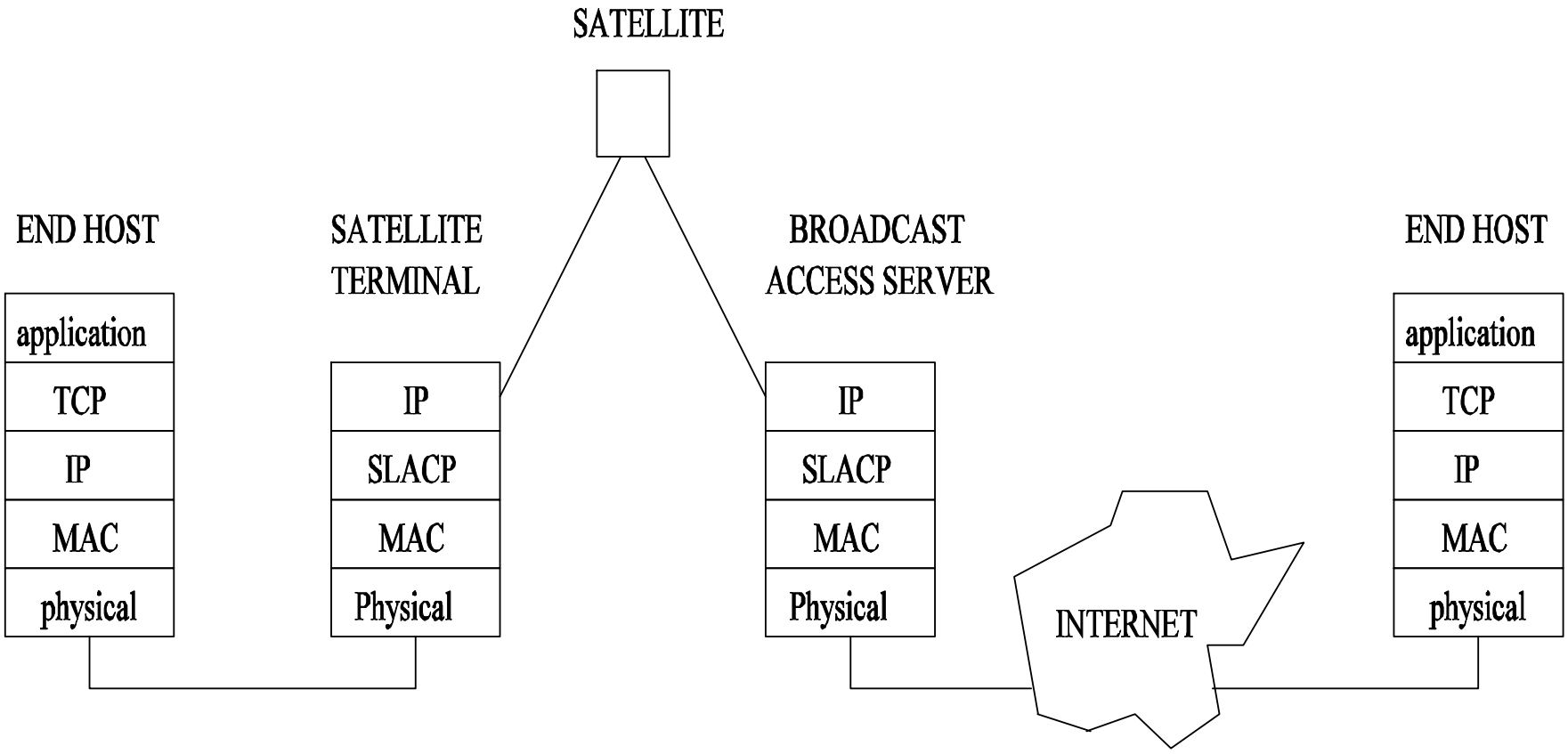
SDL Modelling of a Logical Link Layer Protocol

SLACP (Satellite Link Aware Communication Protocol)

SLACP Overview

- SLACP - a logical link layer protocol
- SLACP - to improve the performance of TCP in satellite links
- Uses selective repeat sliding window mechanism for data transfer
- Provides partially reliable in-order delivery of frames
- Combines ARQ - FEC to reduce residual packet loss rate
- Flow control between IP – SLACP - MAC

