SDL-2010: Background, Rationale, and Survey

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SDL-2010: a revision of SDL-2000
ITU-T Specification and Description Language

Overview of session

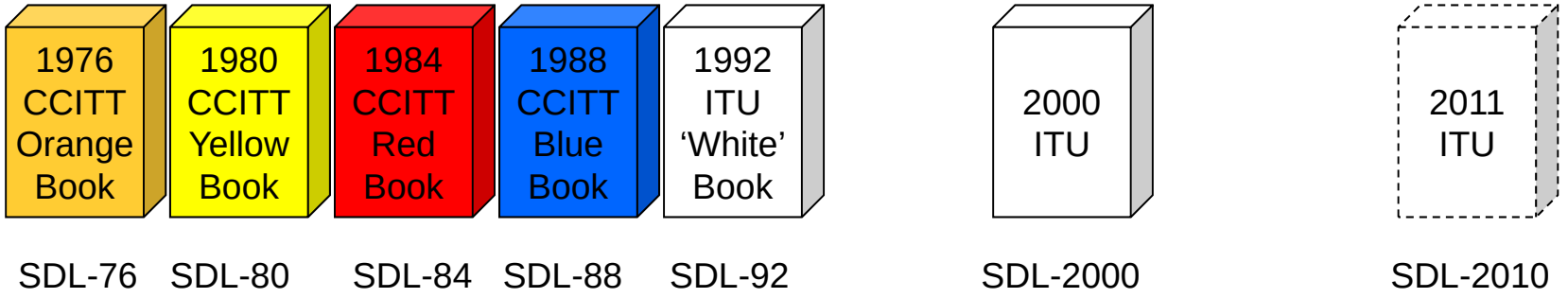
1. Presentation of SDL-2010 cf. SDL-2000

   Rationale for SDL-2010

   Differences between SDL-2010 and SDL-2000

2. Discussion on SDL-2010 & further changes

Rationale for SDL-2010



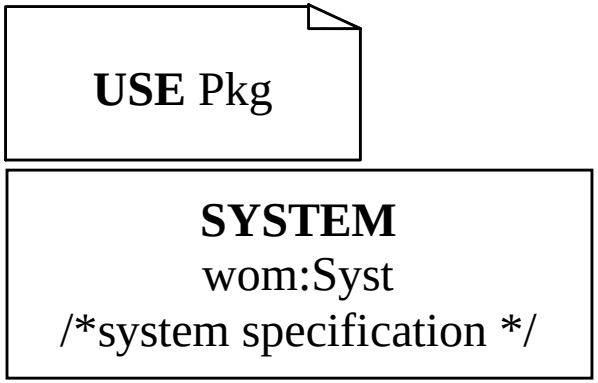
- 11 years since SDL-2000
- SDL-2000 not fully implemented
- Impact of UML use
- Separation of concerns in standard documents

Reorganization

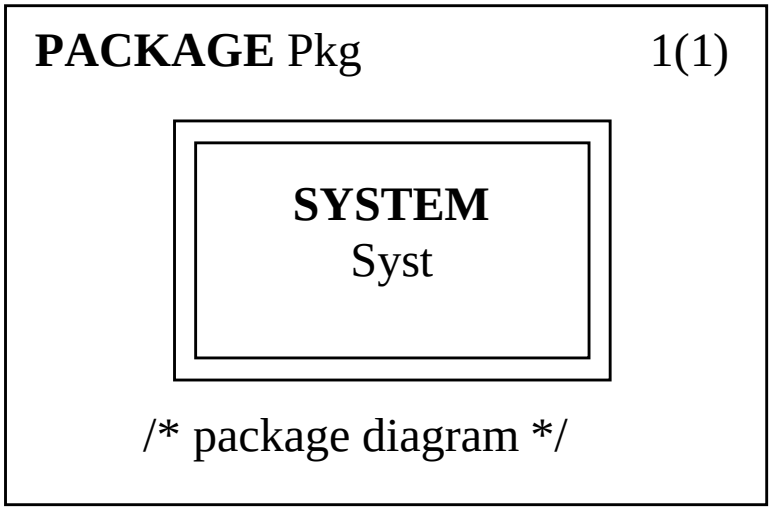
- Basic SDL-2010 - Z.101
  agent type diagrams containing agent instance structures with channels, state type diagrams and the associated semantics for these basic features.
- Comprehensive SDL-2010 - Z.102
  extends Basic SDL-2010 to full abstract grammar corresponding canonical concrete notation: includes features such as continuous signals, enabling conditions, type inheritance, and aggregate states.
- Shorthand notation & annotation in SDL-2010 - Z.103
  shorthands (agent diagrams, asterisk state) for easy and and more concise use; annotations (comments, create lines …), aid understanding but do not add to the semantics.
- Data and action language in SDL-2010 - Z.104
  data types and expressions. SDL-2000 data notation or C with bindings to the abstract grammar and the Predefined data package.
- SDL-2010 combined with ASN.1 modules - Z.105
  As for SDL-2000 except Predefined extensions moved to Z.104.
- Common Interchange Format for SDL-2010 - Z.106
  Similar to SDL-2000 (updated for feature changes).

