Selective choice 'feathering' with XCHANs

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http://www.teigfam.net/oyvind/pub/pub_details.html#FEATHERING
http://wotug.org/paperdb/

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«Feathering»

- Semantics of a verb *to uninterest*
- Avoiding the uninteresting
- Taking *uninterestedness* seriously

(2012)

Background of the XCHAN paper (2012)

- From discussions at Autronica
- Not implemented
- Goal for me was to try to merge asynchronous and synchronous "camps"..
- ..to arrive at a common methodology
- To make it "easier" to comply to SIL (Safety Integrity Level) approving according to IEC 61508 standard for safety critical systems
- Assumed implementation loosely based on implemented ideas with EGGTIMER and REPTIMER. ([9] CPA-2009 paper)

XCHAN =

x-channel + CHAN

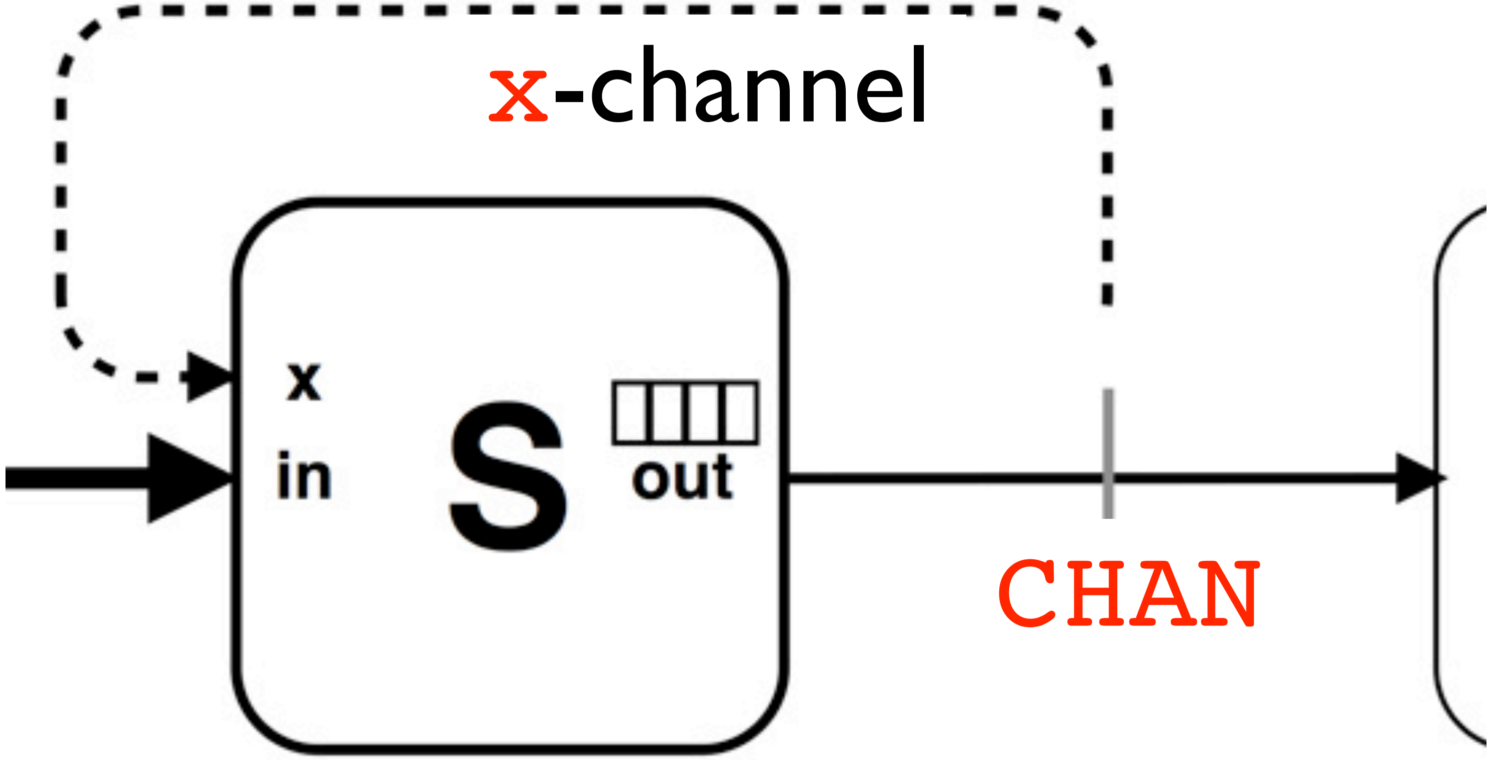


Figure 1. **XCHAN** is **CHAN** plus x-channel

This paper uses

«classic»
solution (from 2012 **XCHAN** paper)

as opposed to occam-pi *model* of **XCHAN**(*)
«preconfirmed»

(*) Peter H. Welch. An occam Model of XCHANs, 2013.
https://www.cs.kent.ac.uk/research/groups/plas/wiki/An_occam_Model_of_XCHANs

```
XCHAN (...) OF BYTE my_xchan:
```

Sender is notified as to its success or "failure"

```
XCHAN (...) OF BYTE my_xchan:
```

Sender is notified as to its success on return of send:
- data moved to buffer
- data moved to receiver

```
XCHAN (...) OF BYTE my_xchan:
```

Sender is notified as to its "failure" on return of send:
- buffer full
- receiver not present

```
XCHAN (...) OF BYTE my_xchan:
```

Sender is notified as to its "failure" on return of send:

- buffer full
- receiver not present

It always returns!

If "failed" to send on XCHAN:

If "failed" to send on XCHAN:

"Not sent" is no fault!

If "failed" to send on XCHAN:

"Not sent" is no fault!

But a contract to send later

If not sent on XCHAN:

- listen to x-channel (in an ALT or select)
- resend old or fresher value when it arrives
- this send will always succeed

If not sent:

"channel-ready-channel"

- listen to x-channel (in an ALT or select)
- resend old or fresher value when it arrives
- this send will always succeed

If not sent:

- listen to x-channel (in an ALT or select)
- resend old or fresher value when it arrives
- this send will always succeed

This contract (design pattern) between sender and receiver must be adhered to

(2013)

