora_2eco_2euk_2fQueeg
p.Telepathy.Connection.Interface.Contacts.GetContactAttributes
gabble/jabber/will_2ethompson_40collabora_2eco_2euk_2fQueeg
op.Telepathy.Connection.Interface.Contacts.GetContactAttributes
1ms
abble/jabber/will_2ethompson_40collabora_2eco_2euk_2fQueeg
p.Telepathy.Connection.Interface.Contacts.GetContactAttributes
gabble/jabber/will_2ethompson_40collabora_2eco_2euk_2fQueeg
op.Telepathy.Connection.Interface.Contacts.GetContactAttributes
0ms
/will_2ethompson_40collabora_2eco_2euk_2fQueeg/ImChannel2
reedesktop.Telepathy.Channel.Interface.ChatState.SetChatState
/will_2ethompson_40collabora_2eco_2euk_2fQueeg/ImChannel2
esktop.Telepathy.Channel.Interface.ChatState.ChatStateChanged
/will_2ethompson_40collabora_2eco_2euk_2fQueeg/ImChannel2
reedesktop.Telepathy.Channel.Interface.ChatState.SetChatState
1ms
abble/jabber/will_2ethompson_40collabora_2eco_2euk_2fQueeg
p.Telepathy.Connection.Interface.Contacts.GetContactAttributes
AuthEve
will_2ejoseph_2... File1
will_2ethompson... Event
will_40willthomp... Call0
gabble
gabble/jabber/will_2ethompson_40collabora_2eco_2euk_2fQueeg
op.Telepathy.Connection.Interface.Contacts.GetContactAttributes
0ms
abble/jabber/will_2ethompson_40collabora_2eco_2euk_2fQueeg
p.Telepathy.Connection.Interface.Contacts.GetContactAttributes

Coming soon to a distro near you!

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BOF “On D-Bus”

Wednesday, 17:00, room 1.401/2

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Any questions?

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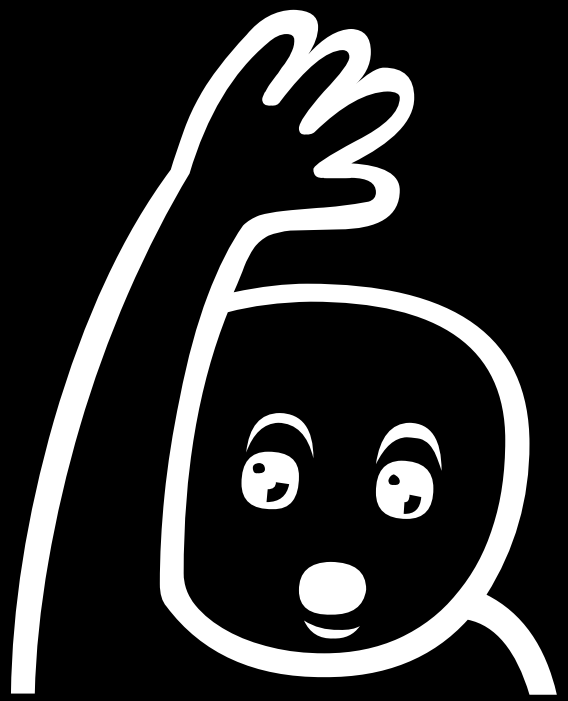
http://www.flickr.com/photos/pelhamgrenville/5931208532/



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