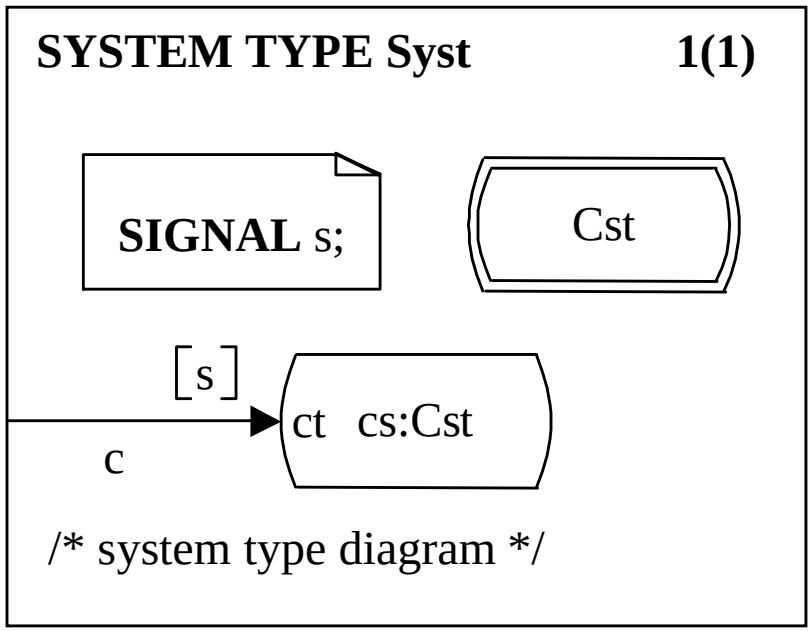
Basic SDL-2010

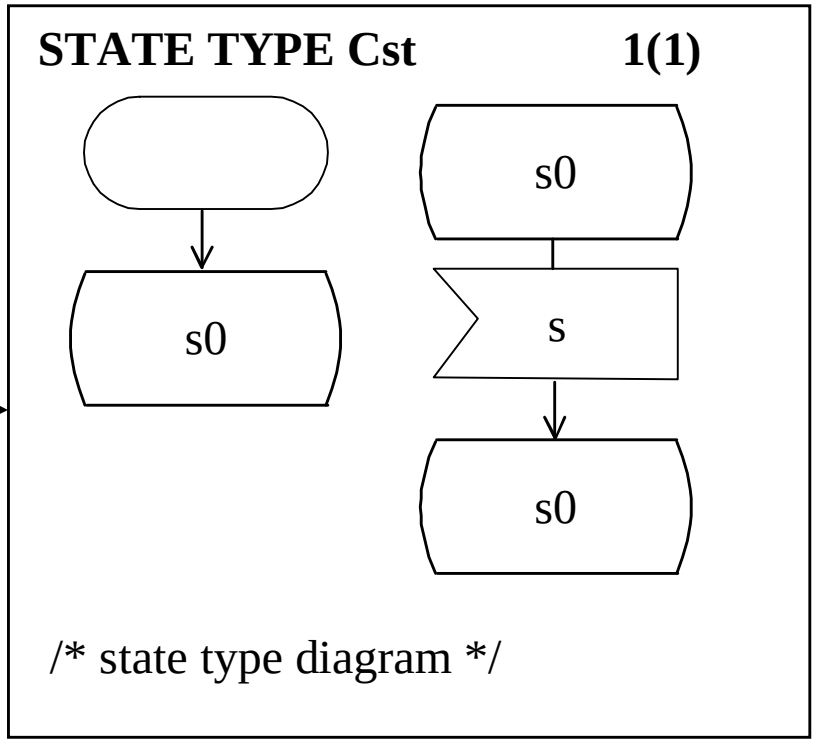
- Each diagram just one page!
- Lexical rules, frame use, page-numbers
- Framework, packages,referenced definitions
- Agent types, state types
- Typebased agents, procedures
- Channels, interfaces, signals
- State transition graphs:
  - start, state with input/save
- Transitions to:
  - nextstate, join, stop, return
- Actions:
  - tasks, create,proc. call, output, decision
- Timers, Data (overview)



Basic SDL-2010







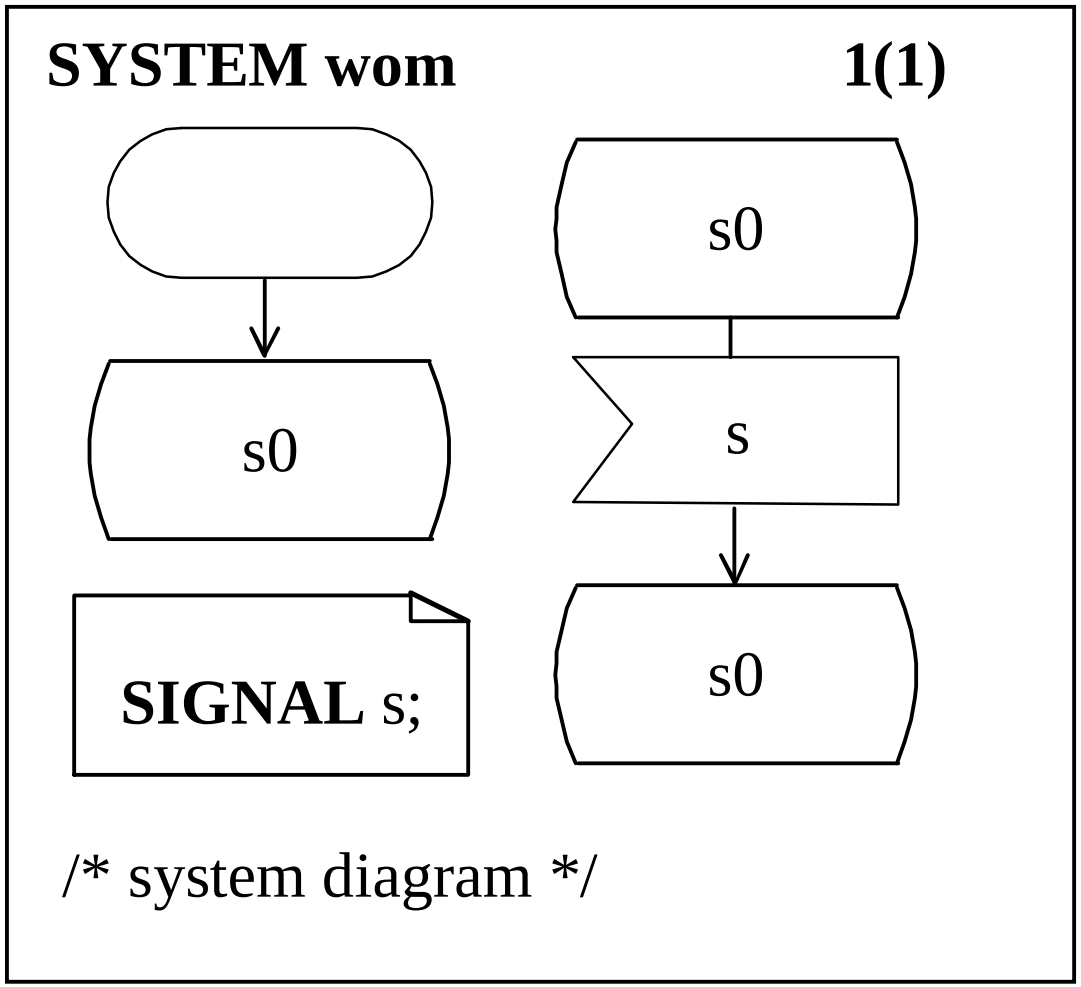
Comprehensive SDL-2010

- Completes the abstract grammar
  - Priority input, Enabling condition, Continuous signal
  - Spontaneous transitions
  - Composite state aggregation
  - Composite state named entry/exit, entry/exit procedures
  - Statement list in tasks/procedures/operations, loops
- Completes (not “syntactic sugar”) features
  - Inheritance (specialization)
    - Virtuality & Context parameters
  - Remote procedures/variables
  - Generic systems (select, optional transition)
  - Macros
  - Unicode handling

