

# Flex Ray: Coding and Decoding, Media Access Control, Frame and Symbol Processing

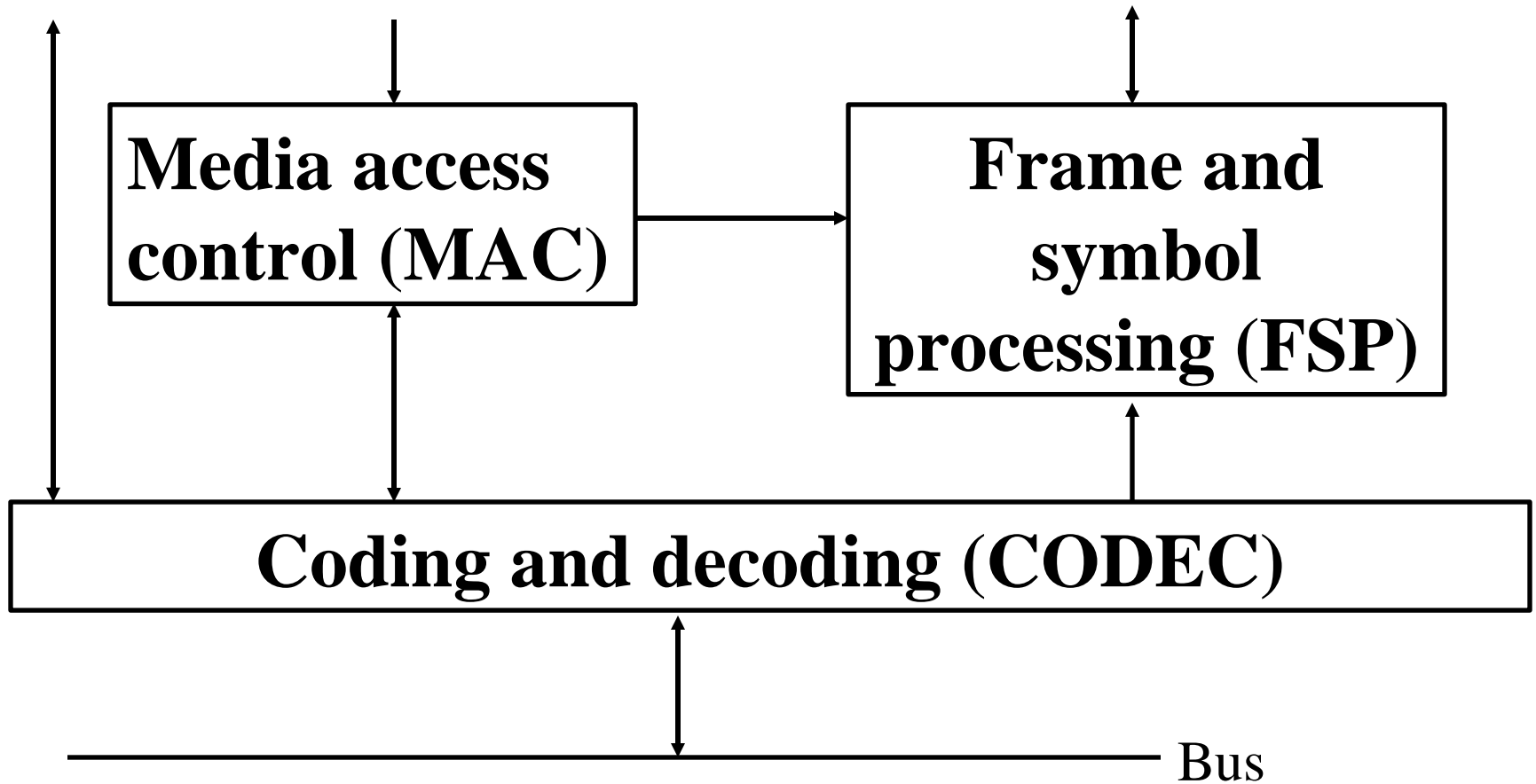
Seminar: The FlexRay Communication Protocol

Chair of Prof. Dr. W. J. Paul

Talk by Michael Gerke

27-9-2005

# Overview

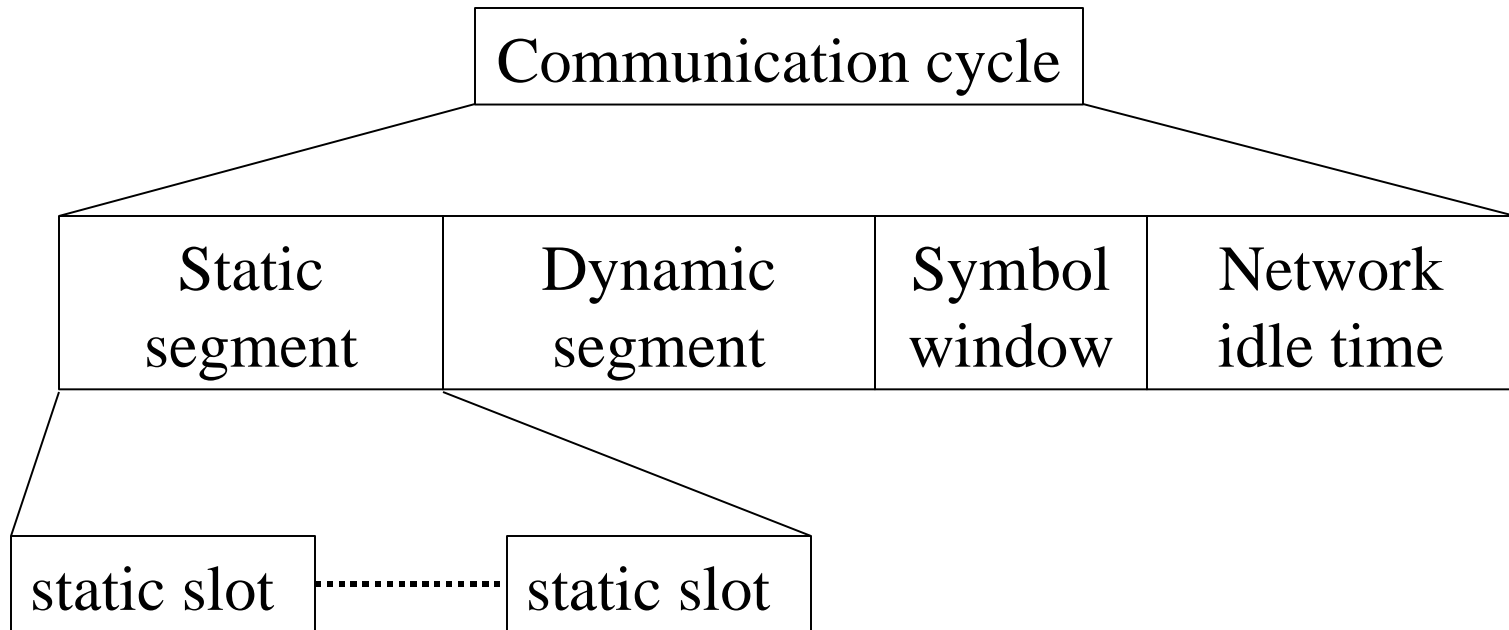


# Media access control (MAC)

- Interface:  
from Controller host interface (Host) to  
Coding and decoding (CODEC)
- Controls timing
- Orders ENC to sent symbols

# Media access control (MAC)

- Controls access to the channels
- Guarantees compliance with schedule



time organization

# Media access control (MAC)

Static slot usage:

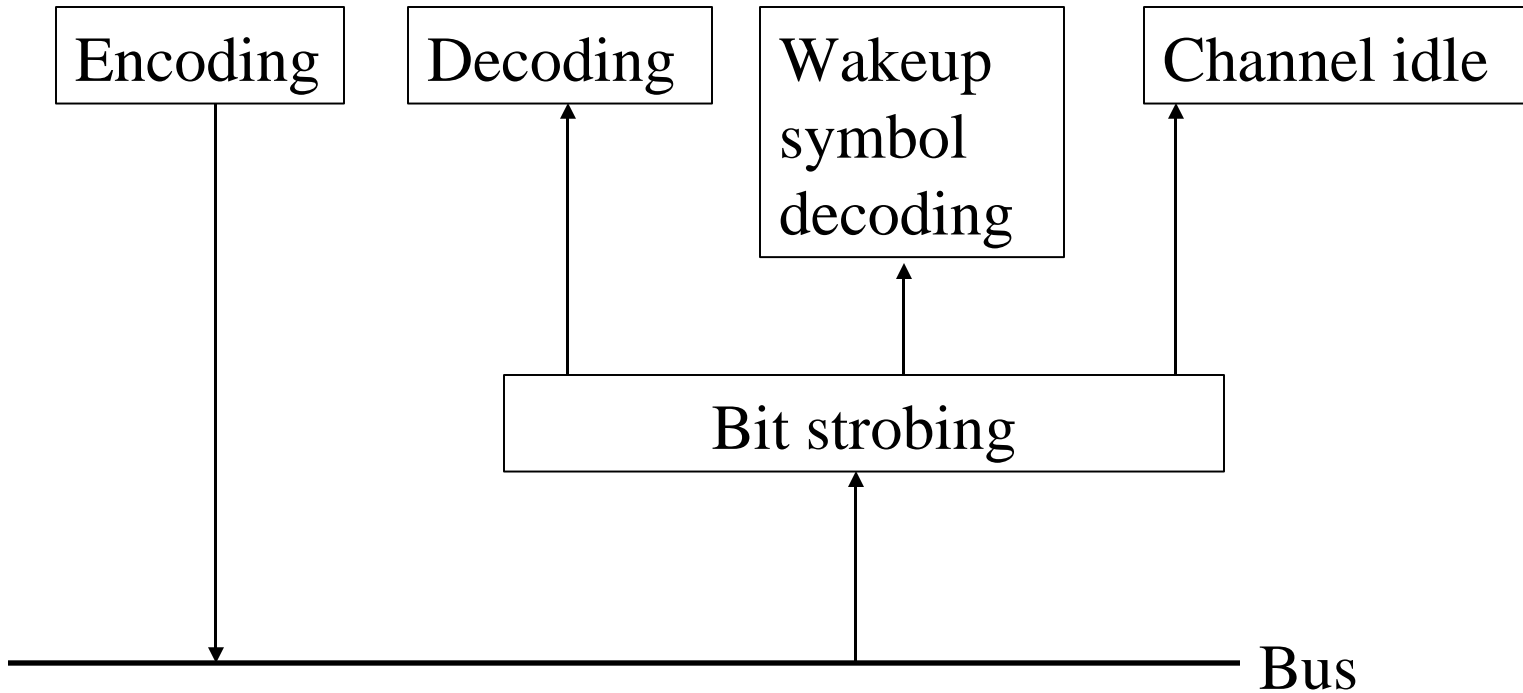
- short idle time
- transfer of the frame
- long idle time

# Media access control (MAC)

Assembles frames:

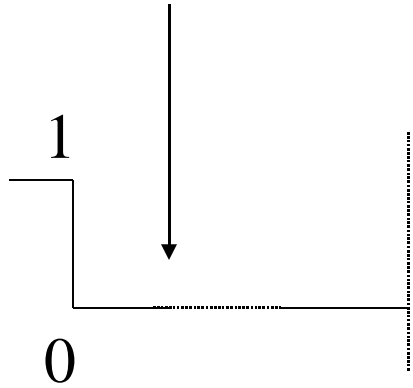
- imports data from controller host interface (Host)
- assembles header