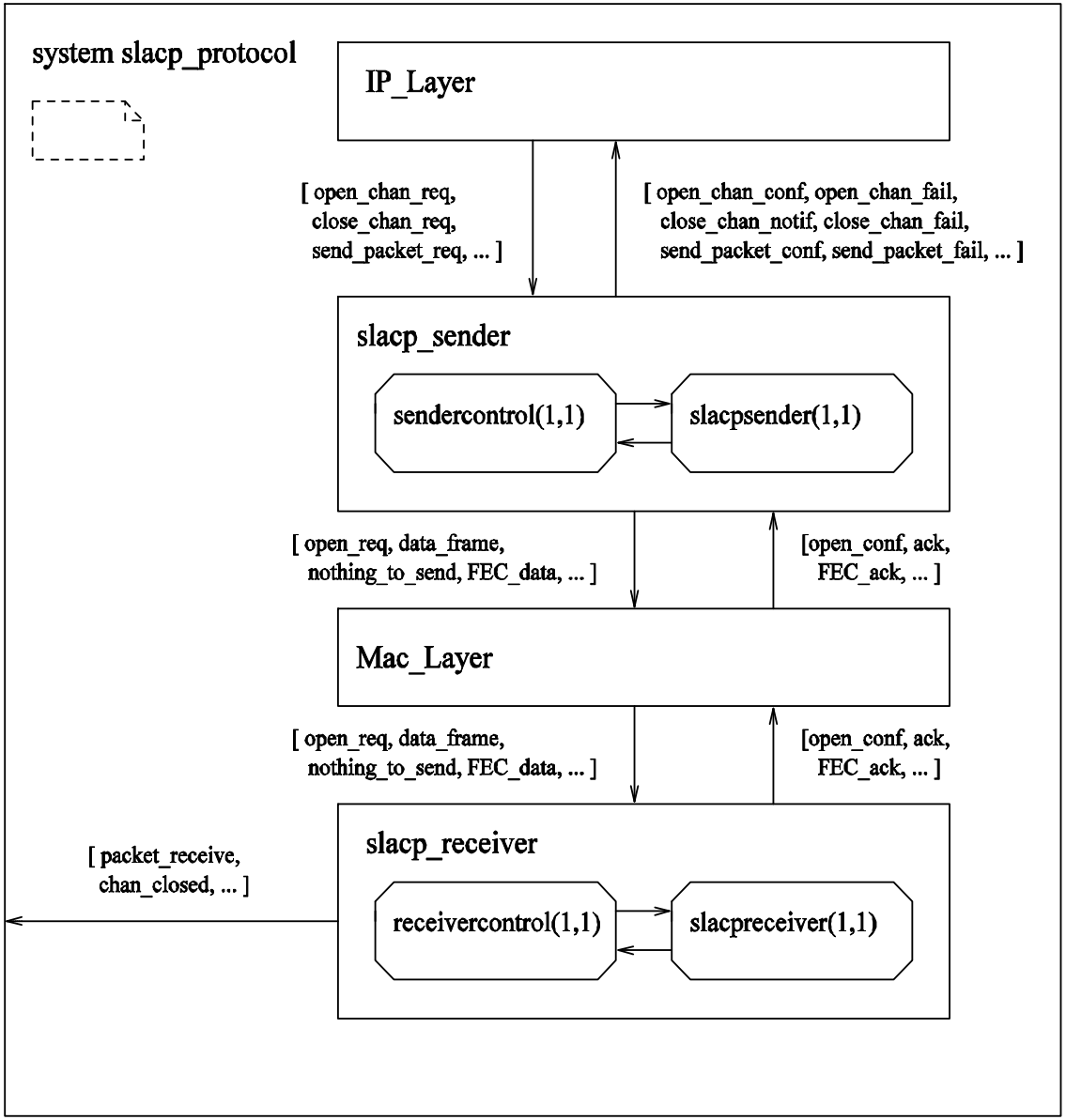
SLACP Environment



SLACP - SDL Model

- SDL allows to define the system model in a top down manner
  - System Model
    - Blocks
      - Processes
- SLACP - SDL Model consists of
  - IP Layer
  - SLACP Sender
  - MAC Layer
  - SLACP Receiver
- Validation oriented Design approach