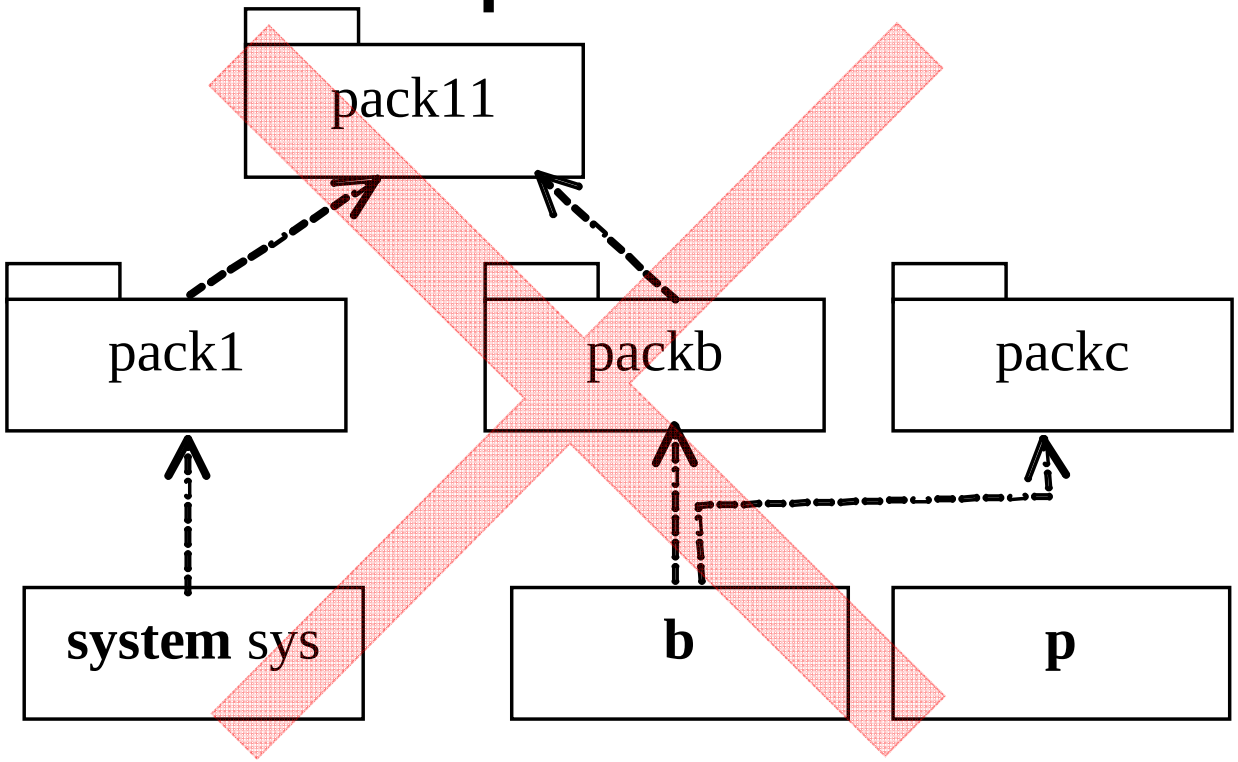
Shorthand SDL-2010 and Annotation

- Instance diagram
- Agent with state graph
- Asterisk input/save, implicit transition
- Signallist, interface as stimulus/on channel
- Asterisk state, multiple state appearance
- Multiple diagram pages
- Various syntax alternatives
- Create line (the only annotation left?)

System diagram (example)

