Improving Interoperability between Autoneg and Forced Mode PHY

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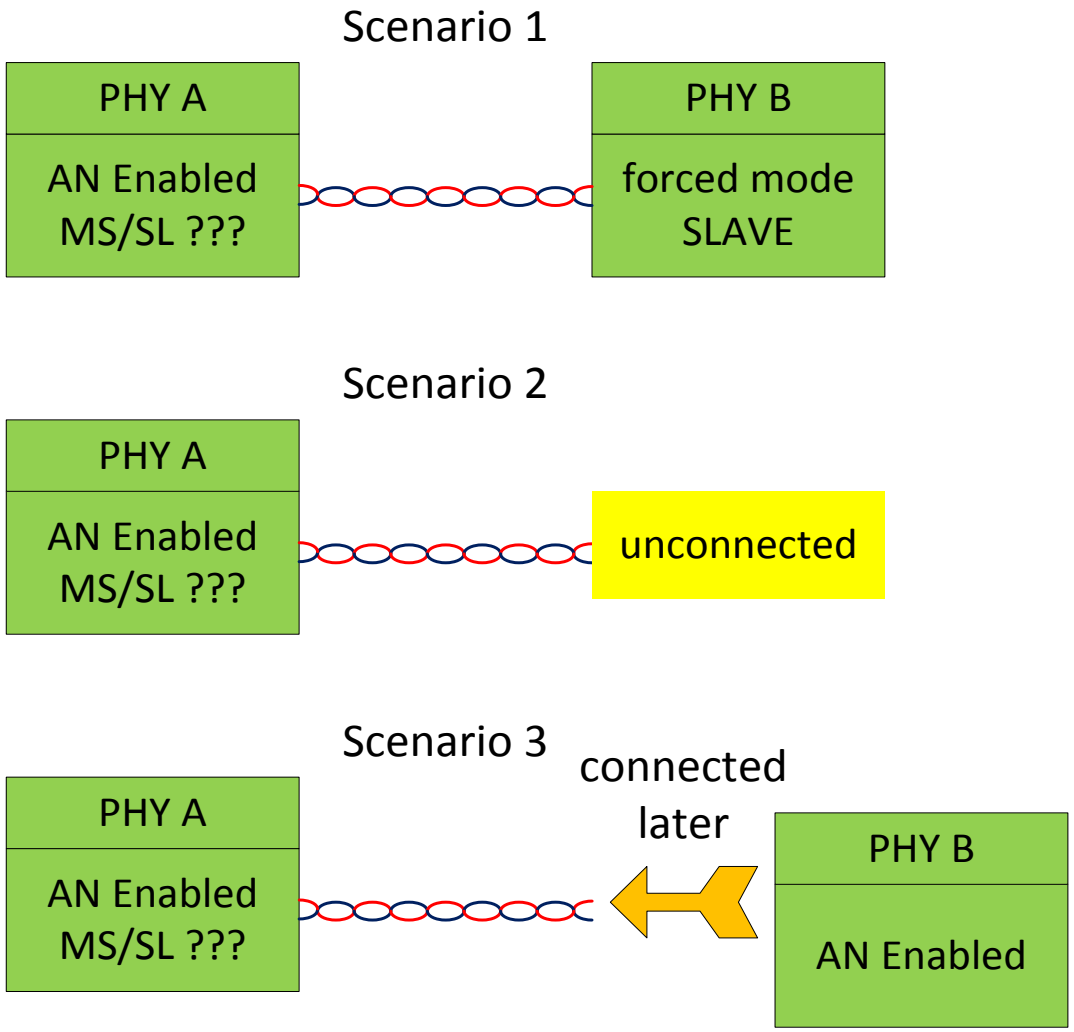
Motivation

- D1.2 defines two synchronization methods
  - Clause 98 single twisted pair auto-negotiation
  - Sub-Clause 97.6 aka forced mode
  - Unable to link between PHYs with different synchronization methods

- For a PHY supporting both autoneg and forced mode, what changes to D1.2 are needed to enable link with PHY supporting only one of the synchronization methods?