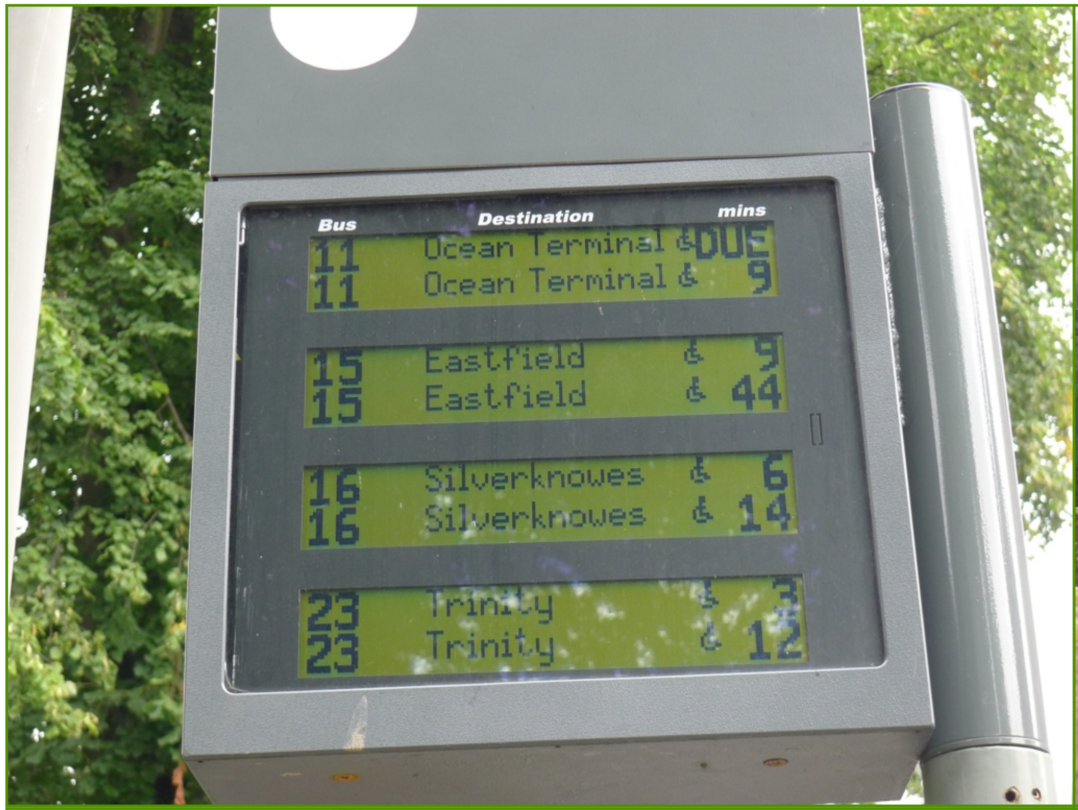
«Feathering»
Ripping a term

- «Turning an oar parallel to the water between pulls»
- But we can hear the oar whip the top of the small waves on its way saying "was there, but not interested"
- So we take the step to name barely touching the small waves as feathering
- And give feathering a new meaning

http://www.amazon.com/Sawyer-Feather-Laminated-Carbon-Touring/dp/B0083CUUHU

«Concurrent programs wait faster»

- Tony Hoare’s lecture from 2003
- Not waiting for a certain bus, but for correct destination..
- ..makes us «wait faster», but..
- XCHAN as a vehicle for a secondary problem not mentioned in Hoare’s lecture:


Bus
Destination
mins
11 Ocean Terminal DUE
11 Ocean Terminal 9
15 Eastfield 9
15 Eastfield 44
16 Silverknowes 6
16 Silverknowes 14
23 Trinity 3
23 Trinity 12

TICKETS ON SALE 19 AUGUST
DON'T HANG AROUND

TICKETS ON SALE 19 AUGUST
DON'T HANG AROUND
Lothian

Holycowthat'scheaproad

Also for non-interesting buses!

- What happens after the first possible bus has arrived is not treated here
- What happens with uninteresting buses while waiting, we have specifically said is not of interest - but..
- ..why do we still have to relate to these bus arrivals afterwards?

I said *not-interesting* buses!

- There is no way to avoid having to flush these messages!
- But we could have avoided sending them!

You're sitting on the first relevant bus, but its conductor requires you to pay for all the buses that stopped while you waited!

- Sending unnecessarily is as bad as paying unnecessarily
- This is state of the art, also for occam!
- Simply because a blocked sender
  has only one way to unblock: to get rid of its message