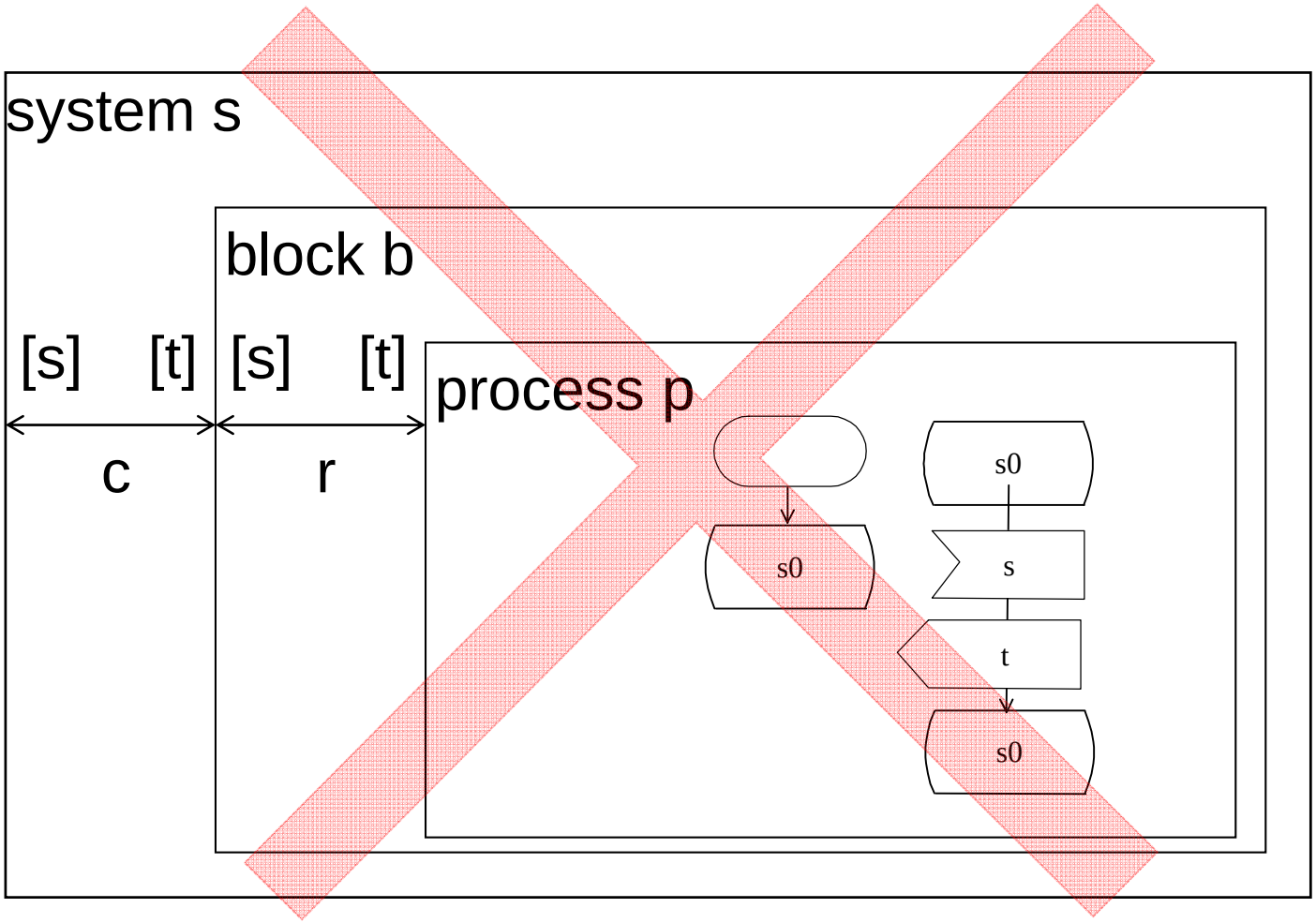


Deleted: Specification area

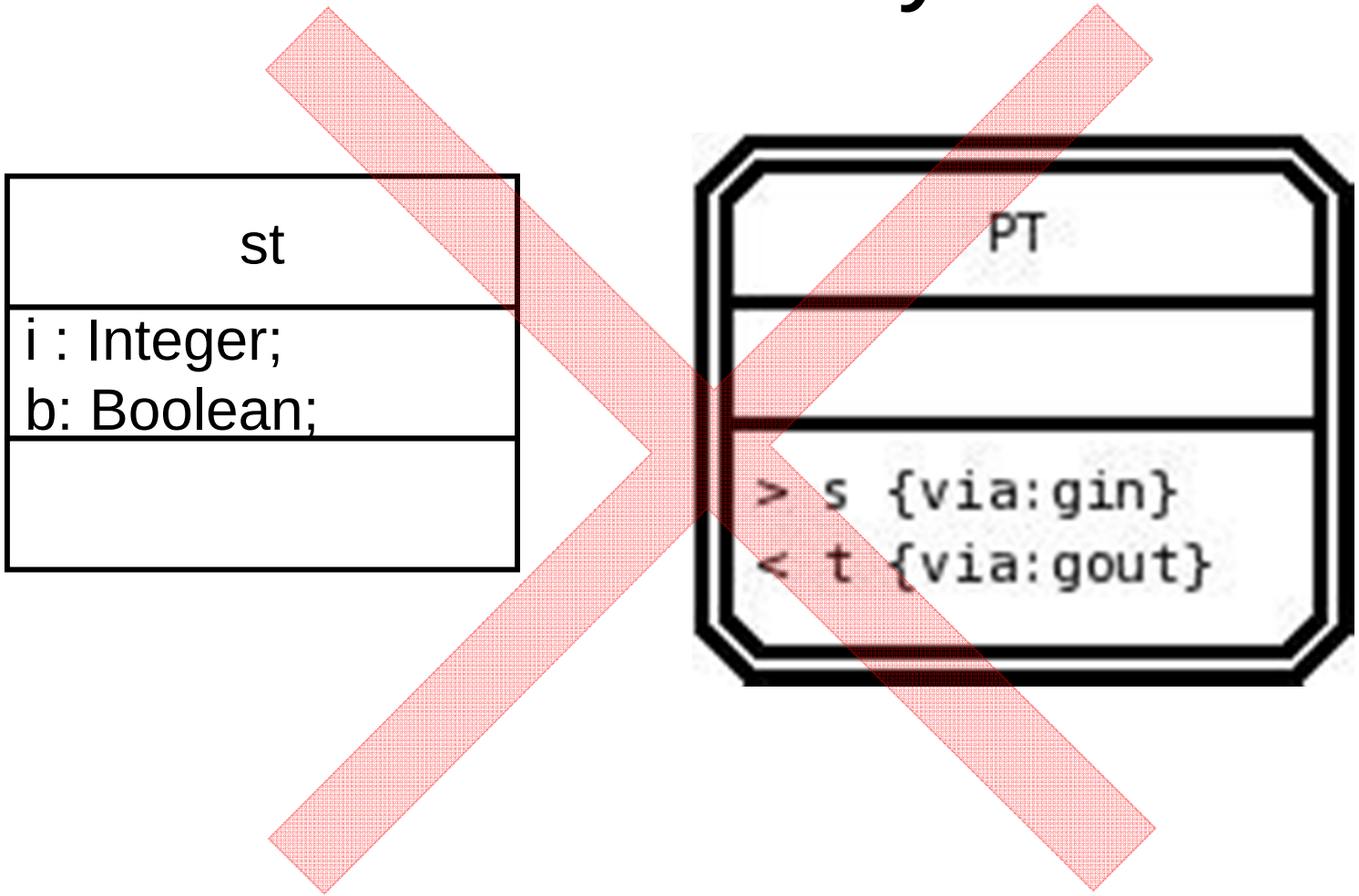


- Attempt to standardize a collective view
  - *"… a graphical depiction of the relationships between <system specification> and <package diagram>s."*

