Broadcasting in CSP-Style Programming

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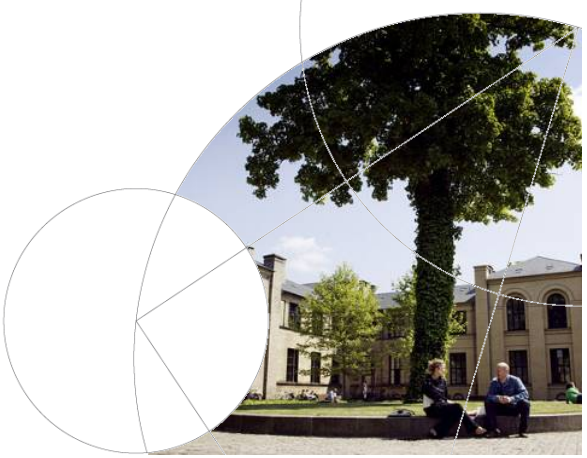


The extended channels

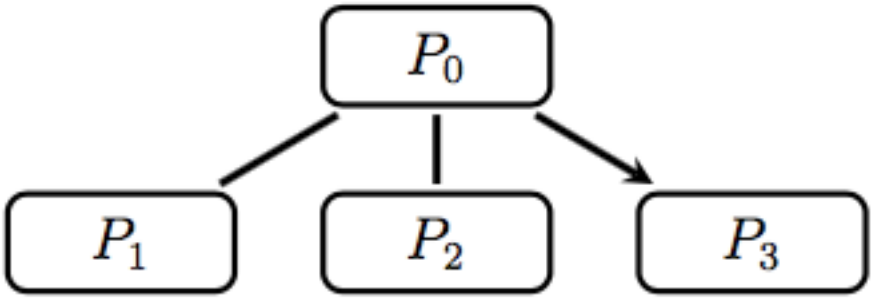
One2Any

Any2One

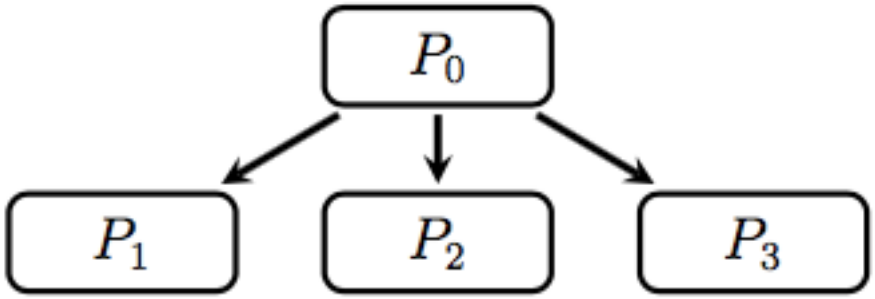
Any2Any

But no “to all”