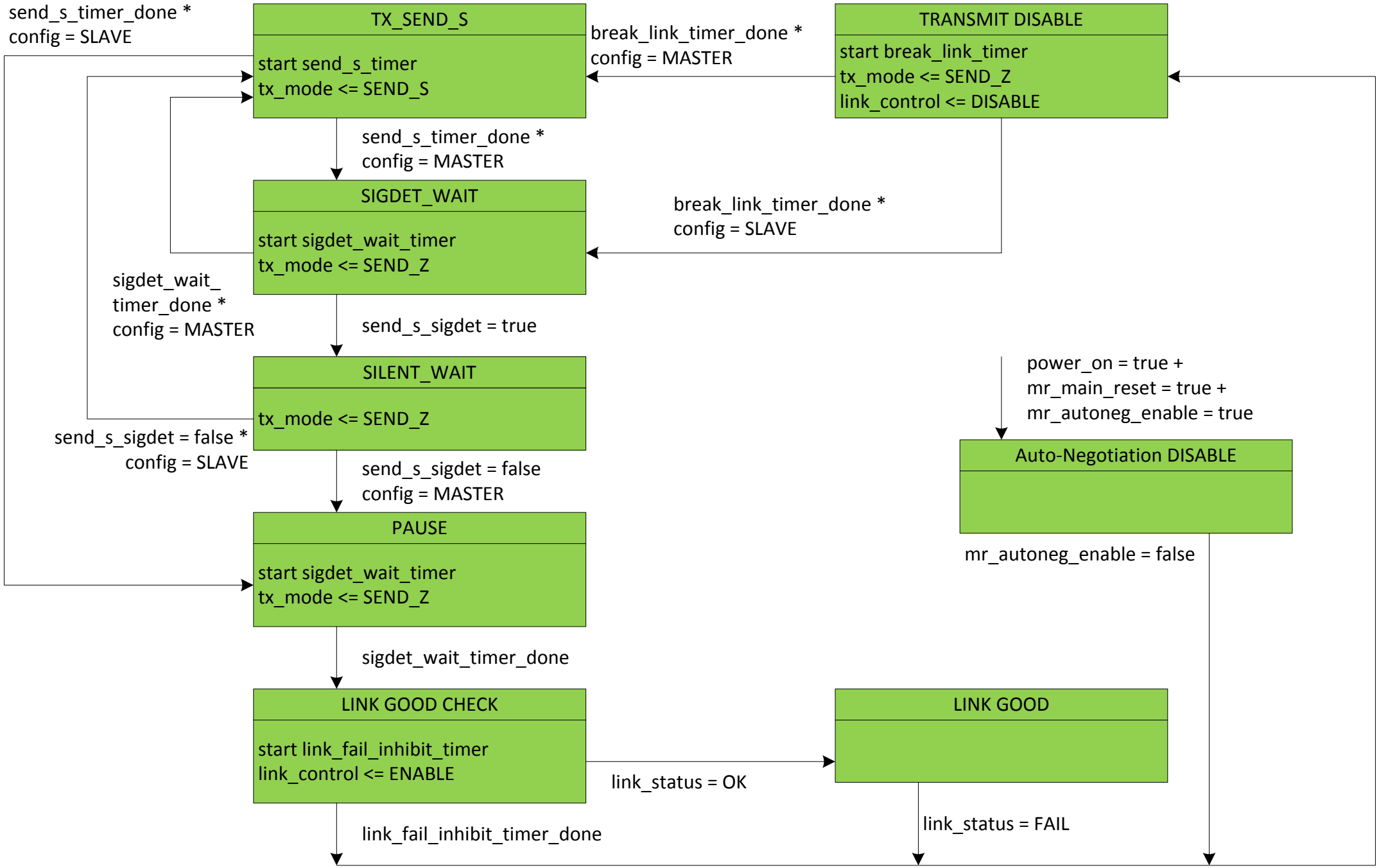
A Corner Case



- Based on D1.2 state diagrams, PHY A will not be able to tell if link partner is connected or not.
- Solution #1
  - PHY A Tx alternates between AN link pulses and SEND_S (MS)
  - Problem: If PHY B with AN support is connected later, they may go into forced mode instead of desired AN.
- Solution #2
  - SLAVE PHY in forced mode needs to start SEND_S (SL)
  - Some changes to SEND_S state diagram is required
  - AN state diagram adding optional SEND_S detection