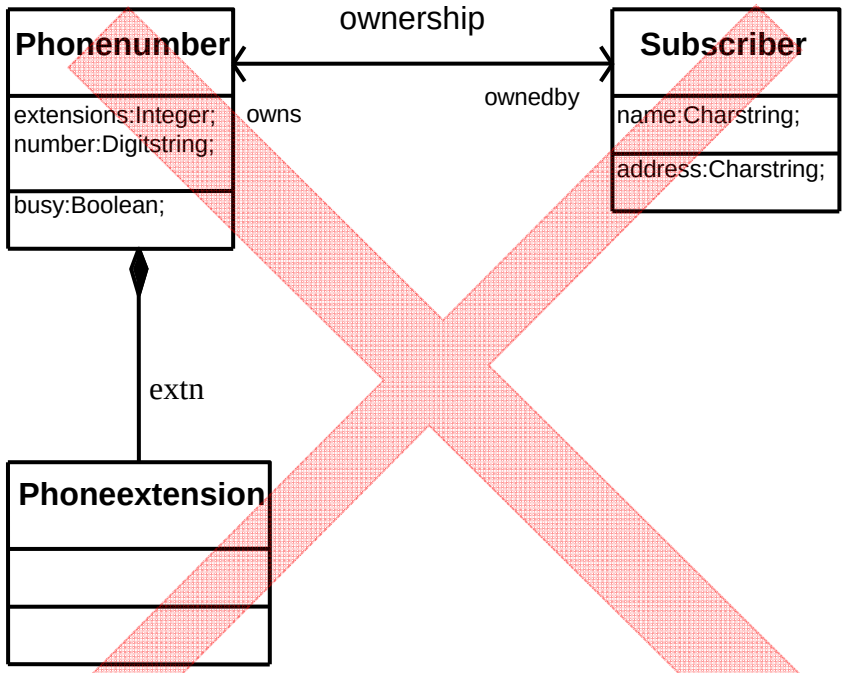
Deleted: Nested diagrams



Deleted: Class symbols



Deleted: Associations



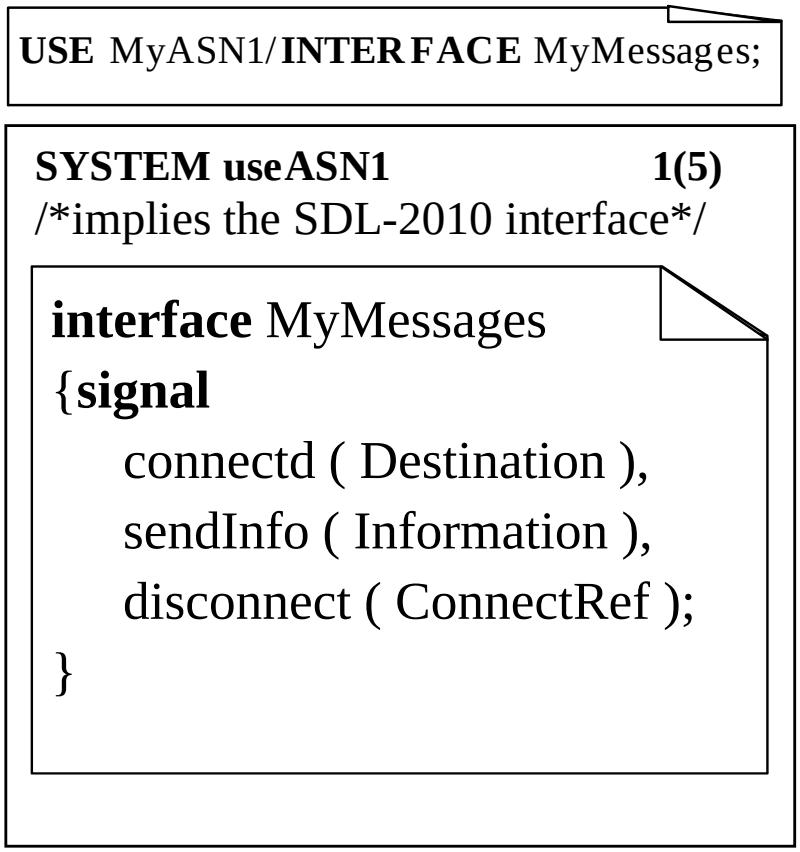
- Some concrete syntax rules to ensure UML-like
- But no meaning (in SDL-2000)
- And consistent with deleting class symbols

Deleted: Name class and spelling

```
value type Digit = Character constants
'0','1','2','3','4','5','6','7','8','9' endsyntype;
value type Dstring
   inherits String < Digit > ( '' = emptystring )
   adding
       operators ocs in nameclass
        '''' ( ('0':'9'))+ '''' ->this Dstring;
    /*strings of digits '0' to '9', '00' to '99' … */
       operator ocs -> this Dstring
       {result mkDs(substring(spelling(ocs),
              2,length(spelling(ocs)-2)};
       operator private mkDs(d Charstring)->this Dstring
       {result mkstring(d[1])//(if length(d)=1 then ''
              else mkDs(remove(d,1,1))};
endvalue type Digitstring;
```

- Removed as user feature
  - still used to explain Predefined data types

Use with ASN.1 (Z.105)



where

```
MyASN1
DEFINITIONS AUTOMATIC TAGS ::=
BEGIN
-- definitions including
   MyMessages ::= CHOICE {
        connectd Destination,
        sendInfo Information,
        disconnect ConnectRef}
-- the data types mentioned
-- above such as Destination
-- and Information visible here.
END
```

Z.104 (10/2004) - implicit choice

For a path that has encoding, a data type is implicitly defined that corresponds to the SDL:

```
value type Implicitname /* an implicit and unique name
*/
{ choice
          signal1 value
          { struct
             1 Sort11 optional;
             2 Sort12 optional;
             3 Sort13 optional;
             /* ... and so on for
              each parameter of signal1 */
           } ;
          signal2 value
          { struct
             1 Sort21 optional;
             2 Sort22 optional;
             3 Sort23 optional;
             /* ... and so on for each
              parameter of the signal2 */
           } ;
          signal3 NULL;/* no parameters */
          /* ... and so on
              for each signal */
}
```

Signal as Structure as Signal

A signal definition with parameters defines a structure data type that is a new <basic sort> alternative <as signal>

<as signal> ::= **as signal** <signal identifier>

```
signal memo ( Cs, Receipt); /* defines
  value type anon{struct anon1 Cs optional;anon2 Receipt optional};*/
dcl my_memo as signal memo /* anon */, r Receipt;
      r := my_memo.2; /* .anon2 */
/* access by <field number> alternative to <field name>
       <field number> ::= <integer name>  */
```

```
signal memo2 (  c1 Cs, r2 Receipt); /* names fields for
   value type anon3 { struct c1 Cs optional; r2 Receipt optional};*/
value type Memo_struct { struct cs1 Cs; r3 Receipt};
signal memo3 ( struct Memo_struct); /* names fields for
   value type anon4 { struct cs1 Cs optional; r3 Receipt optional};*/
dcl my_memo2 as signal memo2, my_memo3 as signal memo3;
      my_memo2.c1 := my_memo3.cs1 /* field names */
```

Choice as interface, gate or channel

An interface, gate or channel definition defines a choice data type that is a new <basic sort> alternative <as interface>, <as gate> or <as channel>:

<as interface> ::= **as interface** <signal identifier>
<as gate> ::= **as gate** <gate identifier>
<as channel> ::= **as channel** <channel identifier>

```
interface pad{signal memo(Cs,Receipt),
                     memo2(c1 Cs,r2 Receipt),
                     memo3(struct Memo_struct);}/* defines
value type anon5 {choice
                     memo as signal memo;
                     memo2 as signal memo2;
                     memo3 as signal memo3};*/
dcl m as interface pad /* anon5 */;
      r :=   if memoPresent(m)then m.memo.2/*anon2*/
             else   if memo2Present(m)then m.memo2.r2
                    else r fi fi;
```

Similarly, for a gate or channel a choice data type for the signals carried.