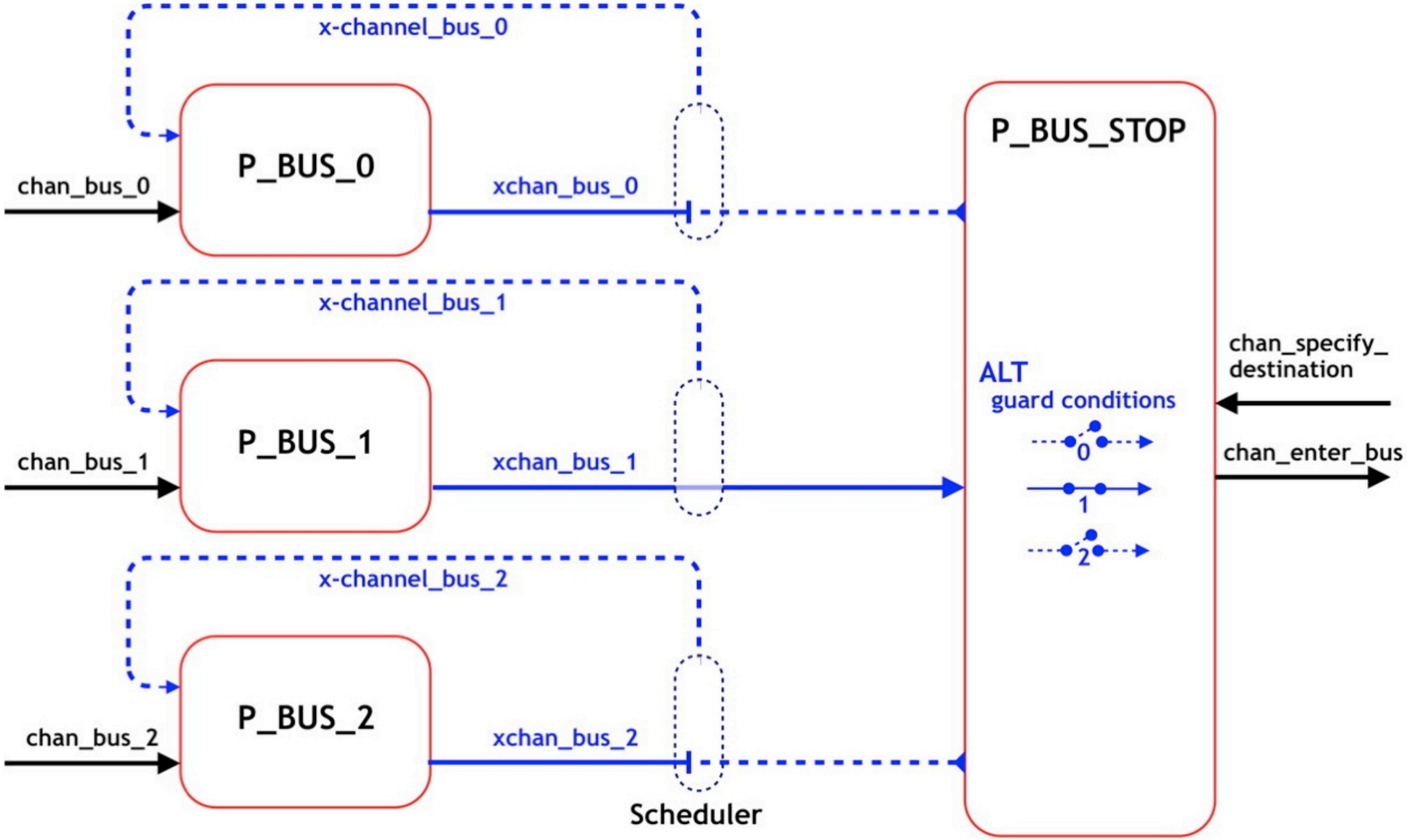


Figure 2. XCHAN (array of 3) and feathering, with only bus #1 as possible to ride

Suggestion 1-10

Feathering semantics (1/10)

1. Feathering semantics inherits XCHAN semantics

   a. Output and input constructs limitations (next page)

   b. This may not include buffered XCHAN: usability analysis needed

Feathering semantics

Where to use it

2. **Receiver** end of XCHAN in ALT,
   not single channel input.

   Sending end single channel output,
   not part of an ALT with output guards
   (XCHAN almost eq. to an output guard)

Feathering semantics

User control

3. Specified with a parameter in the XCHAN send call (not in examples here)

Feathering semantics

Already not interested

4. Feathered status call reply to a sender that is trying to send when a receiver is in an ALT and the requested channel has been tagged by the receiver as not-interesting (i.e. its pre-condition is FALSE)

Feathering semantics (5/10)

Becoming not interested

5. X-feathered status messaged response is sent to a sender on x-channel if it has been trying to send but got await_commit reply; when the receiver enters an ALT and the requested channel is being tagged as not-interesting

   a. Only if the ALT blocks - i.e. it is not immediately taken by another guard
   (channel, timeout or SKIP)

   b. None of the receivers will block indefinitely, commitment to listen on x-channel

Feathering semantics

Usage rule

6. Whenever a sender knows that a channel is feathered it shall obey the rule not to resend before an x-unfeathered message has been received on x-channel

Feathering semantics

Perhaps interested next time, so..