Forced Mode State Diagram Figure 97-27

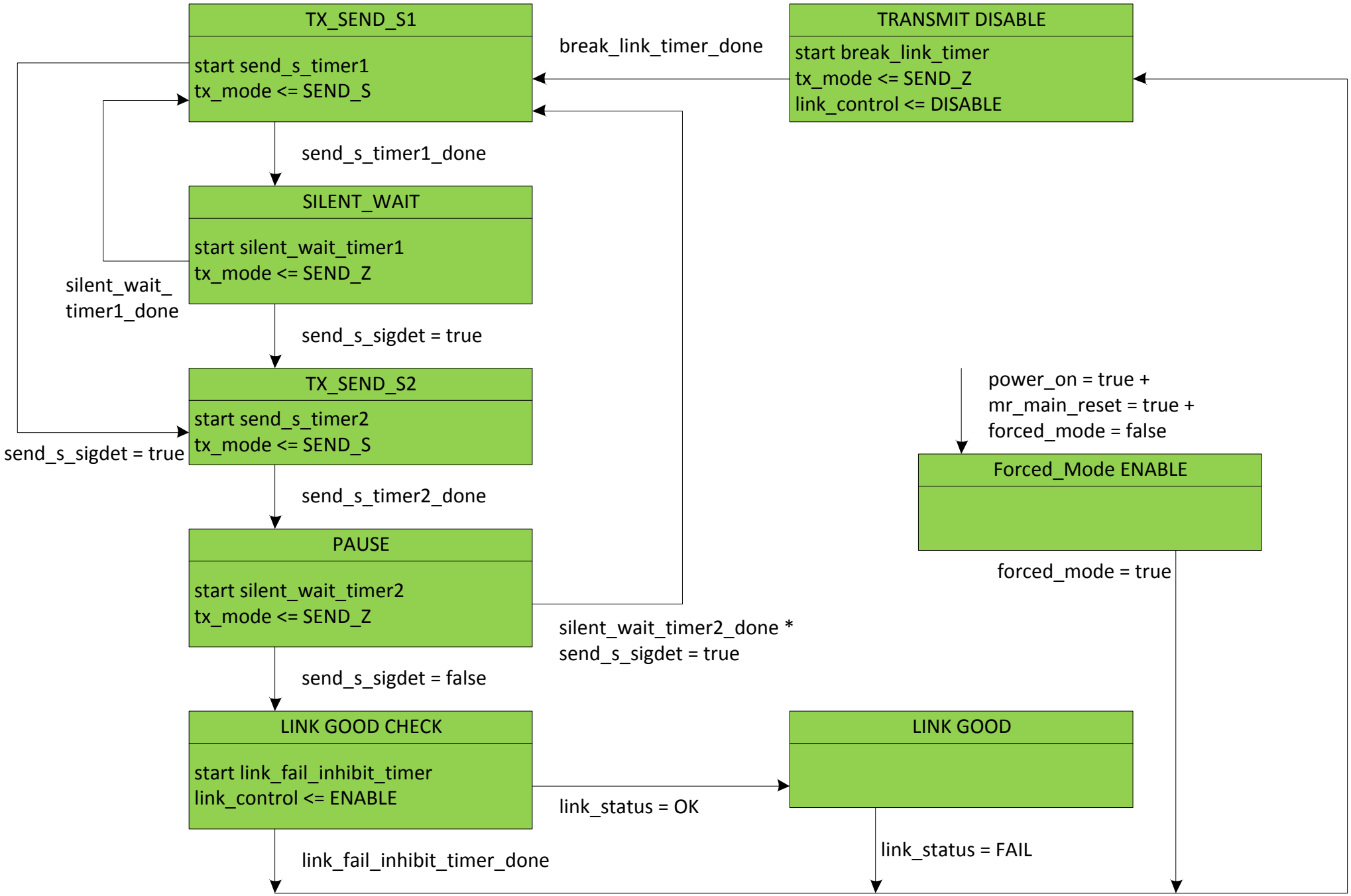
Forced mode
(Fig 97-27)
-- Original



Changes to Figure 97-27

- Same state machine for MS and SL PHY
- SEND_S sigdet does no require turning off transmitter
  - This is always the case, but original state diagram assumes half-duplex.
- Synchronization is achieved when exiting the PAUSE state, when both transmitters are turned off
- Additional state variable “forced_mode”
  - When AN is disabled, default “forced_mode=true” after power_on/reset
  - When AN is enabled, default “forced_mode=false” after power_on/reset
  - AN state machine will set “forced_mode=true” if optional parallel detection sees SEND_S