Because an <interface use list> includes signals defined elsewhere, the name of signal is not necessarily unique, so it is also allowed to denote the field name of the choice by <as signal>, and to use Present(n) to test the presence if field n.

```
r := if Present(2) then m.as signal memo2.r2 else r fi;
```

Choice as gate or channel

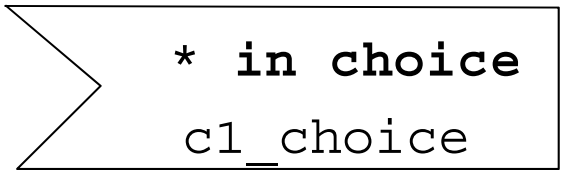
A gate or channel definition defines a choice data type for all the signals carried by the channel in either direction.

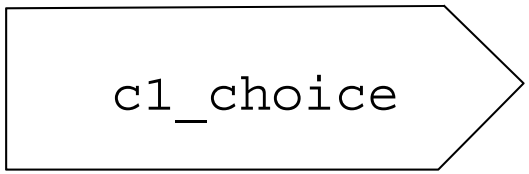
The channel above defines

```
/* value type anon7 {choice
                     s1 as signal s1;
                     s2 as signal s2;
                     s3 as signal s3;
                     s4 as signal s4};*/

 dcl c1_choice as channel c1 /* anon7 */;
```

The choice types are useful in combination with input and output.





Issue not resolved: Variable is NOT transition local so still need to copy signal from input port to choice variable

Defining synonyms as variables

In SDL-2010 the concept of a synonym is redefined as a read-only variable.

This was not possible before SDL-2000 because variables could not be defined anywhere.

Nothing is changed in the concrete grammar, but a synonym in SDL-2010 then has a *Variable-definition* in the abstract grammar that enables mapping of UML read-only attributes to synonyms when using Z.109.

Lower bound on number of instances

<number of instances> ::=

([<initial number>] [, [<maximum number>] [, <lower bound>]])

This makes it possible to specify the number of instances is static.

```
myprocess(2,2,2) /*always 2 */
```

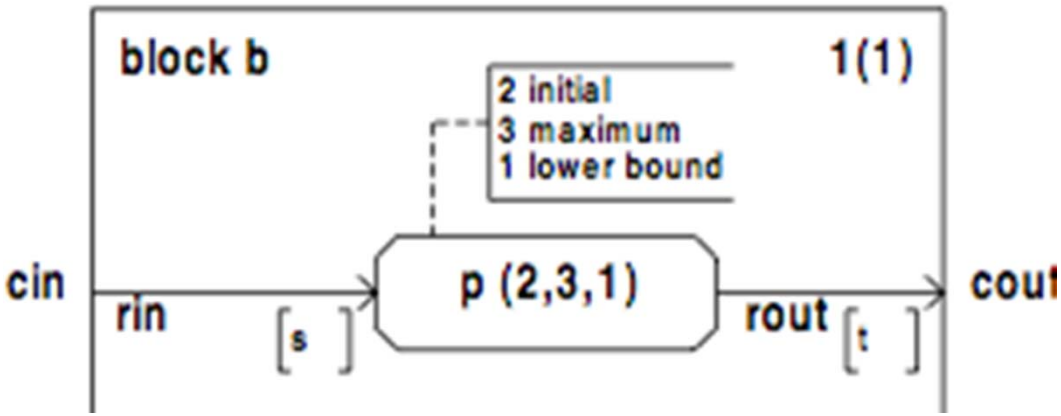
Or for the minimum number to be stated.

```
myprocess(2,,1) /*never < 1*/
```

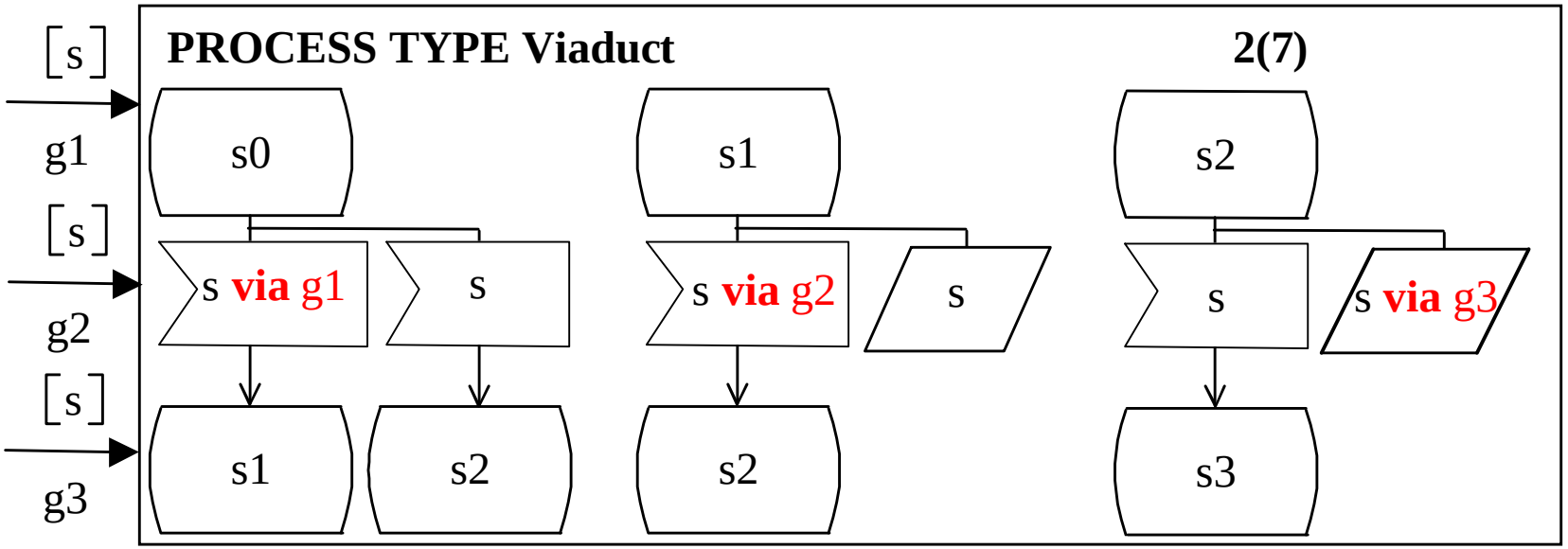
Attempting to stop an instance in a set at the lower bound raises `OutOfRange`, so to avoid this occurring a new active expression

active (myprocess)

gives the number of active instances in an agent set.