7. The x-unfeathered status is delivered to a feathered x-channel when the ALT is later on taken (by another guard) and ‘torn down’, in the same synchronous scheme as described above (5.a-b)

Feathering semantics

Only tell if it is in scope

8. The x-channel will only carry an x-unfeathered after a feathered situation

Feathering semantics

Standard CHAN semantics if sent on first trial

9. The x-channel will only carry x-feathered or x-committed after an await_commit status return on the initial sending call

Feathering semantics (last)

10. A receiver could possibly do a system call to learn if a message in fact did get rejected. This information could alternatively be delivered on an ”n-channel” that could be “parallel” with the XCHAN’s input on the receiver side. This probably is a complicating matter since type of channel is transparent on the receiver side. We will not discuss this here

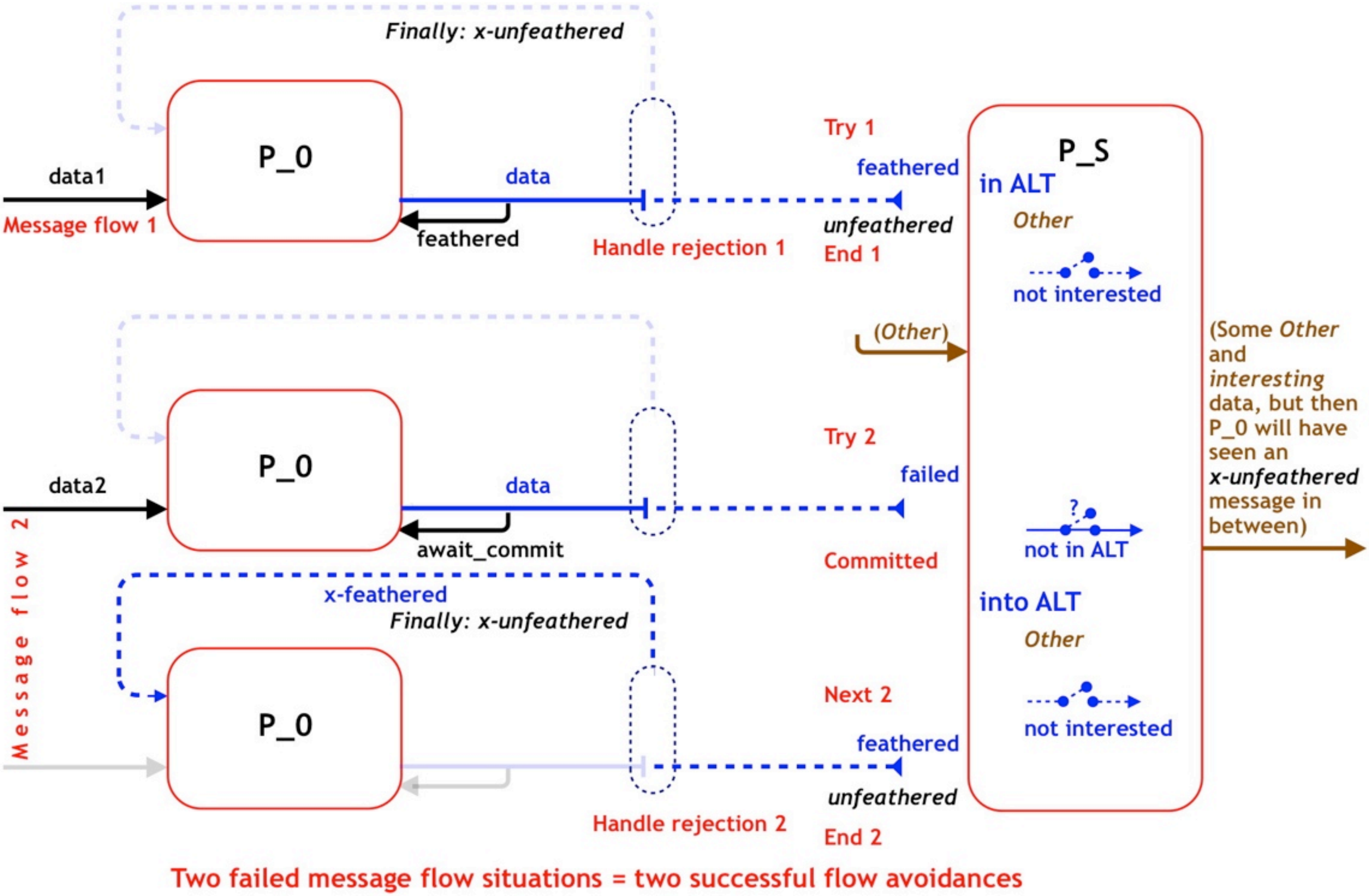


Figure 3. Two mind map scenarios that show message avoidance

An XCHAN standard solution (code from 2012 paper)
ANSI C and macros!

```
01 while (TRUE) {
02   ALT();
03     ALT_SIGNAL_CHAN_IN (XCHAN_READY);      // data-less
04     ALT_CHAN_IN (CHAN_DATA_IN, Value);
05?  ALT_END(); // Delivers ThisChannelId:
06
07   switch (ThisChannelId) {
08     case XCHAN_READY: {                   // sending will succeed
09!      CP->Sent_Out = CHAN_OUT (XCHAN_DATA_OUT,Value);
10     } break;
11     case CHAN_DATA_IN: {
12       if (!CP->Sent_Out) {
13         ...  handle overflow (decide what value(s) to discard)
14       }
15       else {                               // sending may succeed:
16!        CP->Sent_Out = CHAN_OUT (XCHAN_DATA_OUT,Value);
17       }
18     } break;
19     _DEFAULT_EXIT_VAL (ThisChannelId)
20   }
21 }
```

Listing 1. (2012) Overflow handling and output to buffered channels (ANSI C and macros)

An XCHAN feathering solution (code)

```
01 CP->Tag = READY; // READY,SUCCESS,AWAIT_READY,FEATHERED
02 while (TRUE) {
03   PRIALT();
04     ALT_CHAN_IN (X_CHANNEL,X_Tag); // X_COMMITTED,
05                                    // X_FEATHERED,X_UNFEATHERED
06     ALT_CHAN_IN (CHAN_DATA_IN,Value);
07?  ALT_END(); // Delivers ThisChannelId
08
09   switch (ThisChannelId) {
10     case X_CHANNEL: { // After CHAN_OUT ret AWAIT_READY or FEATHERED
11       if (X_Tag == X_FEATHERED) {
12         ...  handle not interested
13         CP->Tag = FEATHERED; // Stop
14       } else if (X_Tag == X_COMMITTED){
15!        CHAN_OUT (XCHAN_DATA_OUT,Value,NIL); // Will succeed
16         CP->Tag = READY; // Finished
17       } else { // == X_UNFEATHERED
18         CP->Tag = READY; // Finished
19       }
20     } break;
21     case CHAN_DATA_IN: {
22       if ((CP->Tag == AWAIT_READY) or (CP->Tag == FEATHERED)) {
23         ...  handle overflow (decide what value(s) to discard)
24       } else { // CP->Tag = READY
25         CP->Tag = CHAN_OUT (XCHAN_DATA_OUT,Value,ALLOW_FEATHERING);
26         if (CP->Tag == SUCCESS) {
27           CP->Tag = READY; // Finished
28         } else if (CP->Tag == FEATHERED) {
29           ...  handle not interested
30         } else { // CP->Tag == AWAIT_READY
31         }
32       }
33     } break;
34   }
35 }
```