# Coding and Decoding



# Encoding (ENC) Frames

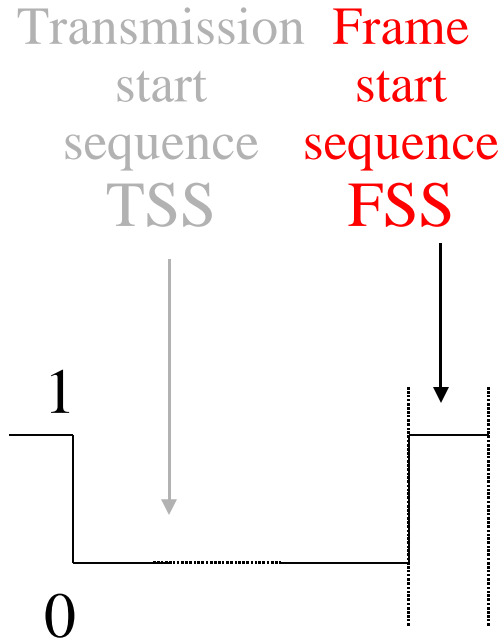
Transmission  
start  
sequence  
TSS



Frame coding in static segment

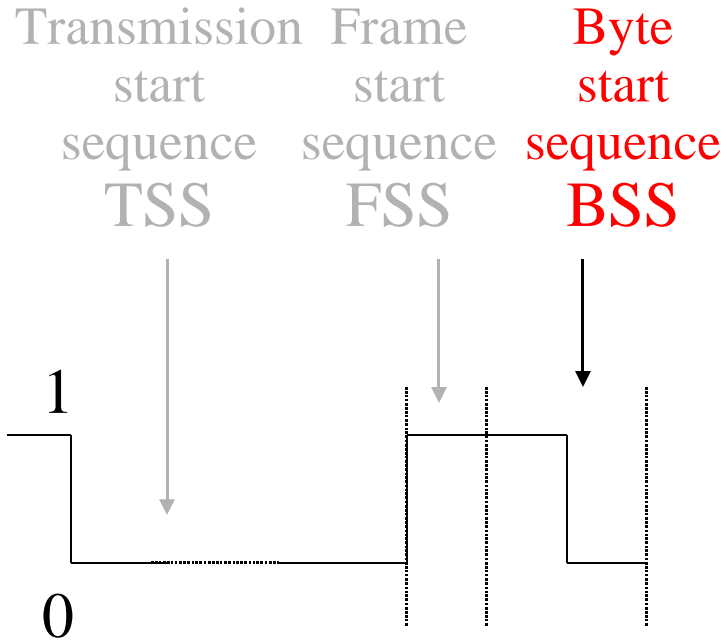


# Encoding (ENC) Frames



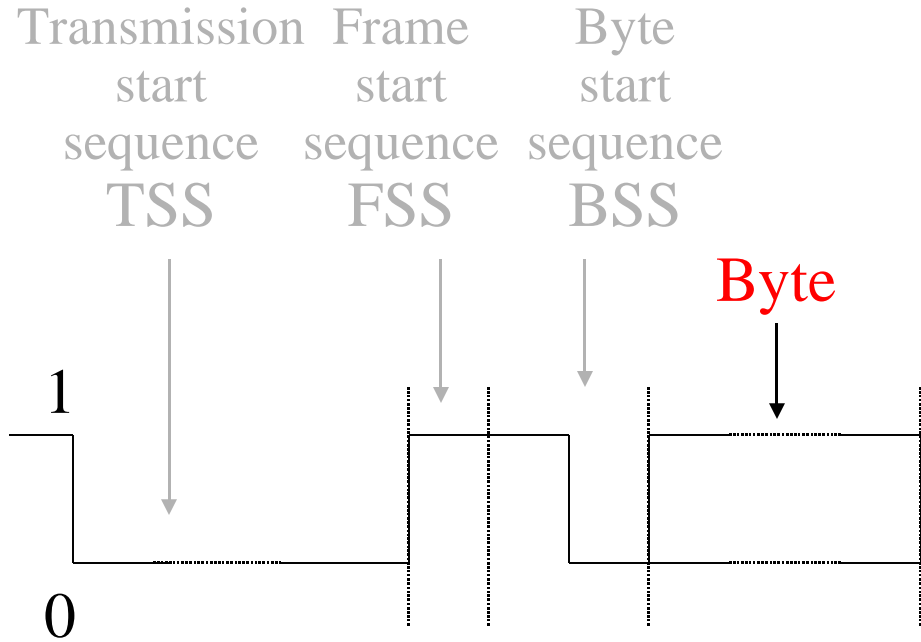
Frame coding in static segment

# Encoding (ENC) Frames



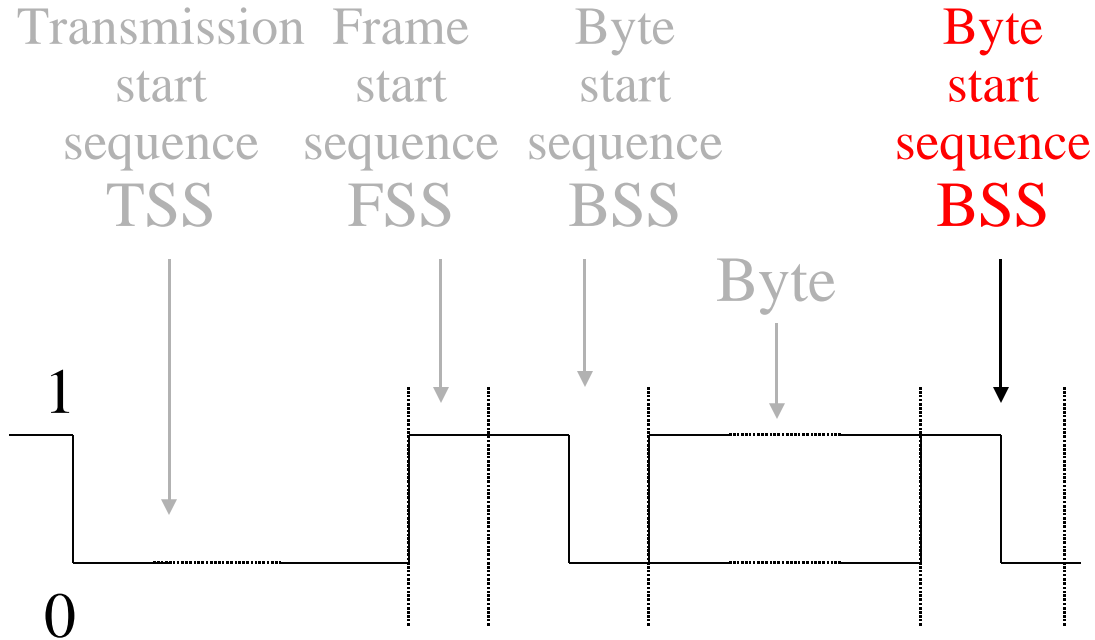
Frame coding in static segment

# Encoding (ENC) Frames



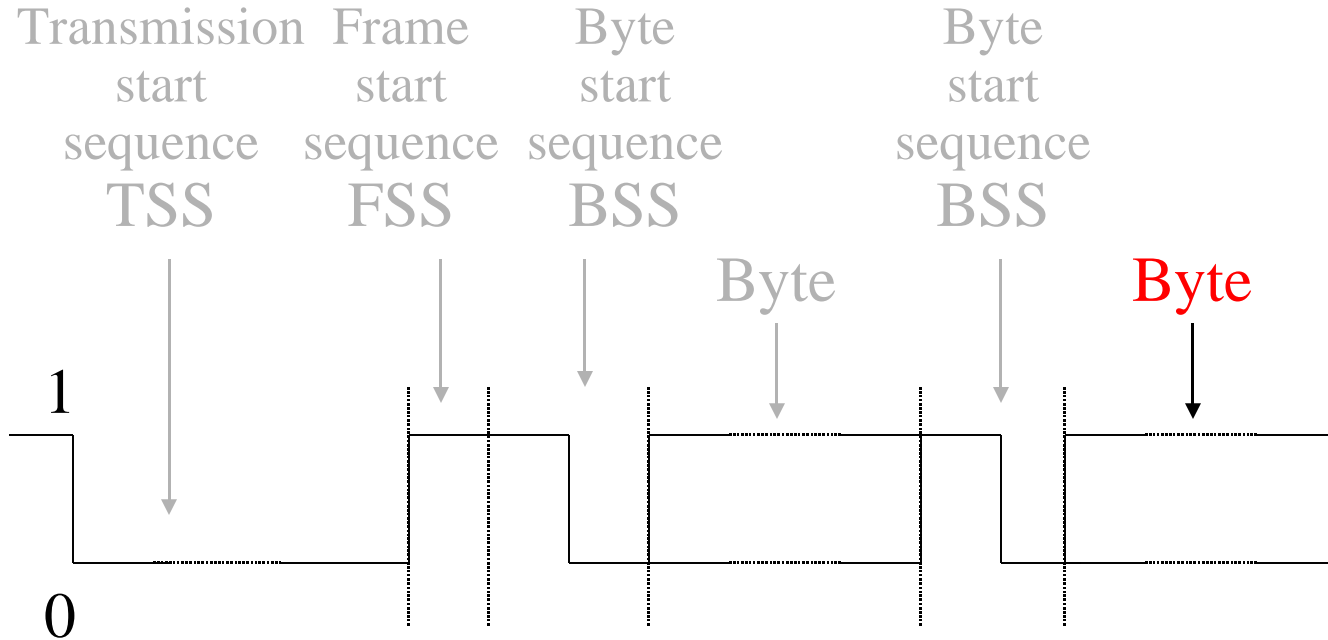
Frame coding in static segment

# Encoding (ENC) Frames



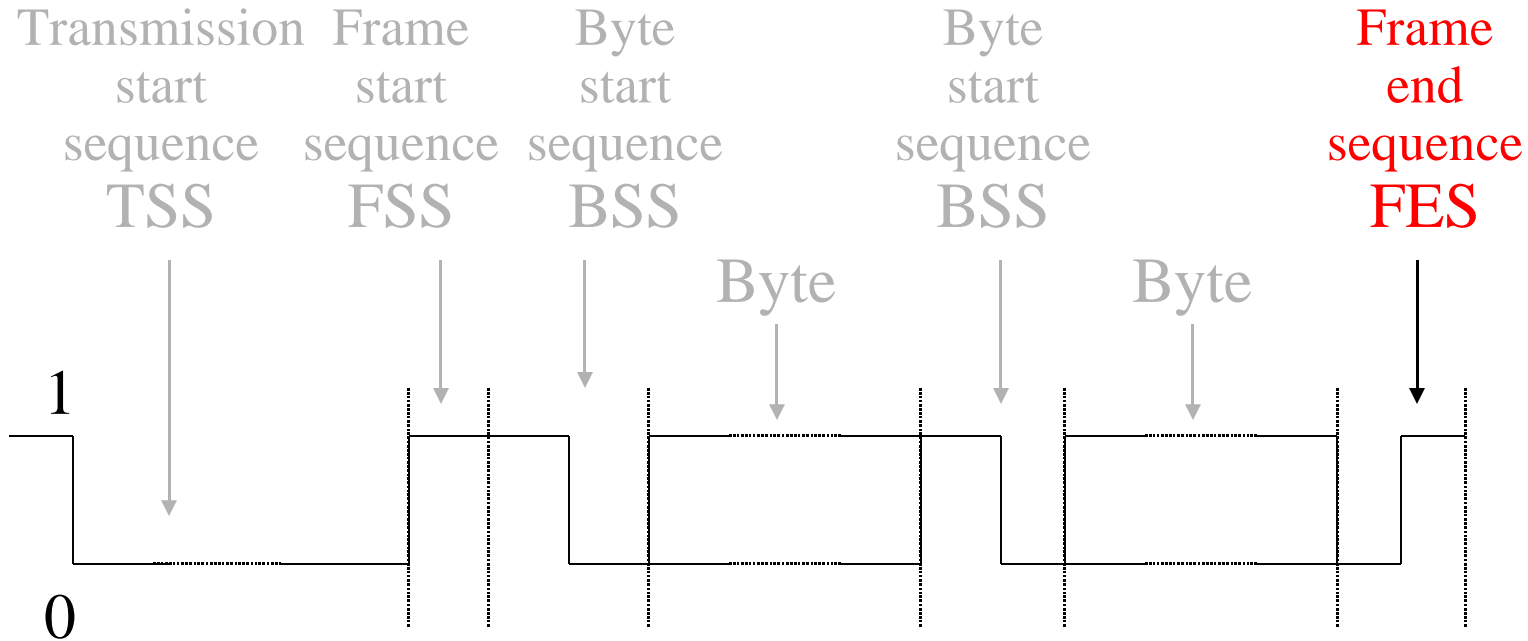
Frame coding in static segment

# Encoding (ENC) Frames



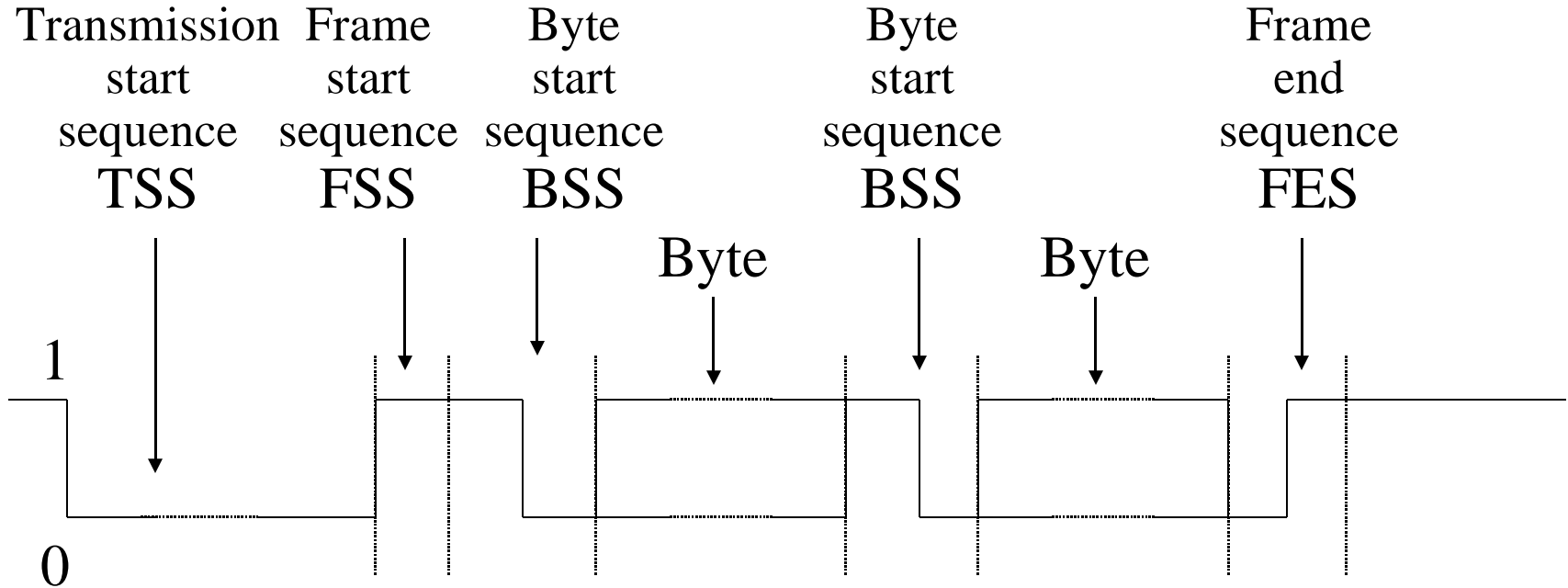
Frame coding in static segment

# Encoding (ENC) Frames



Frame coding in static segment

# Encoding (ENC) Frames



Frame coding in static segment

# Encoding (ENC) Symbols

Collision avoidance and  
media access test symbol (CAS/MTS):

$TSS+0^{30}$

Wakeup symbol (WUS):

$0^{15-60}+idle^{45-180}$