To all

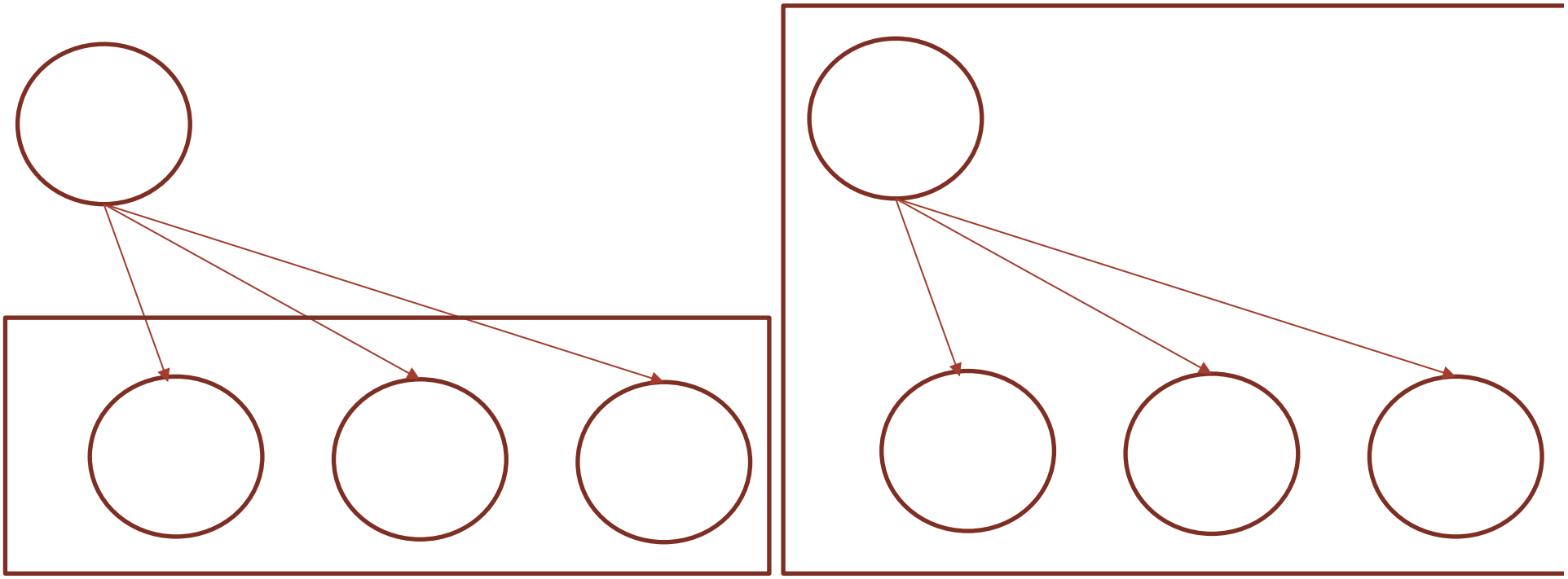


(a) With the one-to-any model a message ends up at one process in the group

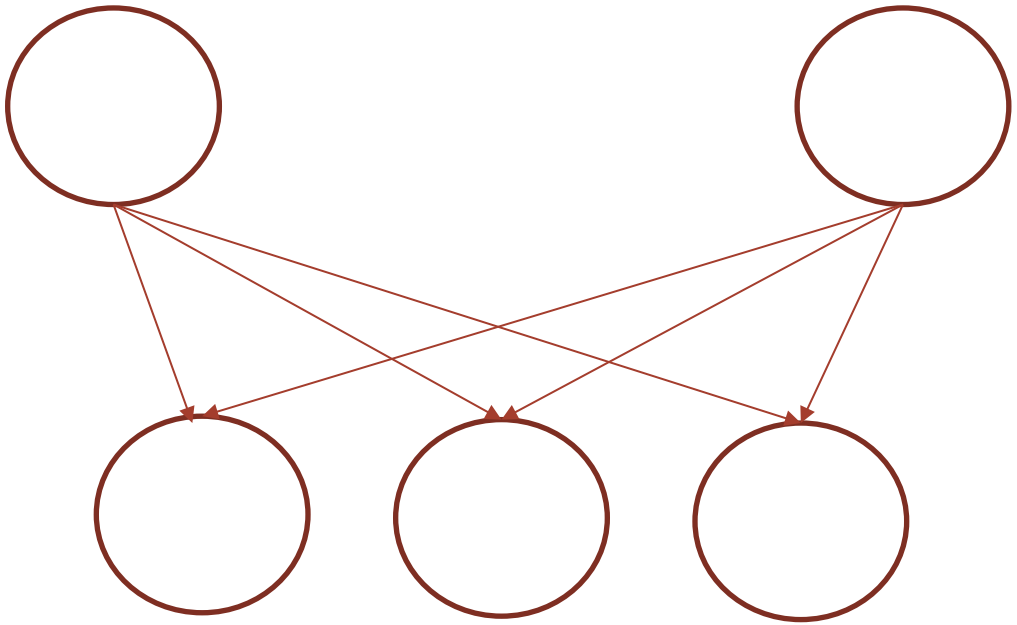


(b) The one-to-all delivers the message to all members of the group.