Listing 1. Overflow and ‘feathered’ handling on an **XCHAN** (ANSI C and macros)

An XCHAN feathering solution (code)

```
01 CP->Tag = READY; // READY,SUCCESS,AWAIT_READY,FEATHERED
02 while (TRUE) {
03   PRIALT();
04     ALT_CHAN_IN (X_CHANNEL,X_Tag); // X_COMMITTED,
05                                    // X_FEATHERED,X_UNFEATHERED
06     ALT_CHAN_IN (CHAN_DATA_IN,Value);
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13         CP->Tag = FEATHERED; // Stop
14       } else if (X_Tag == X_COMMITTED){
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16         CP->Tag = READY; // Finished
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21     case CHAN_DATA_IN: {
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24       } else { // CP->Tag = READY
25         CP->Tag = CHAN_OUT (XCHAN_DATA_OUT,Value,ALLOW_FEATHERING);
26         if (CP->Tag == SUCCESS) {
27           CP->Tag = READY; // Finished
28         } else if (CP->Tag == FEATHERED) {
29           ...  handle not interested
30         } else { // CP->Tag == AWAIT_READY
31         }
32       }
33     } break;
34   }
35 }
```

Listing 1. Overflow and ‘feathered’ handling on an **XCHAN** (ANSI C and macros)

occam semantic non-equivalence

```
01 ALT -- Feathering semantics hidden
02   condition.0 & in.0 ? x.0
03     ...  response 0
04   condition.1 & in.1 ? x.1
05     ...  response 1
```

Without feathering the two blocks of code (lines 1-5 and 10-24) are equal

However, the ALT in line 12 will never take part in any feathering, neither will the two SEQ blocks starting at lines 18 and 22

```
10 IF -- No feathering:
11   condition.0 AND condition.1
12     ALT
13       in.0 ? x.0
14         ...  response 0
15       in.1 ? x.1
16         ...  response 1
17   condition.0 -- condition.1 must be FALSE
18     SEQ
19       in.0 ? x.0
20         ...  response 0
21   condition.1 -- condition.0 must be FALSE
22     SEQ
23       in.1 ? x.1
24         ...  response 1
```

Listing 2 - *Feathering* loss of semantic equivalence (**occam**)

Asymmetry aspect 1

- Receiver defines when it is not interested (time window)
    - But sender does not know about this (or anything at all) before it tries to send

Asymmetry aspect 2

- Sender gets to know that something had been deemed noninteresting by the receiver
  - But receiver does not know that something consequently has not been sent

Pattern extends ALT up to a certain level only

- However, extra «symmetrifying» messaging for this will fast take us into application level publish-subscribe pattern

- This is the price for keeping a «clean» ALT

Overhead

- Uninterestingness is treated with application level receiver's ALT transparently
- Cycles saved should be more than cycles taken
- This will depend on message length