sent in a wakeup pattern (WUP):  $WUS^{2-63}$

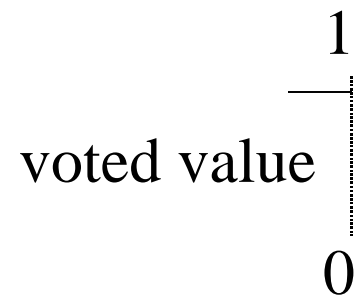
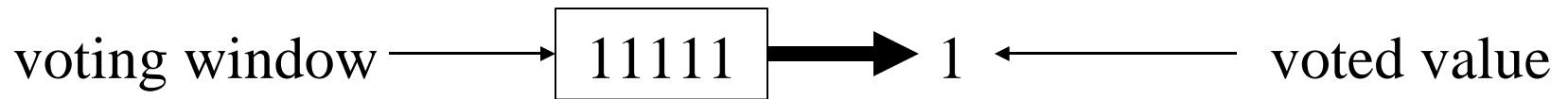


# Bit strobing (BITSTRB)

- Takes 8 samples of every bit
- Majority voting over last 5 bit samples
- Selects 1 sample out of 8
- Low level synchronization

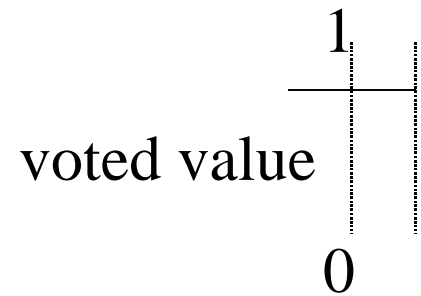
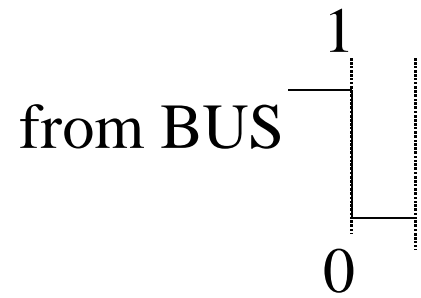
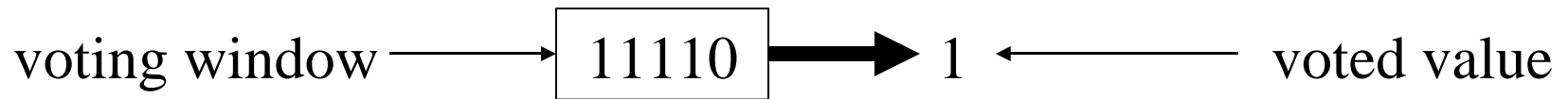
# Bit strobing: Majority voting

## Majority voting over last 5 bit samples



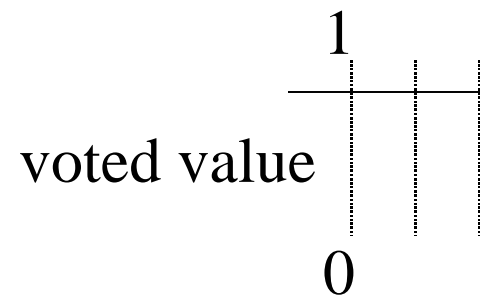
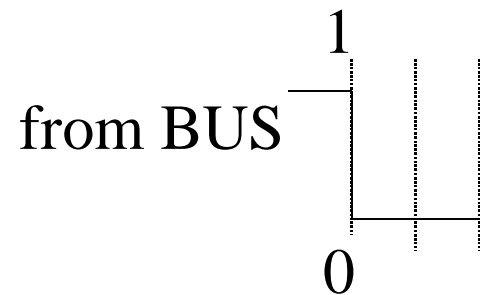
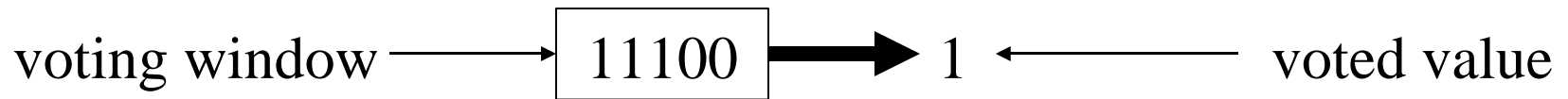
# Bit strobing: Majority voting

## Majority voting over last 5 bit samples



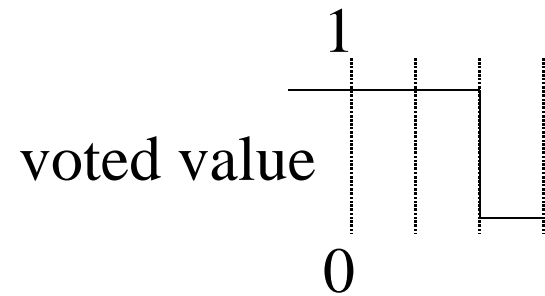
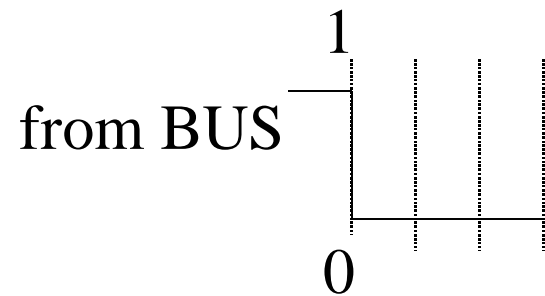
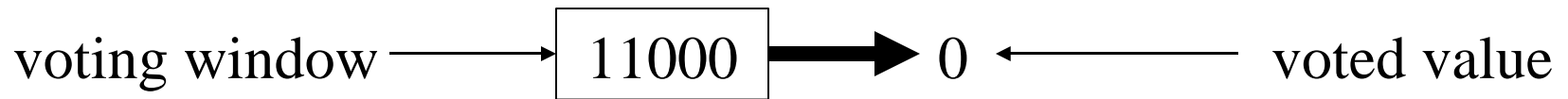
# Bit strobing: Majority voting

## Majority voting over last 5 bit samples



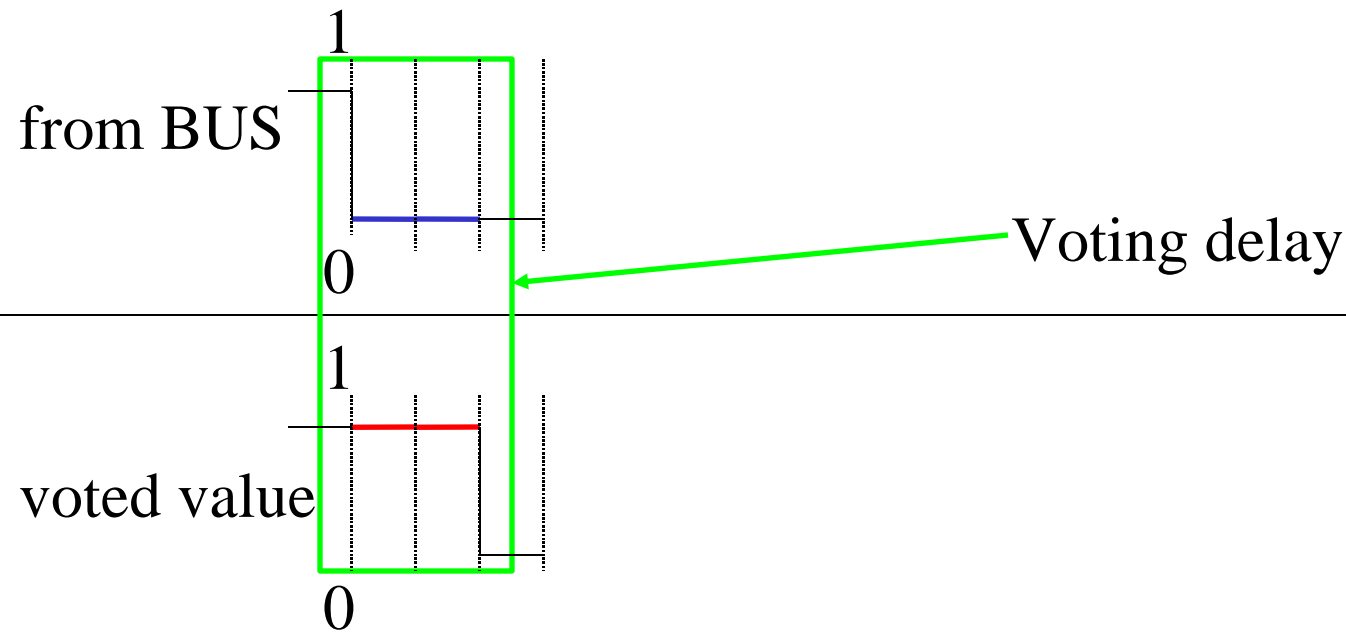
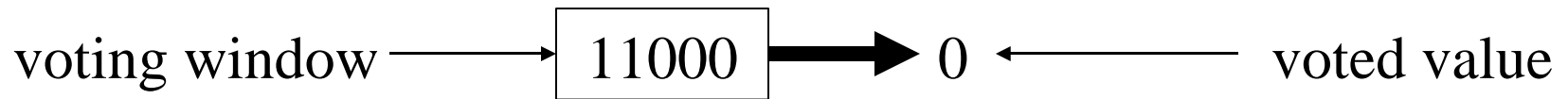
# Bit strobing: Majority voting