SDL System Model of SLACP

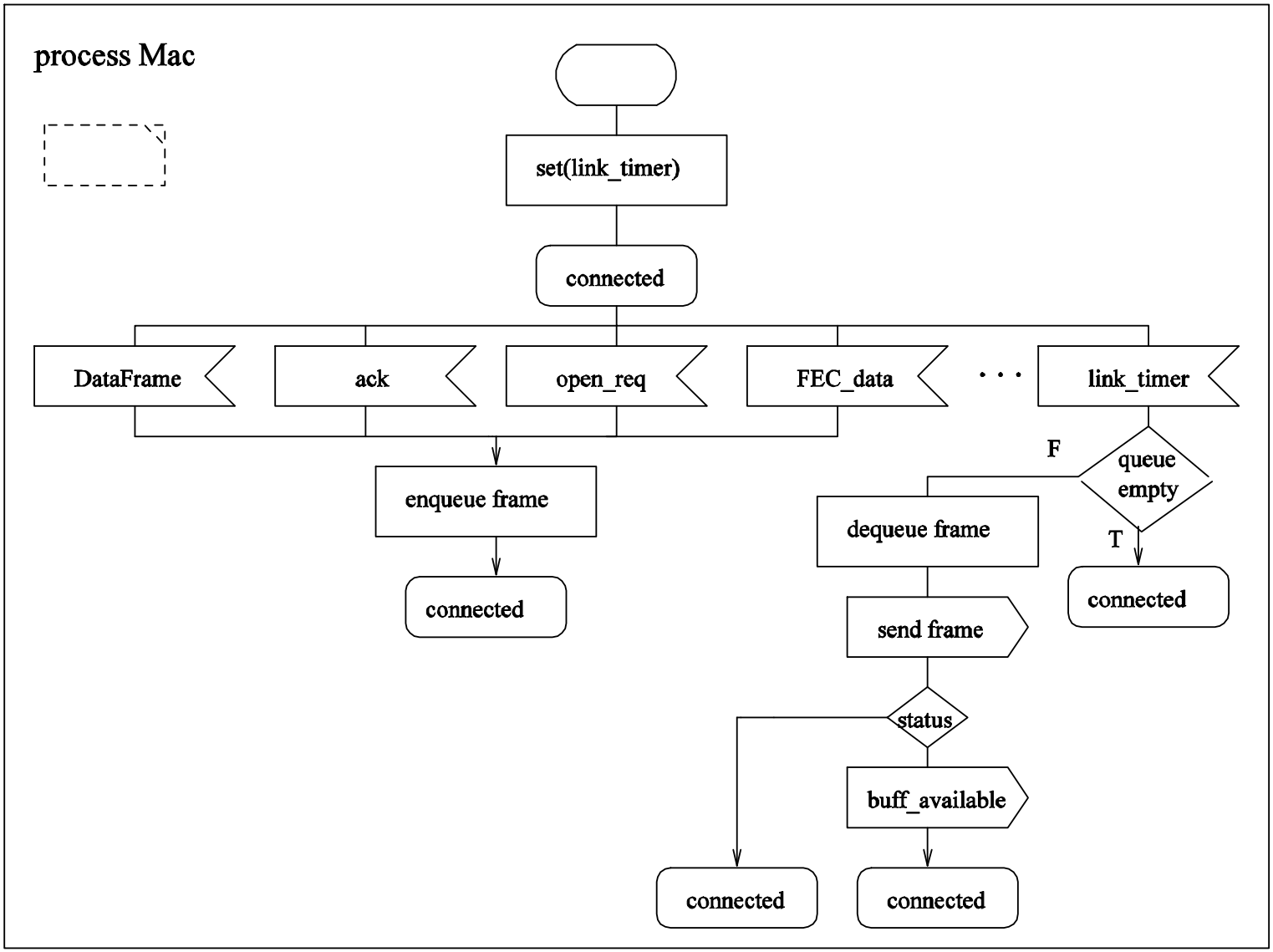


MAC Layer

- Delivery of frames between slacp sender and receiver
- Flow control information to both sender and receiver
- modeling delay and packet losses in the link

Mac process

- Modeling delay
  - Mac process queues all the frames it receives and sends when a link timer expires
  - the timeout of the link timer represents the delay in the wireless link
- Modeling packet loss
  - drops packets in a random way to model packet losses
  - We simulated the packet loss by dropping every mth packet


process Mac
set(link_timer)
connected
DataFrame
ack
open_req
FEC_data
. . .
link_timer
enqueue frame
connected
F
queue empty
T
dequeue frame
connected
send frame
status
buff_available
connected
connected

Data structures used in SDL model

- SLACP Frames
- Queues – struct
  - Mac queue – Mac frame – choice construct
- Scoreboard
- Timers
- Choose small sizes for the frames, queues
  - to reduce the complexity of the validation

SLACP Frames and Packets

- newtype t_slacp_frame struct
  frame_type integer;
  frame_seq_no integer;
  frame_length integer;
  ip_pkt data_pkt;
  endnewtype;

- syntype indexsort=integer
  constants 0:6
  endnewtype

- newtype data_pkt array(indexsort,integer)
  endnewtype

Queues

- newtype t_slacp_queue array(integer, t_slacp_frame)

- newtype t_Macframe choice
  a t_slacp_frame;
  b t_ACKframe;
  .
  .
  .
  i t_FINframe;
  j t_FINACKframe
  endnewtype

Timers

- Timer Link_Timer;
- set(now+delay,Link_Timer);

Validation Scenarios

1. opening/closing a channel
2. sending and receiving a frame without frame loss
3. sending and receiving frames with flow control
4. sending and receiving frames with frame loss
5. sending and receiving frames with frame loss and flow control
6. resetting a channel

SDT Support for Validation

- Validation reports
  - Error situations found during exploration
- Execution and error traces in SDL graphs and MSC (Message Sequence Charts).
  - This helped to eliminate many design errors
- Symbol Coverage
  - Percentage of coverage of SDL symbols