Forced mode
(Fig 97-27)
-- New

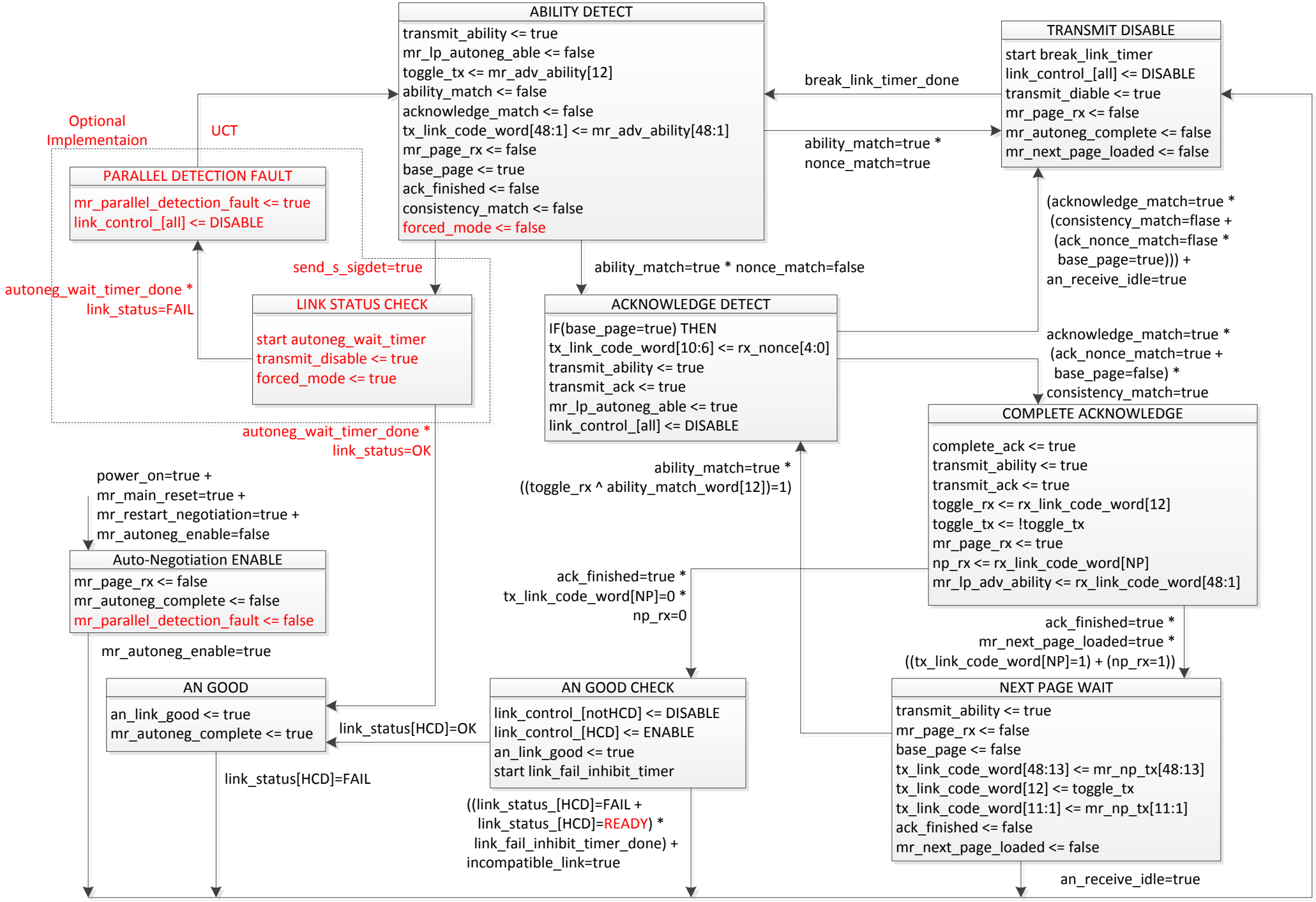


Timers

- send_s_timer1: Timer used to control the duration SEND_S is transmitted during TX_SEND_S1. The timer shall expire 1.0 us±0.04 us after being started.
- silent_wait_timer1: Timer used to control the duration of Tx silence during SILENT_WAIT. The timer shall expire 4.0 us±0.1 us after being started.
- send_s_timer2: Timer used to control the duration SEND_S is transmitted during TX_SEND_S2. The timer shall expire 8.0 us±0.1 us after being started.
- silent_wait_timer2: Timer used to control the duration of Tx silence during PAUSE. The timer shall expire 8.0 us±0.1 us after being started.