## Majority voting over last 5 bit samples



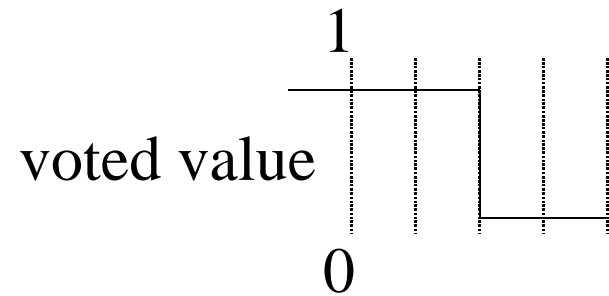
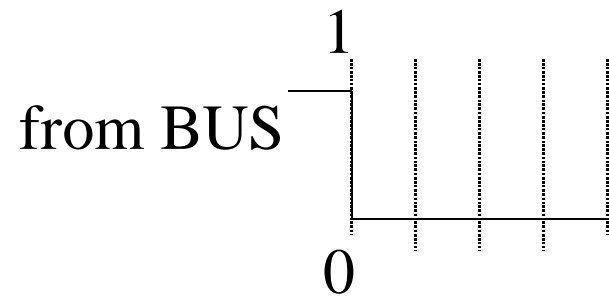
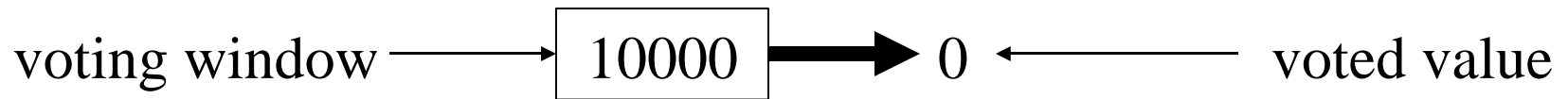
# Bit strobing: Majority voting

## Majority voting over last 5 bit samples



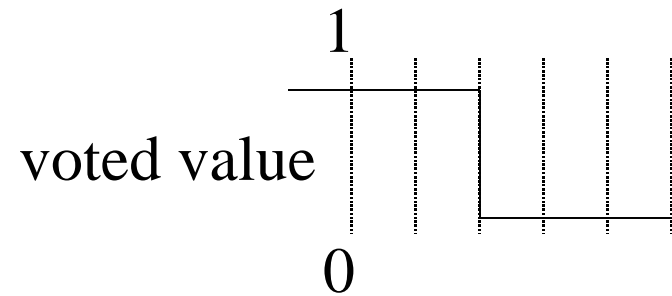
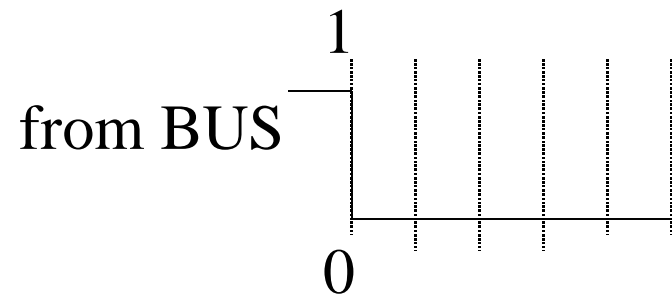
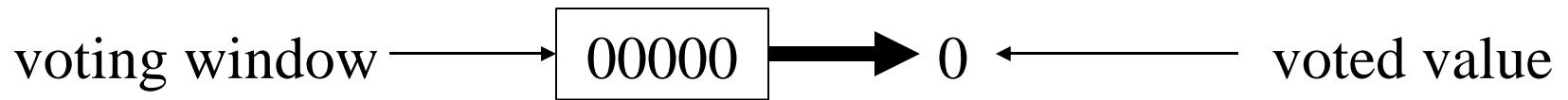
# Bit strobing: Majority voting

## Majority voting over last 5 bit samples



# Bit strobing: Majority voting

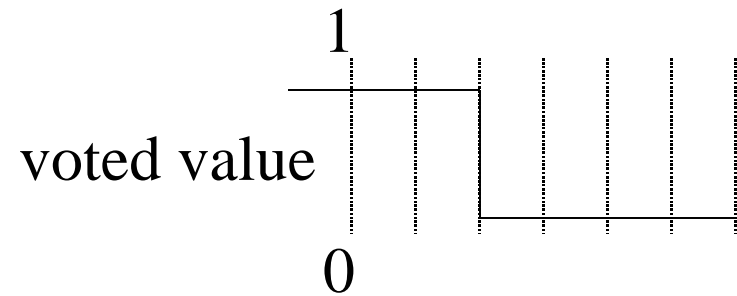
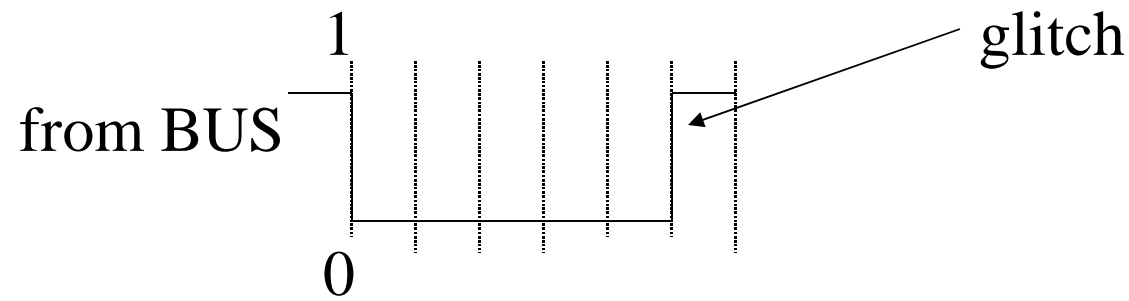
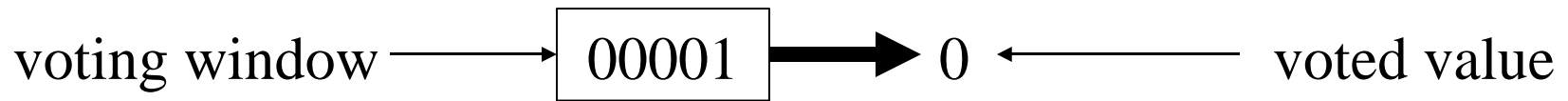
## Majority voting over last 5 bit samples





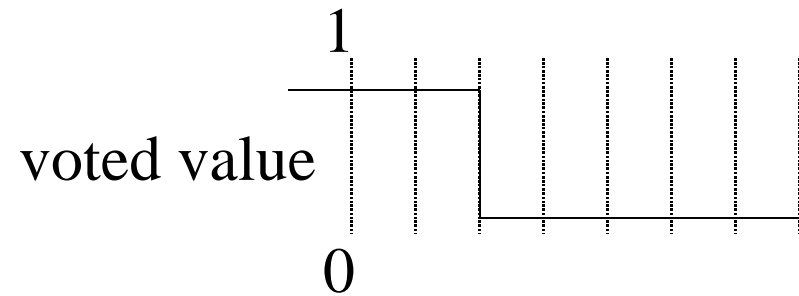
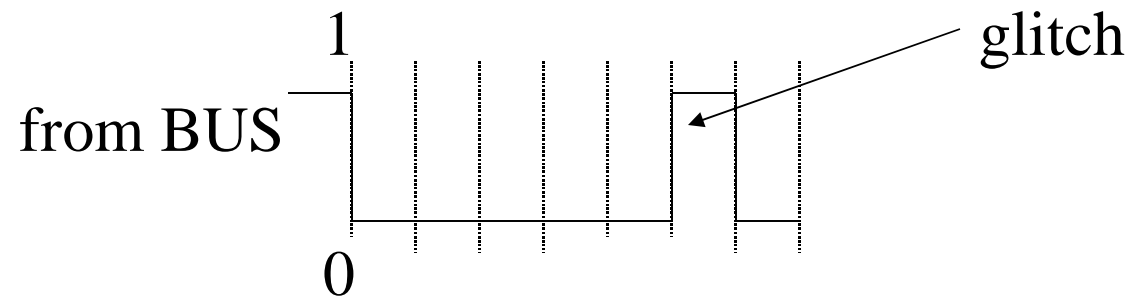
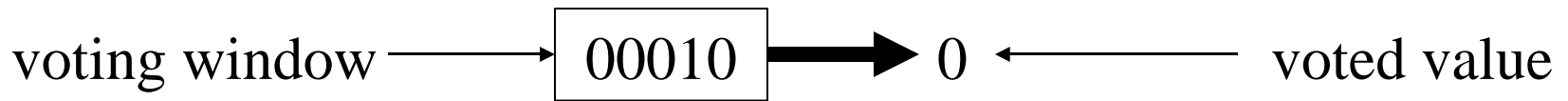
# Bit strobing: Majority voting

## Majority voting over last 5 bit samples



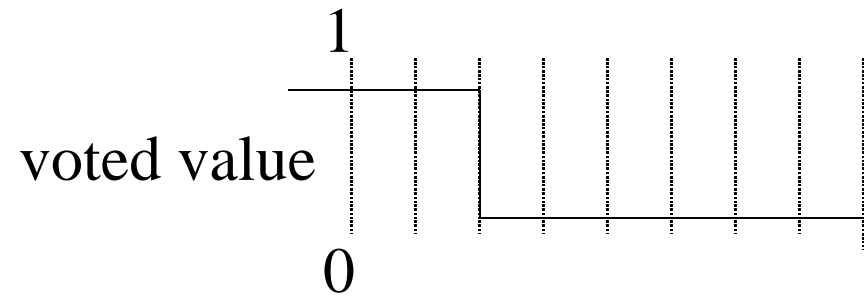
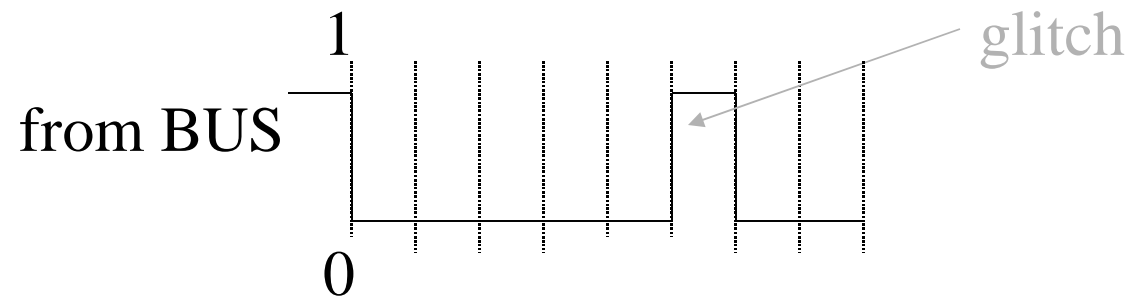
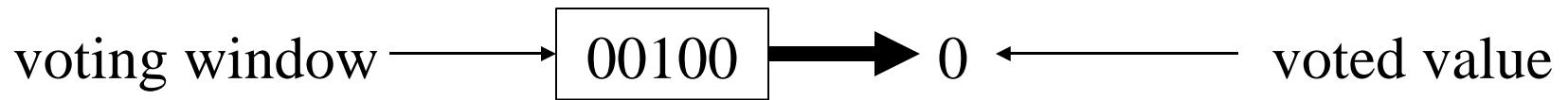
# Bit strobing: Majority voting