Open vs closed groups



Challenges in broadcasting



Broadcast types

Simple

Reliable

Atomic

Causal

Synchronous

Asynchronous

Broadcast as a general message

Send

```
info = pvm_initsend(PvmDataRaw);
info = pvm_pkint(array, 10, 1);
info = pvm_bcast("worker", 42);
```

Receive

```
buf_id = pvm_recv(&tid, &tag)
info   = pvm_upkint(array, 10, 1)
```

Broadcast as a special message

Send and Receive

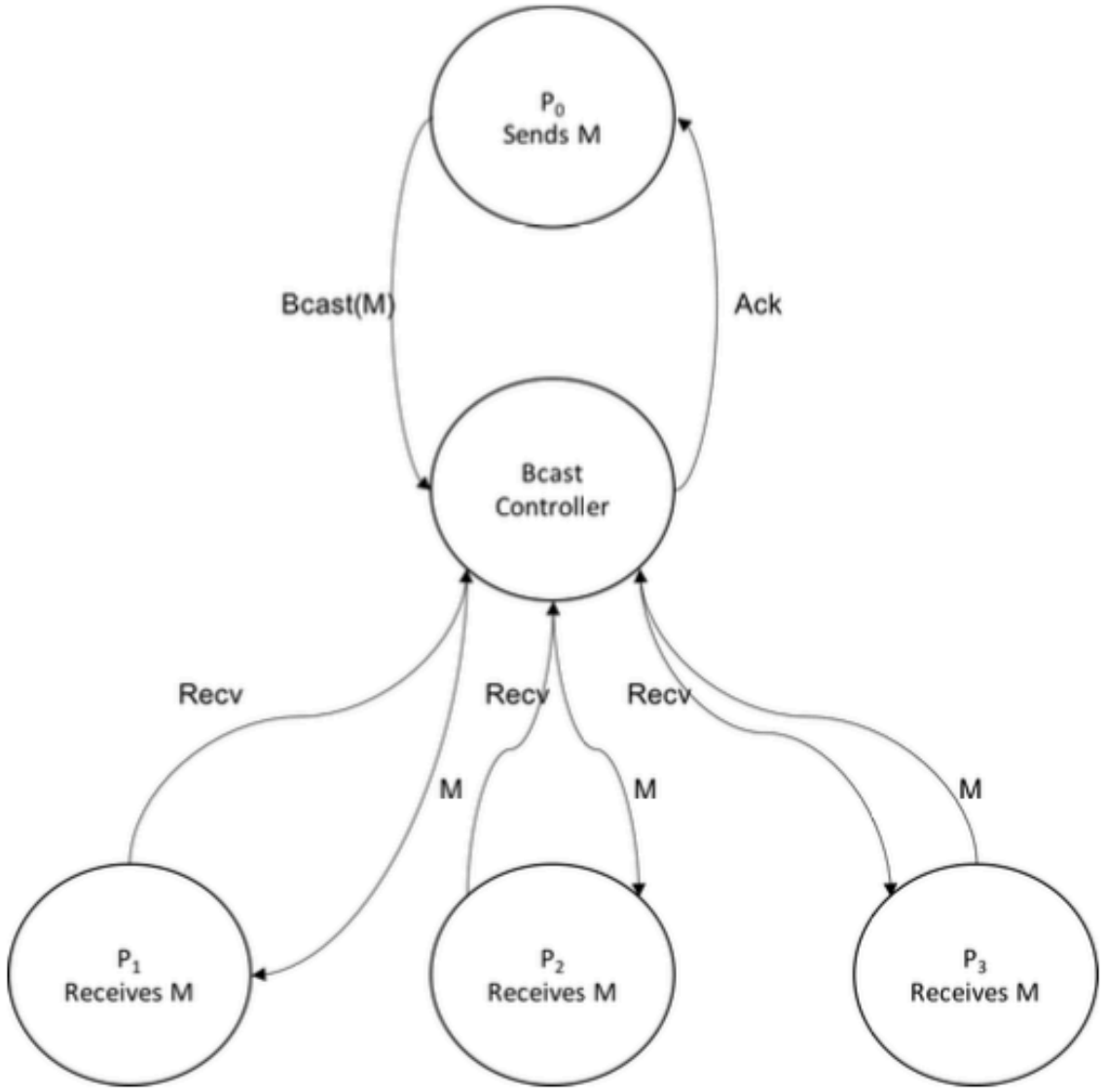
```
result = MPI_Bcast(data, 10, MPI_Int, 0, MPI_COMM_WORLD)
```