Input via



Only one input or save can contain `s via g1` for the same state.
Only one input or save can contain `s` (without a gate).
Assume signal `s` is the next signal in the input queue.
In state `s0`, if `s` arrived `via g1` the next state is `s1`. If `s` did not arrive `via g1` next state is `s2`.
In state `s1`, if s arrived `via g2` the next state is `s2`.
If `s` did not arrive `via g2`, the signal remains in the input queue
(if this is the only transition from `s1`, until a signal s arrives `via g2`).
In state `s2`, if `s` arrived `via g3` the signal remains in the input queue.
If `s` did not arrive `via g3`, the next state is `s3`.
If there is no explicit input/save for `s` without a gate, there is an implicit input for `s` without a gate.
In a process (rather than a process type), the name of a channel attached to a gate can be used for the via. In the implicit process type this is transformed to the gate connected to the channel.

Priority input value

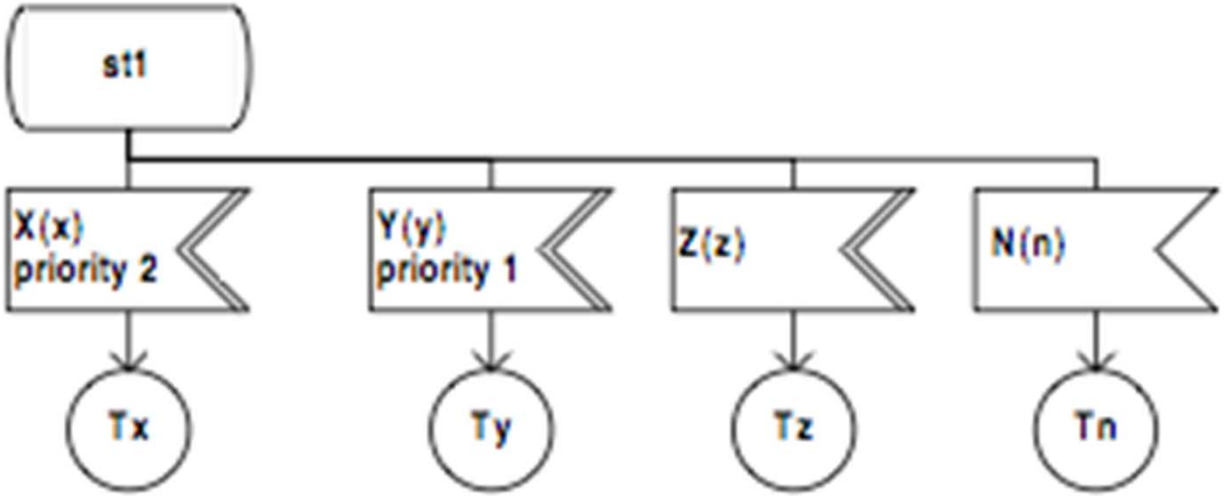
<priority input list> ::=
  <priority stimulus> {, <priority stimulus>}*

<priority stimulus> ::=
  <stimulus> [**priority** [<priority name>]]

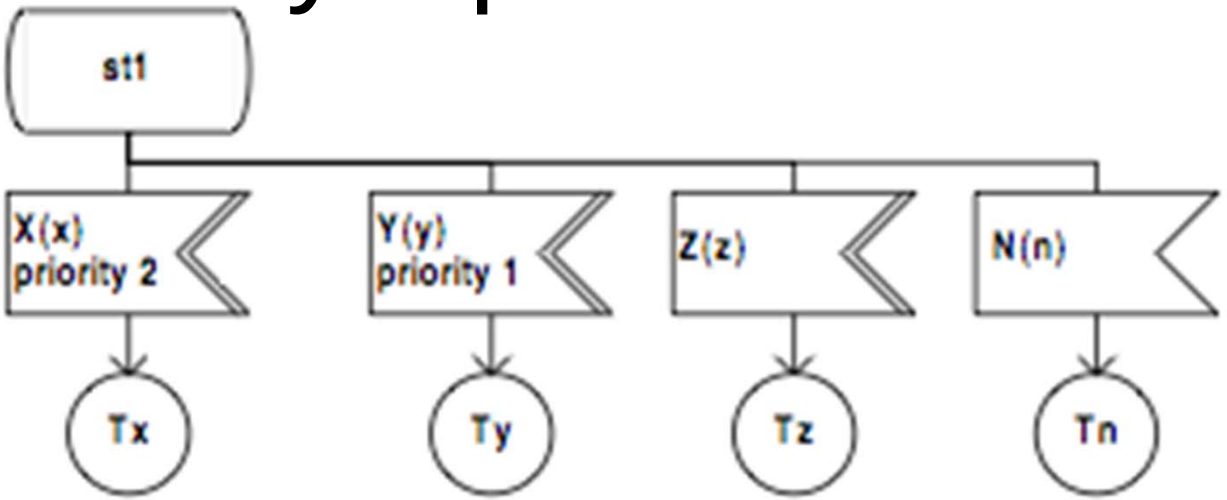
The change is to allow multiple levels of priority specified by a <priority name> (a natural number literal).

The higher the number the lower the priority, with zero the highest priority (consistent with Continuous signal priority).

An omitted <priority name> is one greater than the highest explicit <priority name>.