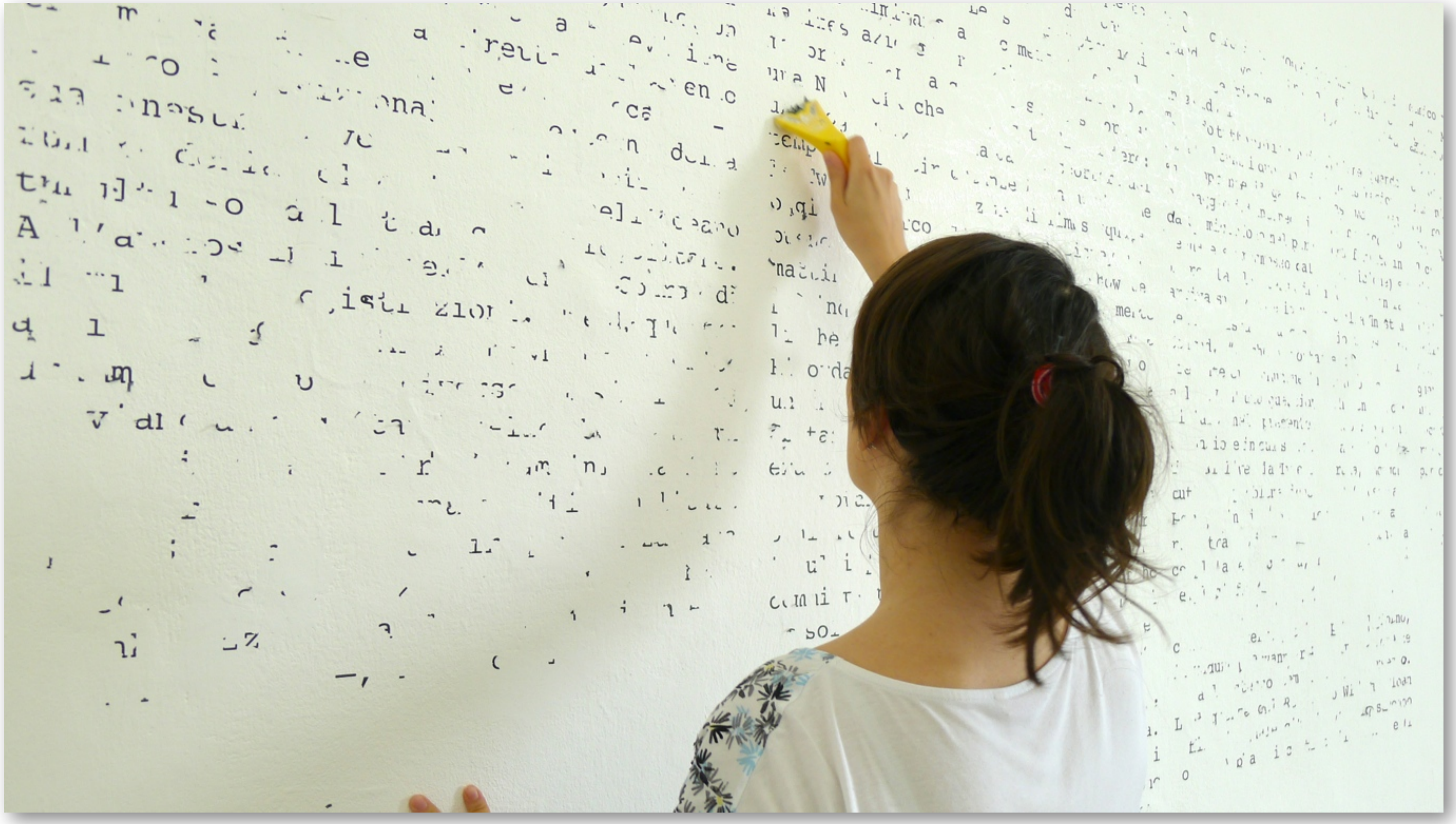
Abstraction

- Not having to send and not having to treat not-interesting messages is an «abstraction gain»
- «Cognitive message clutter» avoided
- Increases «non-determinsm»

Safe

- XCHAN with feathering is a safe concept:
- Overflow and dropping of uninteresting messages are both handled at application level
- No overflow like malloc heap overflow, which causes restart

Selective choice 'feathering' with XCHANs



questions?

About the two pictures in the last slide

Pictures

Front picture is a base of a structure in Porto Antico
in Genova, Italy. It holds a large tent, an elevator basket etc.

The last picture is from Museum Villa Croce Contemporary
in Genova, where we discovered a student *uninteresting*
a text for a previous exhibition

Both © Øyvind Teig, 2013

Thank you!