PyCSP Channel recap

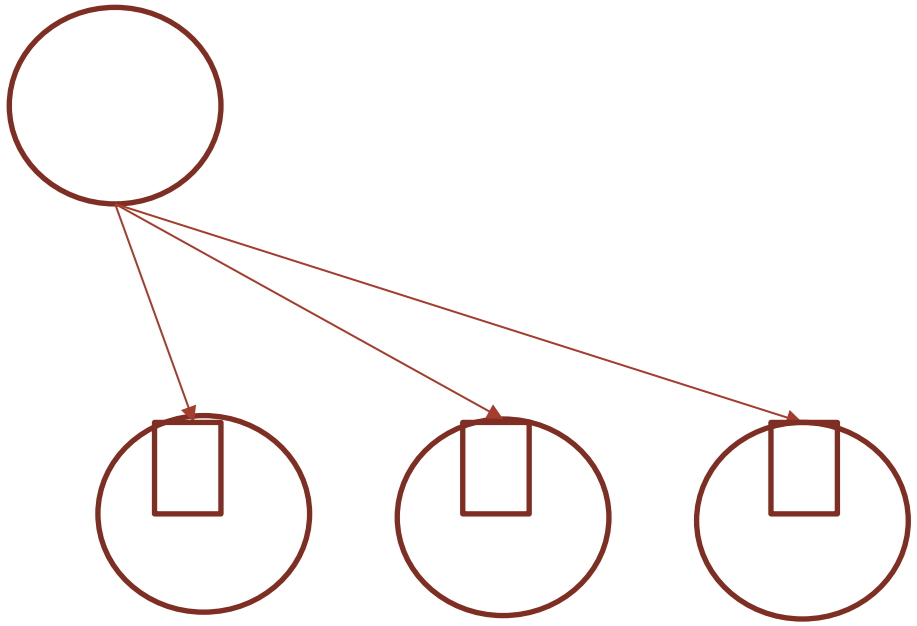
All channels are Any2Any

All channels supports both input guards and output guards

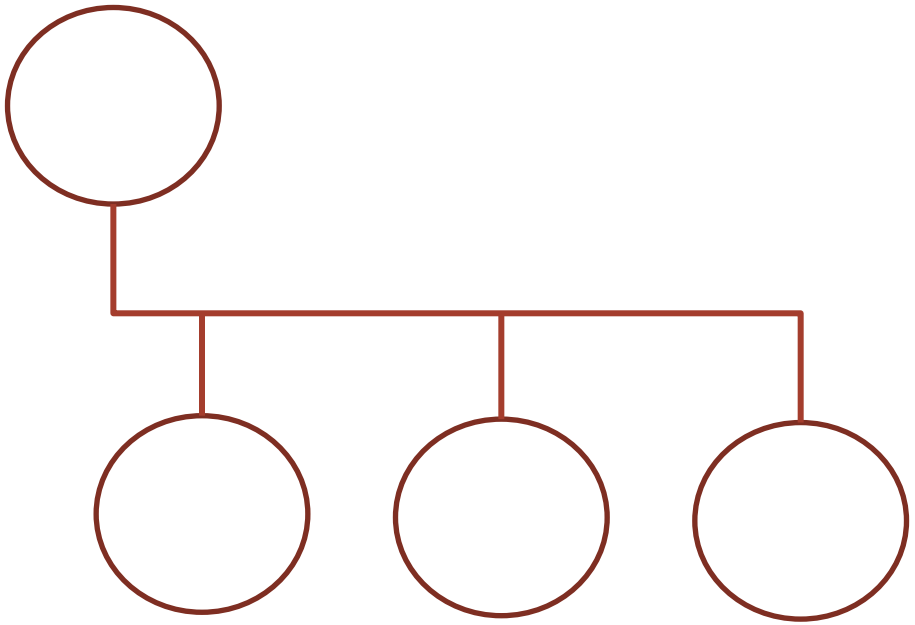
Naïve CSP style broadcast



Mailbox approach



Broadcast Channel



Can it be done?