Priority input value example



Assume signals X, Y, Z, N each with one parameter saved in x, y, z, n resp..
Assume Tx, Ty, Tz and Tn connect to transitions that terminate in state st1.
Assume st1 reached & input port contains in arrival order signals N, Y, Z, X.
Z input for has an implied Priority-name of 3.
The signal Y is enabled and consumed - has highest priority and Ty is taken.
If no Y signals have arrived, at st1 again signal X is enabled and consumed.
If no X or Y signals have arrived, at st1 again signal Z is enabled and consumed.
If no X, Y or Z in the input port in state st1, Signal N is enabled and consumed.
If the inputs for two or more signals have the same input priority, the signal that arrived first is consumed.

Using signallist as an interface

- In SDL-2010

  Every **signallist** definition is a shorthand for an interface definition.

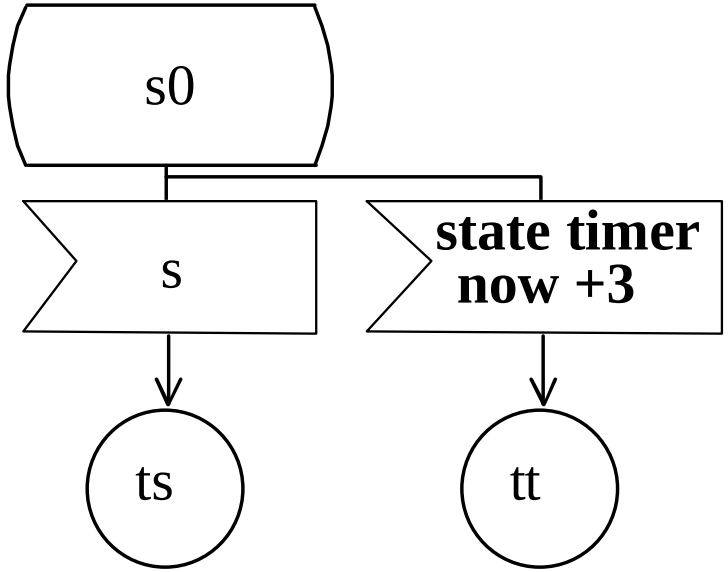
  ```
  signallist sl := s, t, u, v;
  ```

  Defines an interface definition sl containing signals s, t, u and v.

  The notation “(sl)” has the same meaning as “**interface** sl”

  When used on a channel or gate or in another signallist, the signallist name stands for the list of signals of the interface (as in SDL-2000).

Timer supervised states



<state timer> ::=

state timer <Time expression> | **set** <set clause>

For an optional *State-timer*, the timer is set entering the state and reset entering a *Transition*, except for an empty *Transition* to the state. Timer expiry: the timer signal is consumed +*Transition* of the *State-timer* taken.

Pending: Specified delay

Output-node :: *Signal-identifier Actual-parameters* [*Signal-destination*] *Direct-via* *Activation-delay Signal-priority*

<output body item> ::= <signal identifier> [<actual parameters>] [<activation delay> [<signal priority>]]

<activation delay> ::= **active** <Duration expression>

<signal priority> ::= **priority** <Natural expression>

If <activation delay> is omitted, the *Activation-delay* is zero: that is, there is no delay in activating the signal at the destination.

If <signal priority> is omitted, the *Signal-priority* is zero: that is, the signal has the highest signal priority.

Conveyed "availability time" = **now** + *Activation-delay* - sent only if *Activation-delay +ve*

Agent

If a signal conveys an availability time, the signal is not delivered to the input port until this time has been reached.

The set of retained signals is ordered in the input port according to their availability time, which for signals that do not convey an availability time is the same as their arrival time.

Issues: pids and instance sets

Issue: How to handle the pid values of agent instances.

Option: if an agent instance set is named ais, treat the expression

```
ais[k]
```

as indexing a string of pid values for the `ais` instances.

But if `k` is an integer index, may be too simplistic as the number of instances is potentially variable, so `ais[2]` may not be constant.

Could have `k` as a “key value”, but then need some way of defining keys.

Issue: Initializing static agent instance sets.

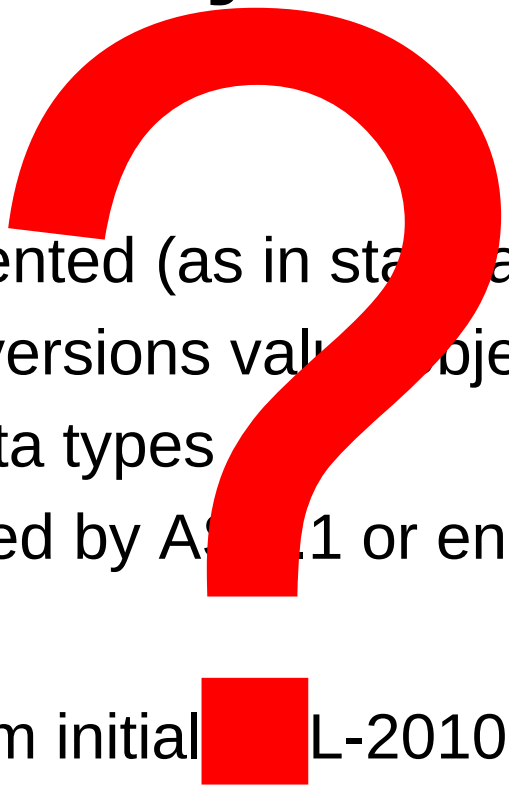
Not currently allowed to give any agent parameters in the set definition.

In any case, each instance probably needs different parameters.

Before system execution so dynamic evaluation is not possible.

There may be a relationship between keys (see above) and parameters.

Deleted: **object** data types



- Complex
  - Not implemented (as in sta ard)
  - Implicit conversions val bject
  - Dynamic data types
  - Not supported by A 1 or encoding rules
- Strategy
  - Remove from initial L-2010, but further study on extending Z.104 is in progress.

ITU maintenance guidelines (extract)

Study group experts should determine the level of support and opposition for each change and evaluate reactions from users. A change will only be put on the accepted list of changes if there is substantial user support and no serious objections to the proposal from more than just a few users. Finally, all accepted changes will be incorporated into a revised ITU-T Rec. Z.100. Users should be aware that until changes have been incorporated and approved by the Study Group responsible for ITU-T Rec. Z.100 they are not recommended by ITU-T.

Status

Z.100 (Introduction) needs finishing

Z.101 to Z.105 ‘almost complete’ need review.

Z.106 needs to be revised

Z.1xx Object data - in progress - Feb 2012

Z.109 Work in progress for Feb 201