## Majority voting over last 5 bit samples



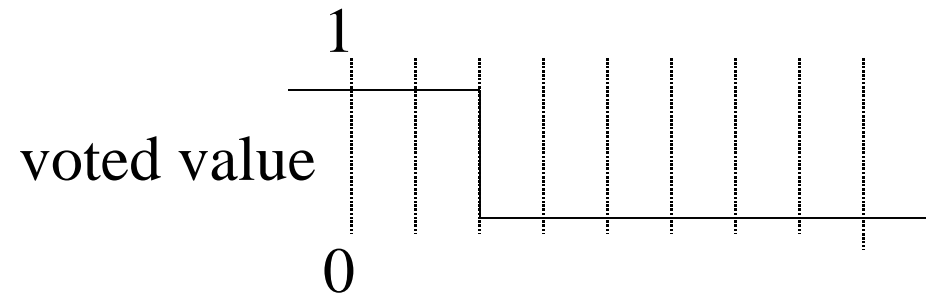
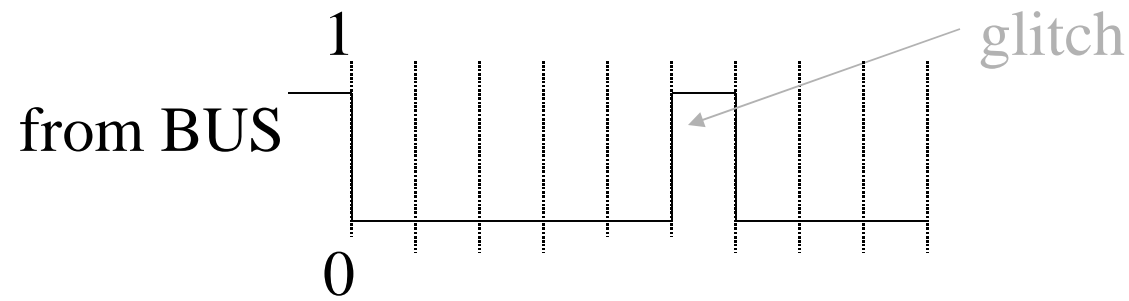
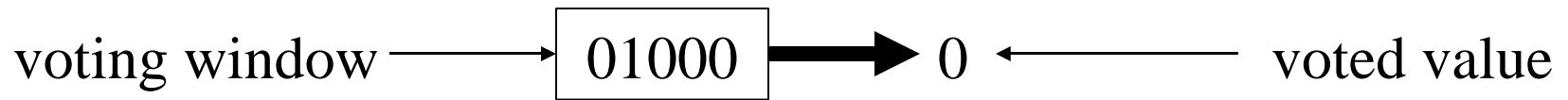
# Bit strobing: Majority voting

## Majority voting over last 5 bit samples



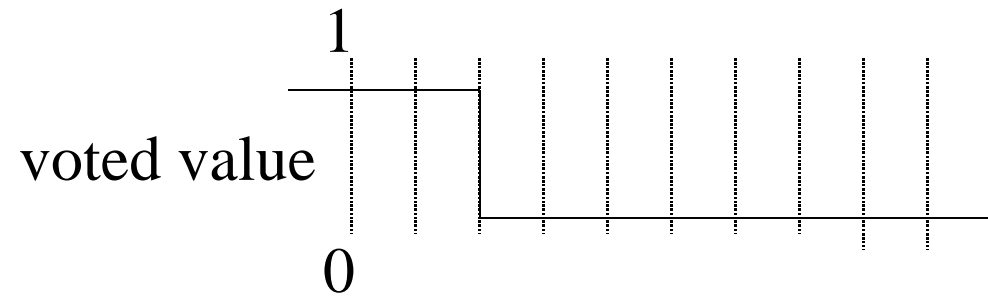
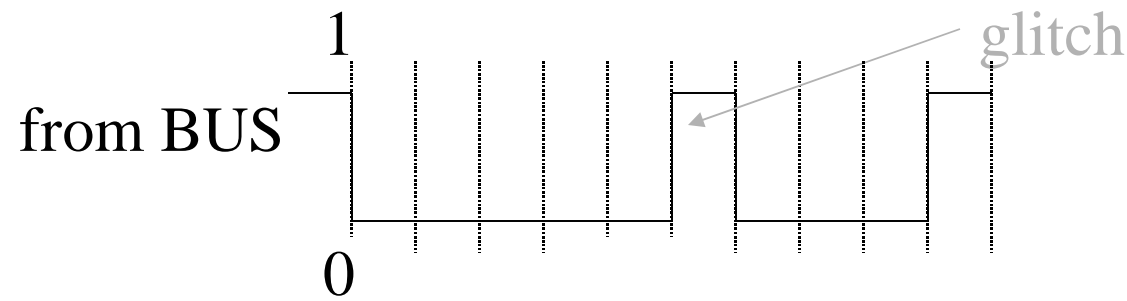
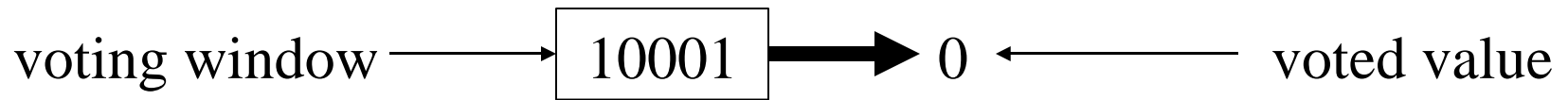
# Bit strobing: Majority voting

## Majority voting over last 5 bit samples



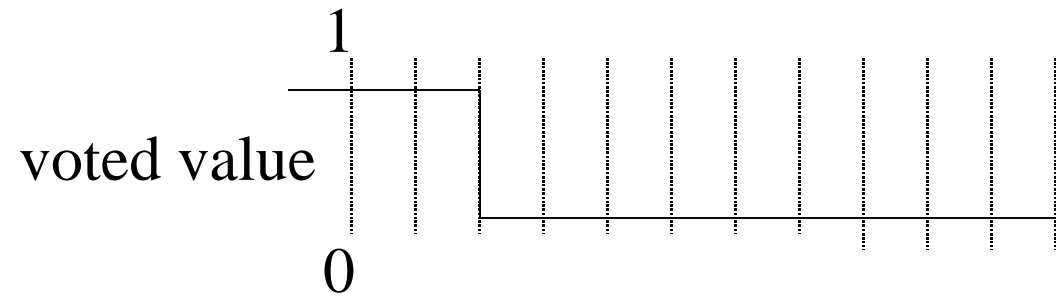
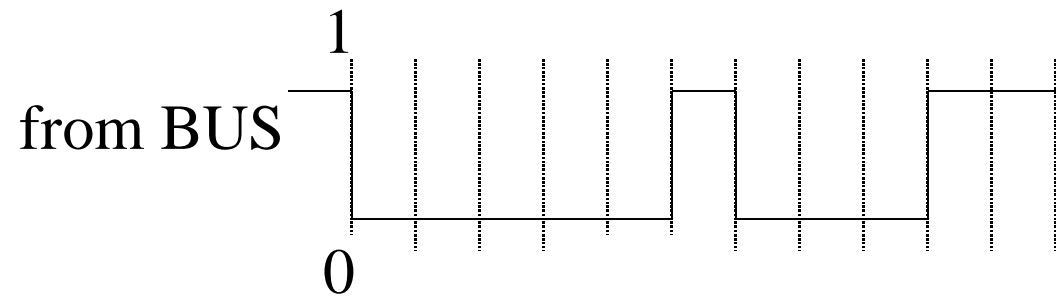
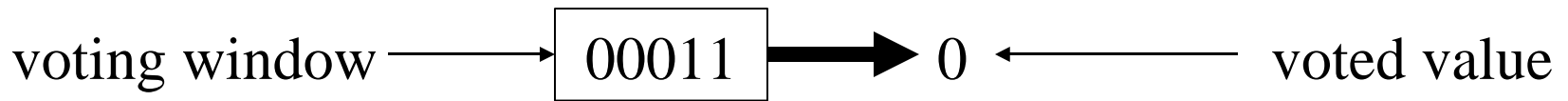
# Bit strobing: Majority voting

## Majority voting over last 5 bit samples



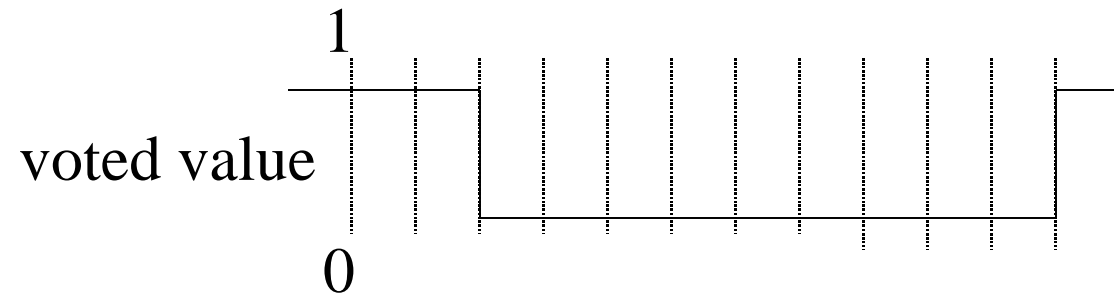
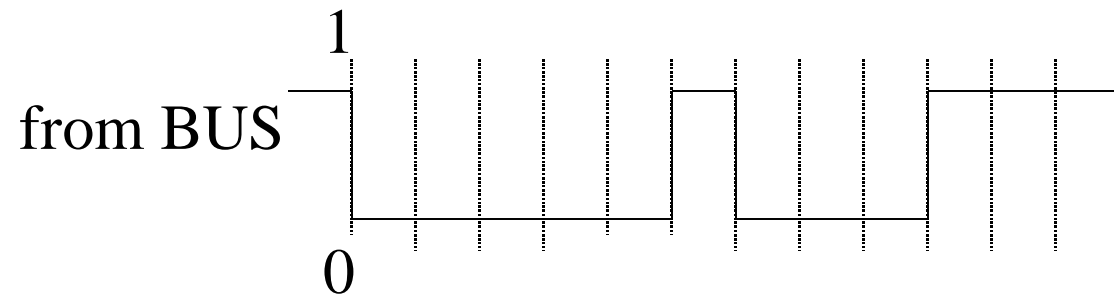
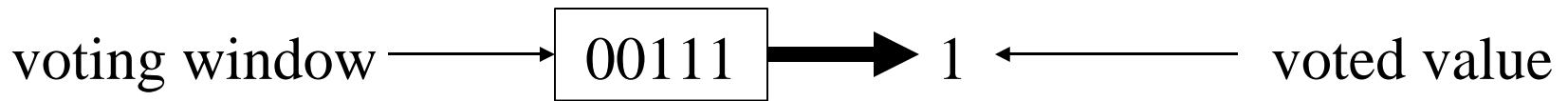
# Bit strobing: Majority voting

## Majority voting over last 5 bit samples



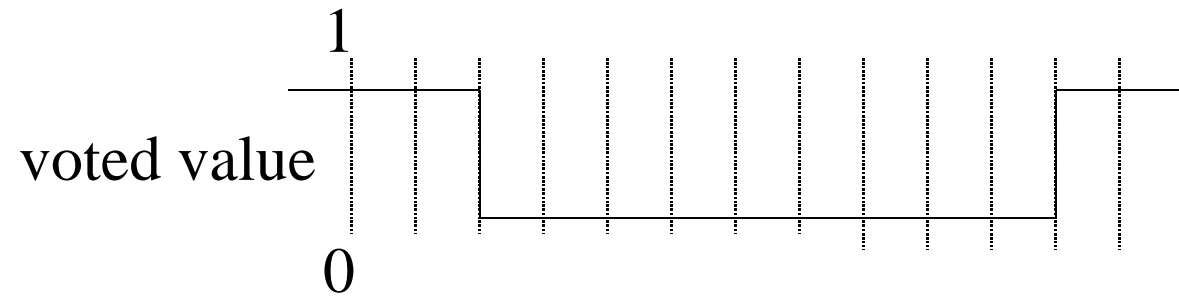
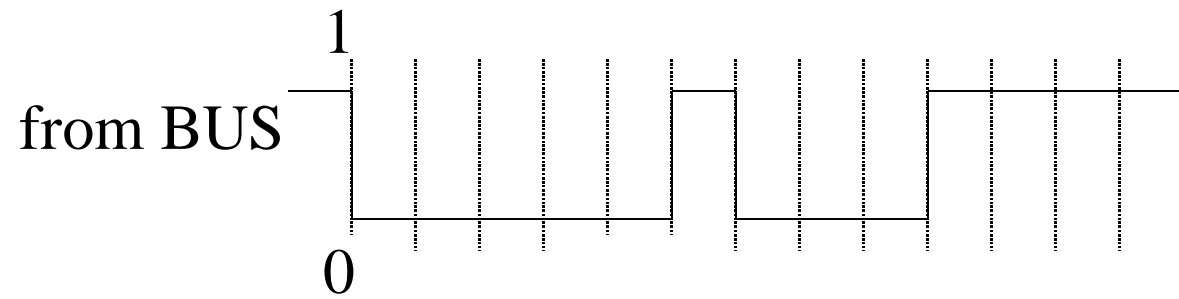
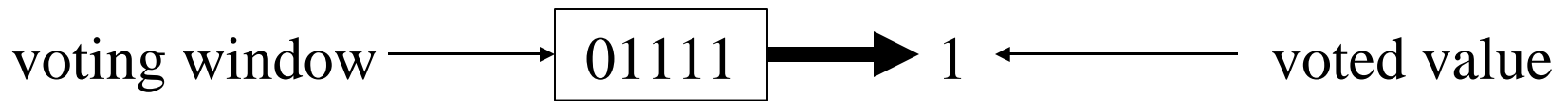
# Bit strobing: Majority voting