$$S = m!x \rightarrow S'$$

$$P_i = m?x \rightarrow P_i'$$

$$S \parallel \left(\Vert_{i=0}^{n} P_i \right)$$

Better approach

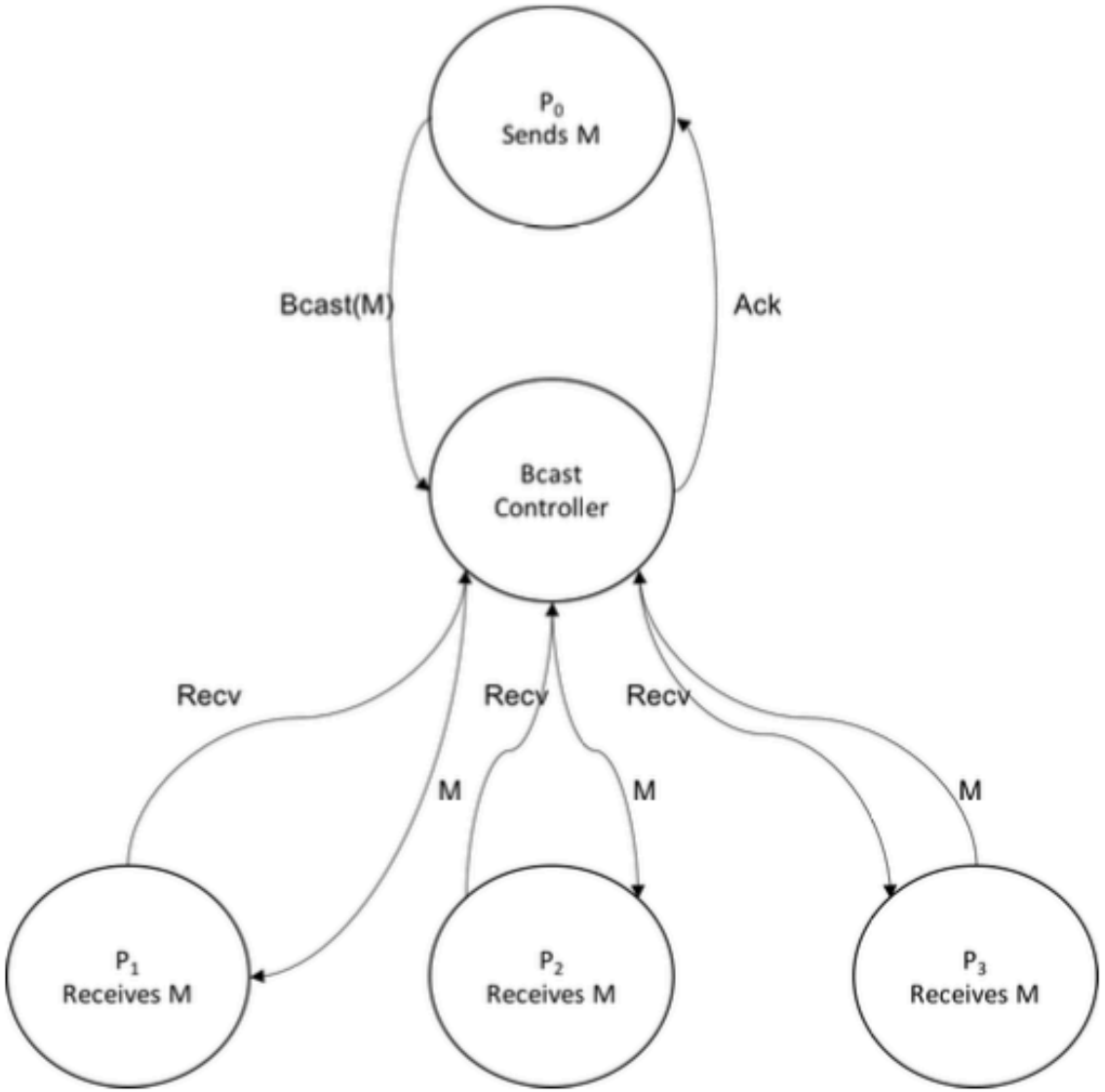
$$S = m!x \rightarrow m_{\text{ACK}} \rightarrow S'$$

$$B_c = m?x \rightarrow \left(\Vert\Vert_{i=0}^{n} c_i!x \rightarrow c_{i,\text{ACK}} \rightarrow \checkmark \right) ; \; m_{\text{ACK}} \rightarrow B_c'$$

$$P_i = c_i?x \rightarrow c_{i,\text{ACK}} \rightarrow P_i'$$

$$S \parallel B_c \parallel \left(\Vert_{i=0}^{n} P_i \right)$$

The result


P0
Sends M
Bcast(M)
Ack
Bcast
Controller
Recv
Recv
Recv
M
M
M
P1
Receives M
P2
Receives M
P3
Receives M

Should it be done???

Broadcasting in CSP has many convenient features

There is no simple way to fold point-to-point messages with broadcasting messages

The motivating example was SME and here the remaining CPS features were not needed