## Majority voting over last 5 bit samples



# Bit strobing: Majority voting

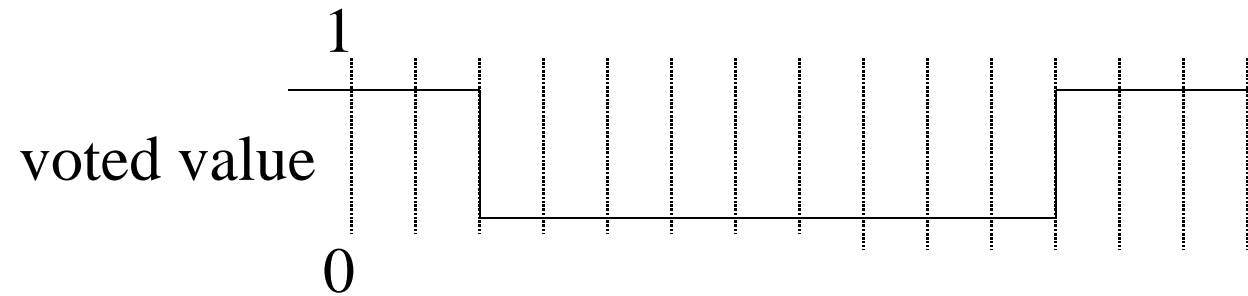
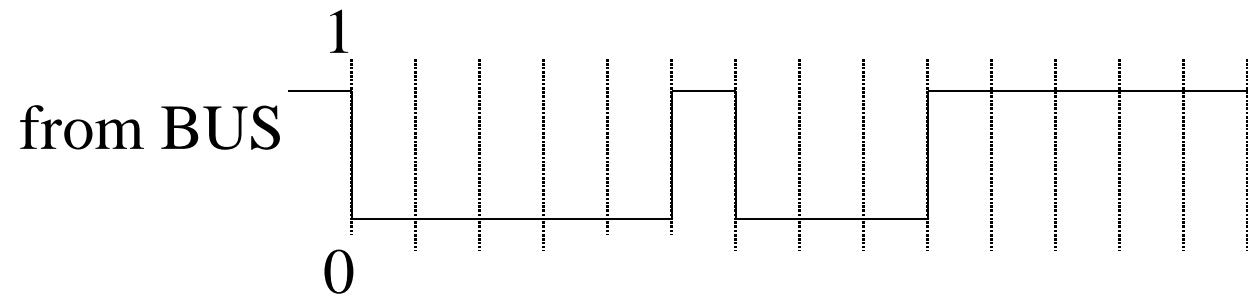
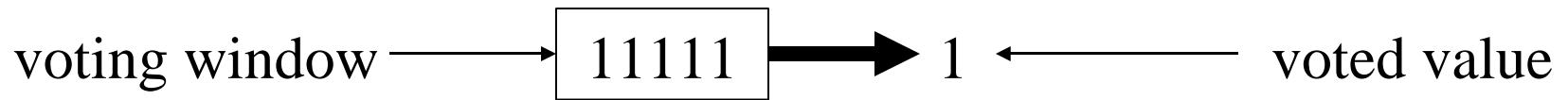
## Majority voting over last 5 bit samples





# Bit strobing: Majority voting

## Majority voting over last 5 bit samples

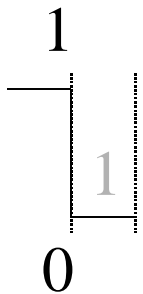




# Bit strobing: Strobing

- Every 5<sup>th</sup> sample out of the 8 samples „strobed“
- Low-level synchronization of strobecounter in BSS

voted value

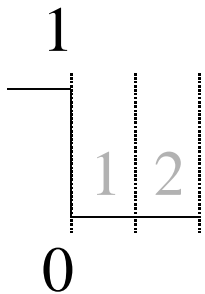


Strobecounter 1  
:

# Bit strobing: Strobing

- Every 5<sup>th</sup> sample out of the 8 samples „strobed“
- Low-level synchronization of strobecounter in BSS

voted value

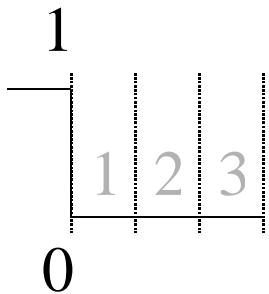


Strobecounter 2  
:

# Bit strobing: Strobing

- Every 5<sup>th</sup> sample out of the 8 samples „strobed“
- Low-level synchronization of strobecounter in BSS

voted value

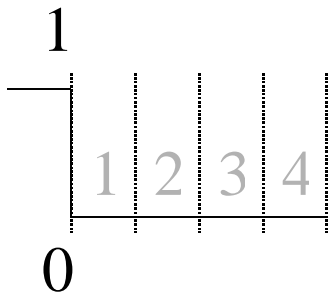


Strobecounter 3  
:

# Bit strobing: Strobing

- Every 5<sup>th</sup> sample out of the 8 samples „strobed“
- Low-level synchronization of strobecounter in BSS

voted value

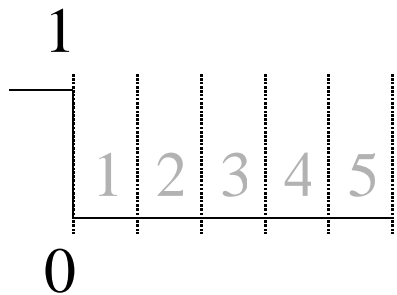


Strobecounter 4  
:

# Bit strobing: Strobing

- Every 5<sup>th</sup> sample out of the 8 samples „strobed“
- Low-level synchronization of strobecounter in BSS

voted value

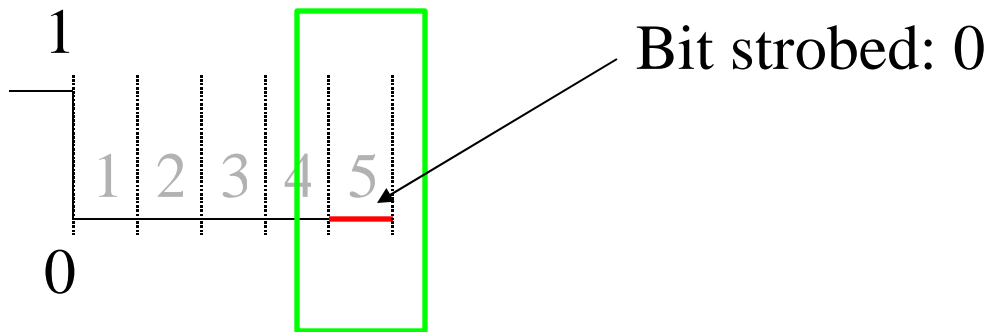


Strobecounter 5  
:

# Bit strobing: Strobing

- Every 5<sup>th</sup> sample out of the 8 samples „strobed“
- Low-level synchronization of strobecounter in BSS

voted value



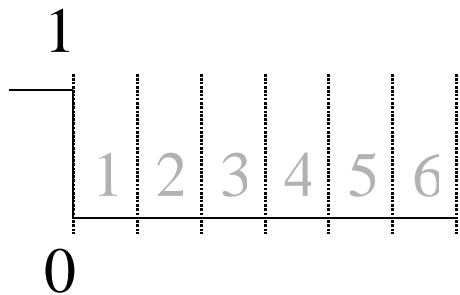
Strobecounter 5  
:



# Bit strobing: Strobing

- Every 5<sup>th</sup> sample out of the 8 samples „strobed“
- Low-level synchronization of strobecounter in BSS

voted value

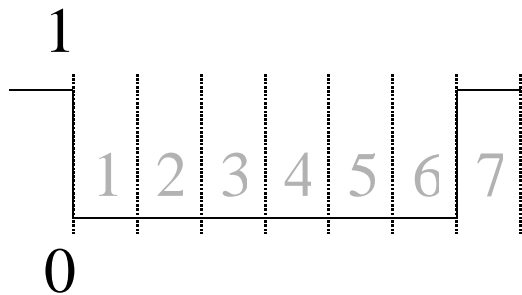


Strobecounter 6  
:

# Bit strobing: Strobing

- Every 5<sup>th</sup> sample out of the 8 samples „strobed“
- Low-level synchronization of strobecounter in BSS

voted value

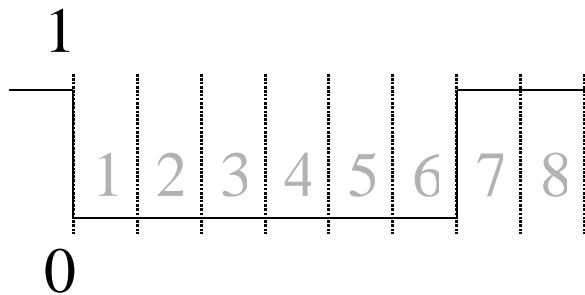


Strobecounter 7  
:

# Bit strobing: Strobing

- Every 5<sup>th</sup> sample out of the 8 samples „strobed“
- Low-level synchronization of strobecounter in BSS

voted value

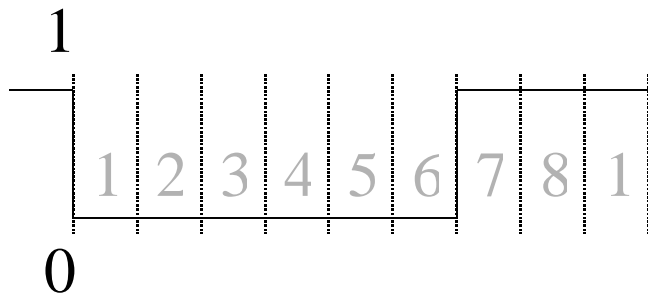


Strobecounter 8  
:

# Bit strobing: Strobing

- Every 5<sup>th</sup> sample out of the 8 samples „strobed“
- Low-level synchronization of strobecounter in BSS

voted value



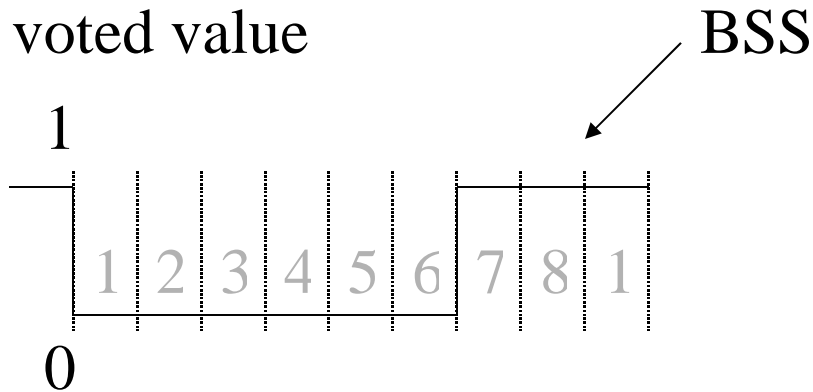
Strobecounter 

1
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:

# Bit strobing: Synchronization

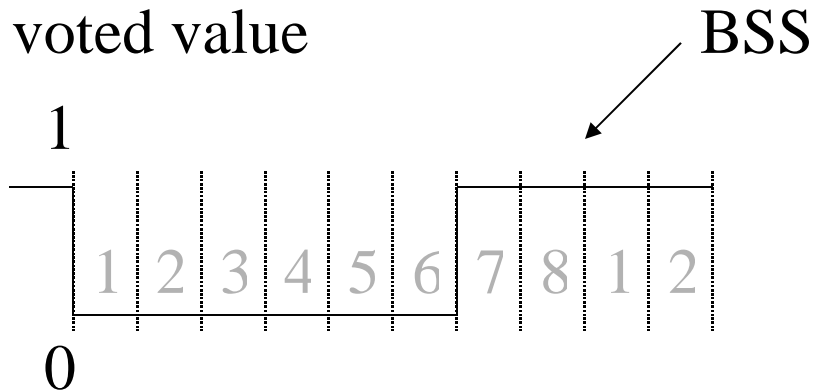
- Every 5<sup>th</sup> sample out of the 8 samples „strobed“
- Low-level synchronization of strobecounter in BSS



Strobecounter 1  
:

# Bit strobing: Synchronization

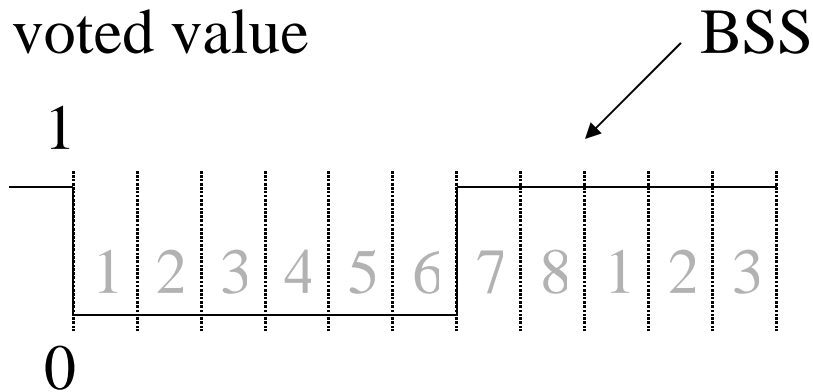
- Every 5<sup>th</sup> sample out of the 8 samples „strobed“
- Low-level synchronization of strobecounter in BSS



Strobecounter 2  
:

# Bit strobing: Synchronization

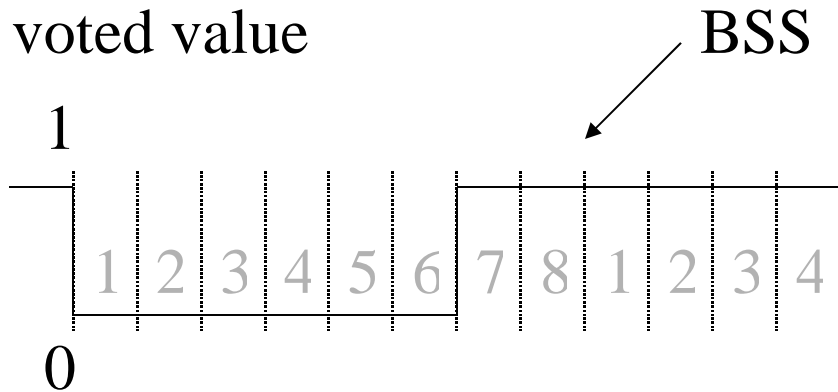
- Every 5<sup>th</sup> sample out of the 8 samples „strobed“
- Low-level synchronization of strobecounter in BSS



Strobecounter 3  
:

# Bit strobing: Synchronization

- Every 5<sup>th</sup> sample out of the 8 samples „strobed“
- Low-level synchronization of strobecounter in BSS

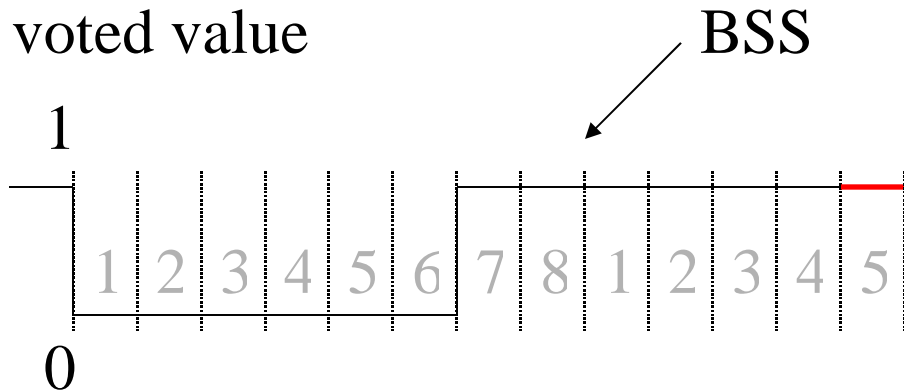


Strobecounter 4  
:



# Bit strobing: Synchronization

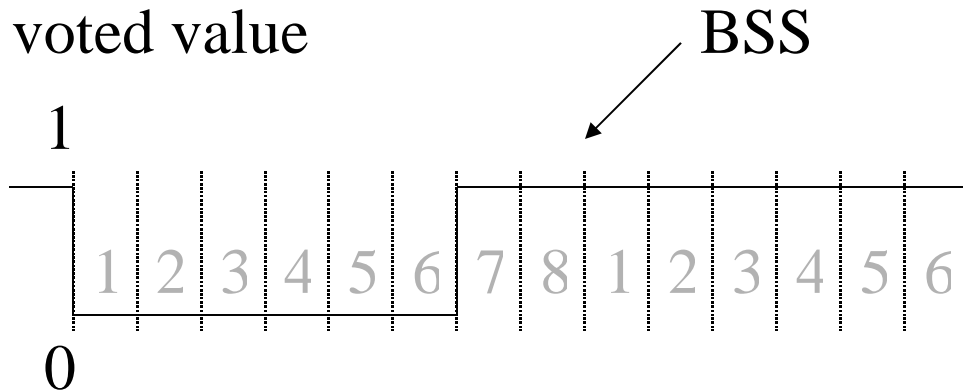
- Every 5<sup>th</sup> sample out of the 8 samples „strobed“
- Low-level synchronization of strobecounter in BSS



Strobecounter 5  
:

# Bit strobing: Synchronization

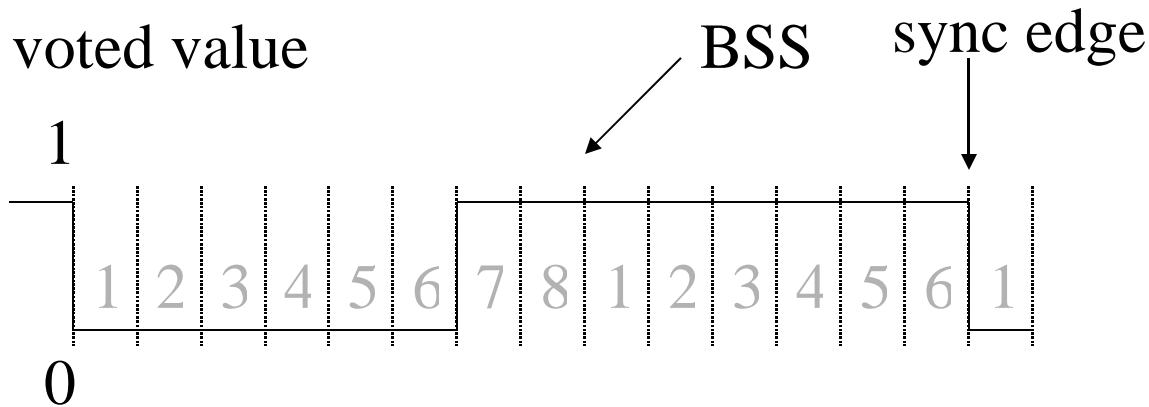
- Every 5<sup>th</sup> sample out of the 8 samples „strobed“
- Low-level synchronization of strobecounter in BSS



Strobecounter 6  
:

# Bit strobing: Synchronization

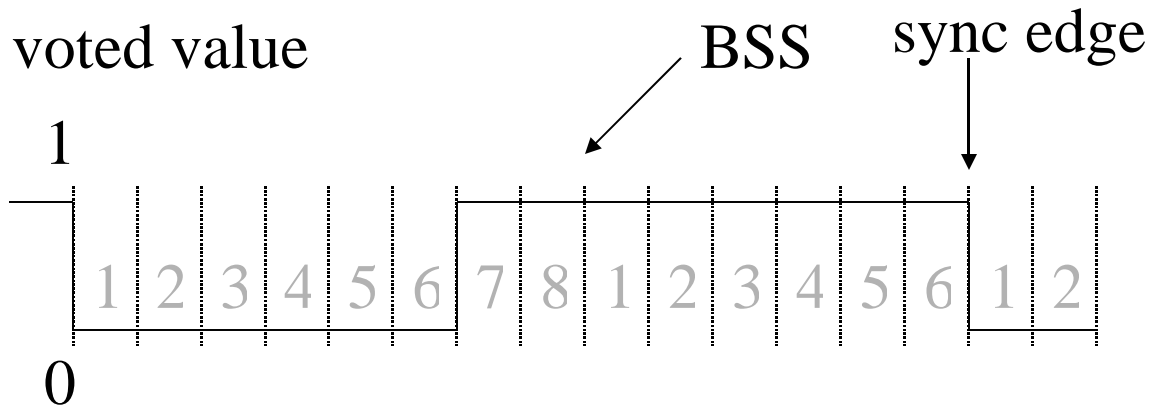
- Every 5<sup>th</sup> sample out of the 8 samples „strobed“
- Low-level synchronization of strobecounter in BSS



Strobecounter 1  
:

# Bit strobing: Synchronization

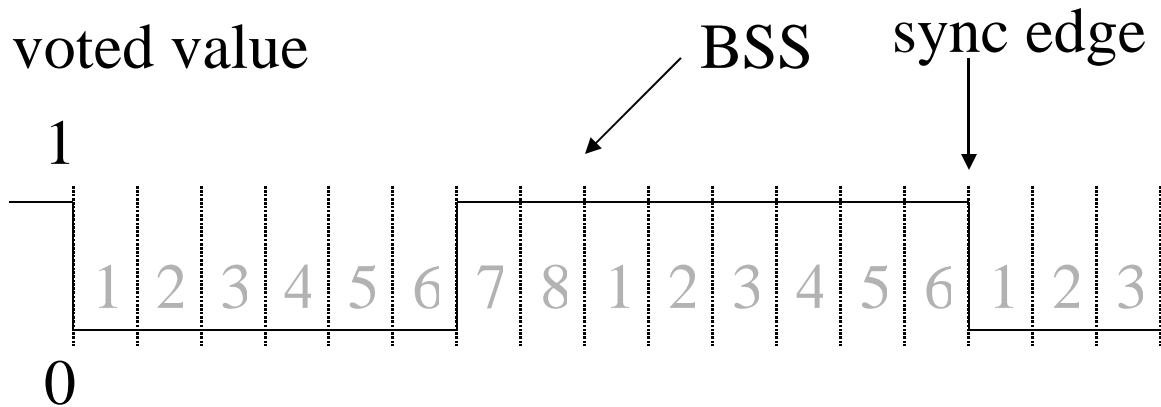
- Every 5<sup>th</sup> sample out of the 8 samples „strobed“
- Low-level synchronization of strobecounter in BSS



Strobecounter 2  
:

# Bit strobing: Synchronization

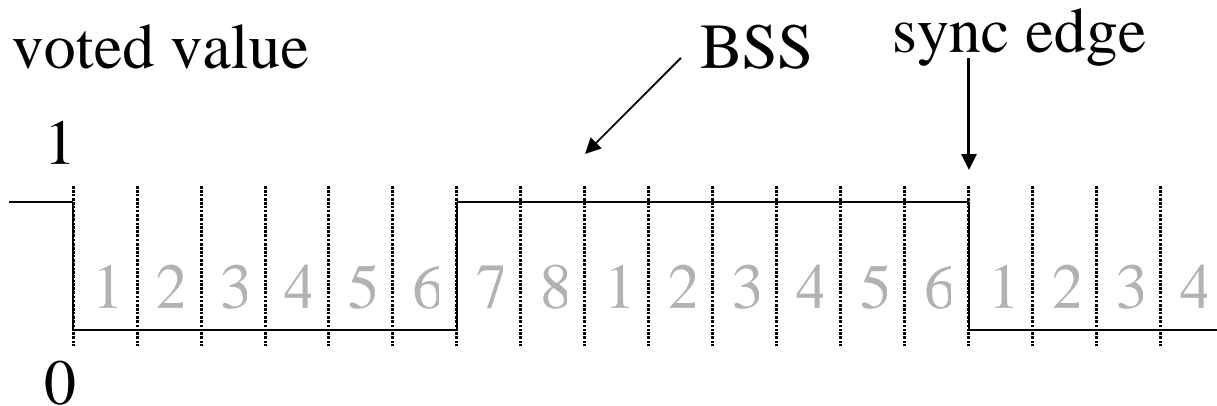
- Every 5<sup>th</sup> sample out of the 8 samples „strobed“
- Low-level synchronization of strobecounter in BSS



Strobecounter 3  
:

# Bit strobing: Synchronization

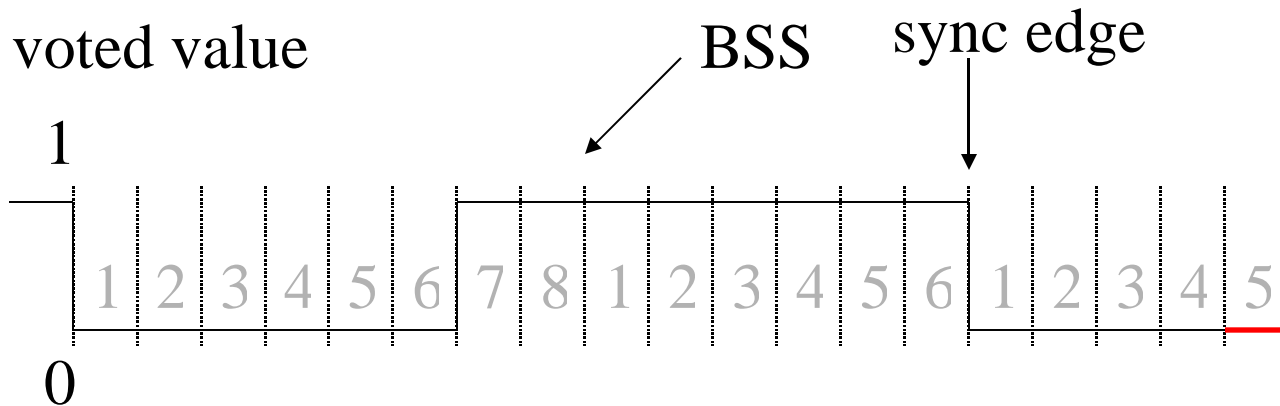
- Every 5<sup>th</sup> sample out of the 8 samples „strobed“
- Low-level synchronization of strobecounter in BSS



Strobecounter 4  
:

# Bit strobing: Synchronization

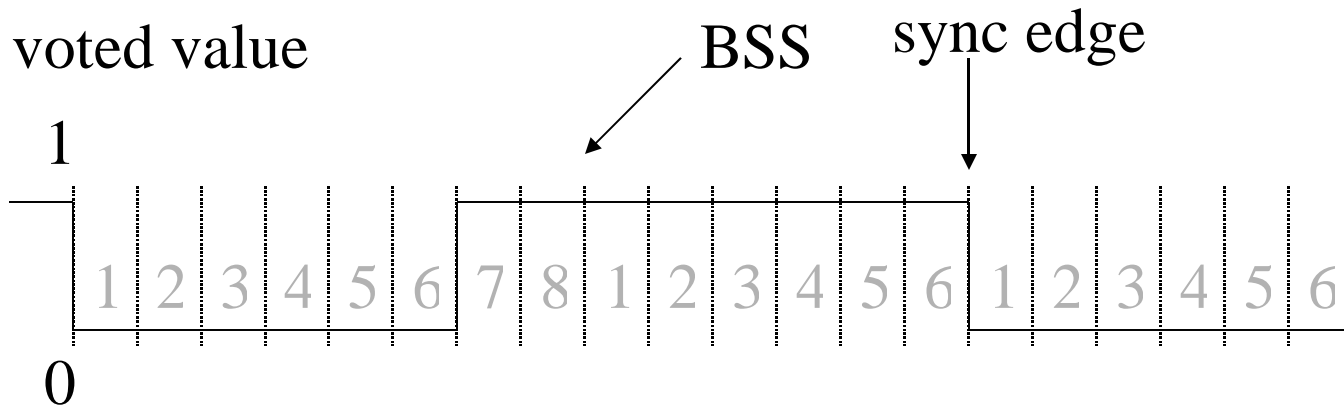
- Every 5<sup>th</sup> sample out of the 8 samples „strobed“
- Low-level synchronization of strobecounter in BSS



Strobecounter 5  
:

# Bit strobing: Synchronization

- Every 5<sup>th</sup> sample out of the 8 samples „strobed“
- Low-level synchronization of strobecounter in BSS

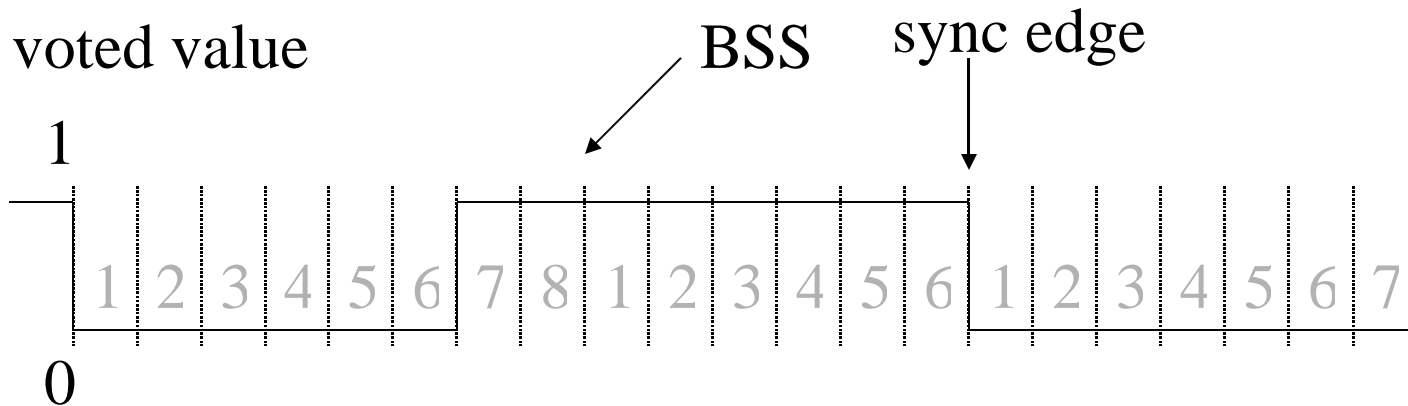


Strobecounter 6  
:



# Bit strobing: Synchronization

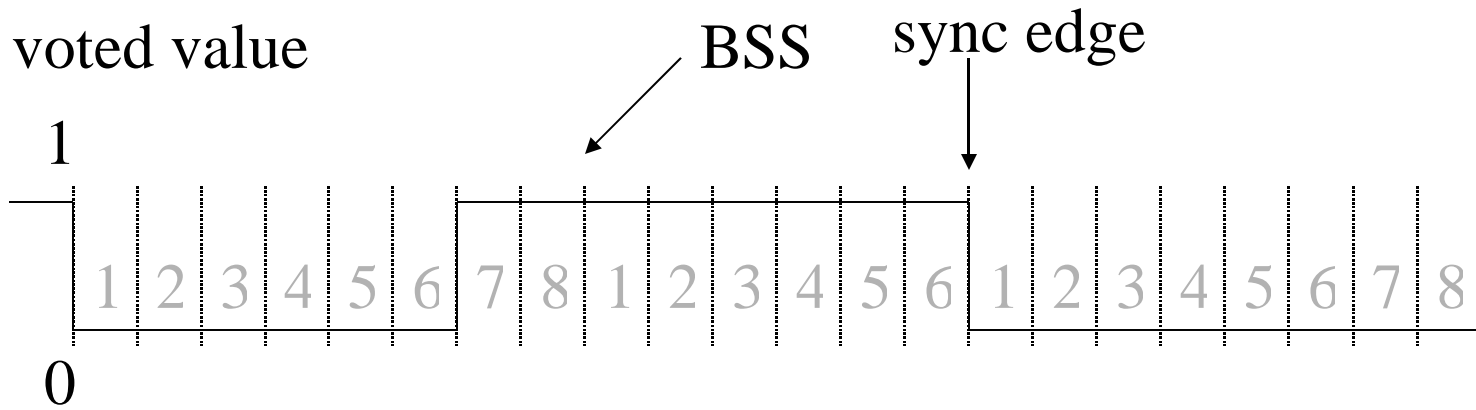
- Every 5<sup>th</sup> sample out of the 8 samples „strobed“
- Low-level synchronization of strobecounter in BSS



Strobecounter 7  
:

# Bit strobing: Synchronization

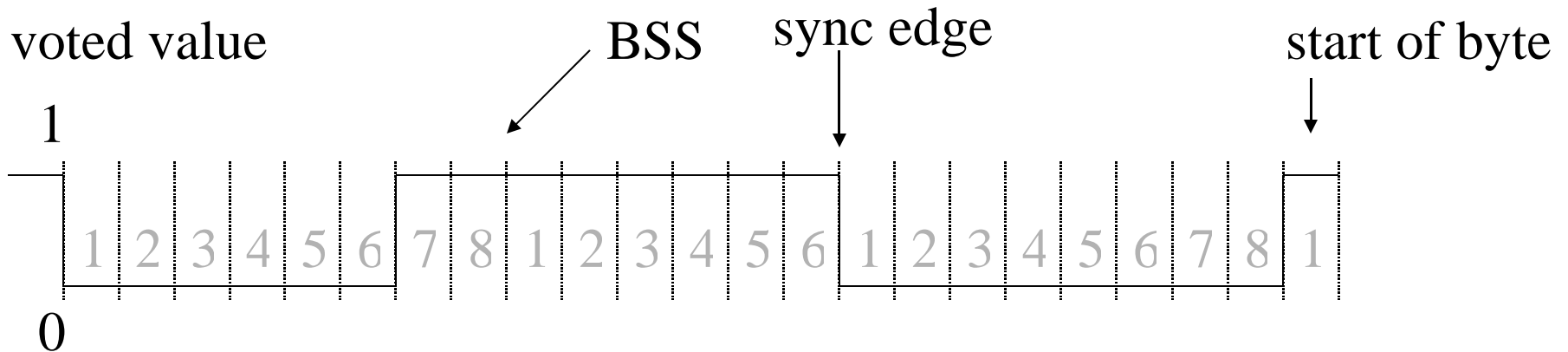
- Every 5<sup>th</sup> sample out of the 8 samples „strobed“
- Low-level synchronization of strobecounter in BSS



Strobecounter 8  
:

# Bit strobing: Synchronization

- Every 5<sup>th</sup> sample out of the 8 samples „strobed“
- Low-level synchronization of strobecounter in BSS



Strobecounter 1  
:

# Wakeup symbol decoding (WUSDEC)

- Waits for a WUP like pattern:

$$0^x+1^y+0^x$$

produced by two consecutive WUS

- Reports to protocol operation control(POC)

# Channel idle (IDET)

Whenever  $1^{11}$  is received,  
a channel idle recognition point (CHIRP)  
is reported.

# Decoding (DEC)

- Handles reception of CAS/MTS and frames
- Interface from BITSTRB to FSP and POC
- Checks for errors

## **Frames:**

- reassembles the message
- checks format
- checks CRC (frame “fingerprint”)

## **CAS/MTS:**

- checks length of  
LOW signal

# Frame and symbol processing (FSP)

- Interface from DEC to Host
- Controls integrity of communication:
  - Checks for appropriate segment
  - Checks length of communication elements
  - Checks for correct header
- Reports errors
- Dismantles frame and passes on the payload