Auto-Negotiation State Diagram Figure 98-14

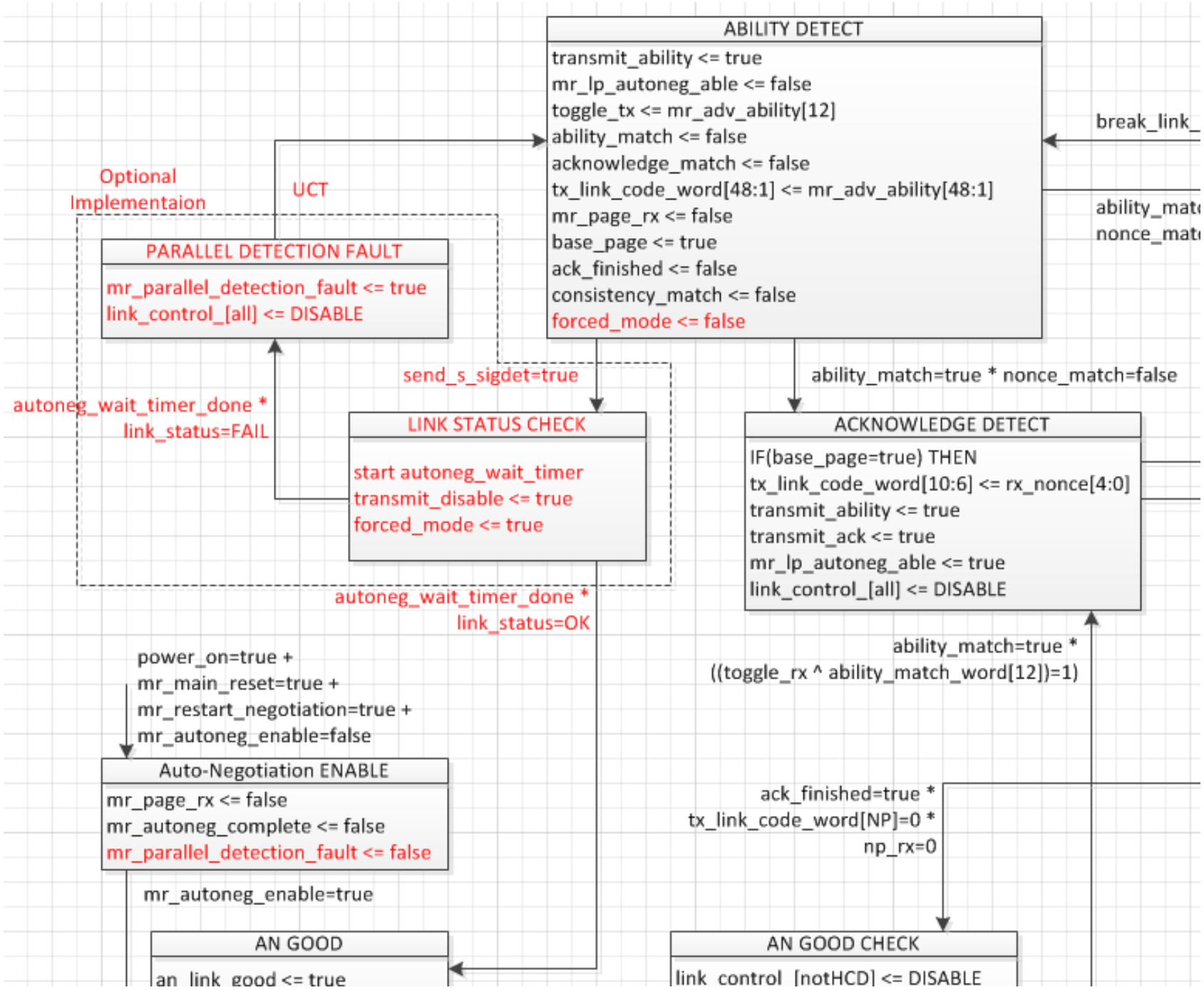
New AN State Diagram (Fig. 98-14)



Changes to Figure 98-14

- Added new optional states “LINK STATUS CHECK” and “PARALLEL DETECTION FAULT”.
- In “ABILITY DETECT” state the PHY may implement correlation detectors for SEND_S(MS) and SEND_S(SL), in parallel to DME link pulse detector.
- If “send_s_sigdet = true”, then the link partner MS/SL configuration is resolved as well
- In “LINK STATUS CHECK” state the PHY will
  - Set “forced_mode <= true” to activate the forced mode state machine
  - Start autoneg_wait_timer and wait for normal training to finish
  - Transition to the “AN GOOD” state directly if link_ststus = ok.
- For PHY capable of both AN and forced mode, the state variable “forced_mode” determines which synchronization approach is active

AN State Diagram (Fig. 98-14) cont.



Conclusion

- Changes to the synchronization state diagrams are needed in order to improve interoperability (and future backward compatibility) for 1000BASE-T1 PHY.
- New states added to AN state diagrams Figure 98-14 are all optional.
- Forced mode state diagram Figure 97-27 shall be replaced with current proposal.

Motion

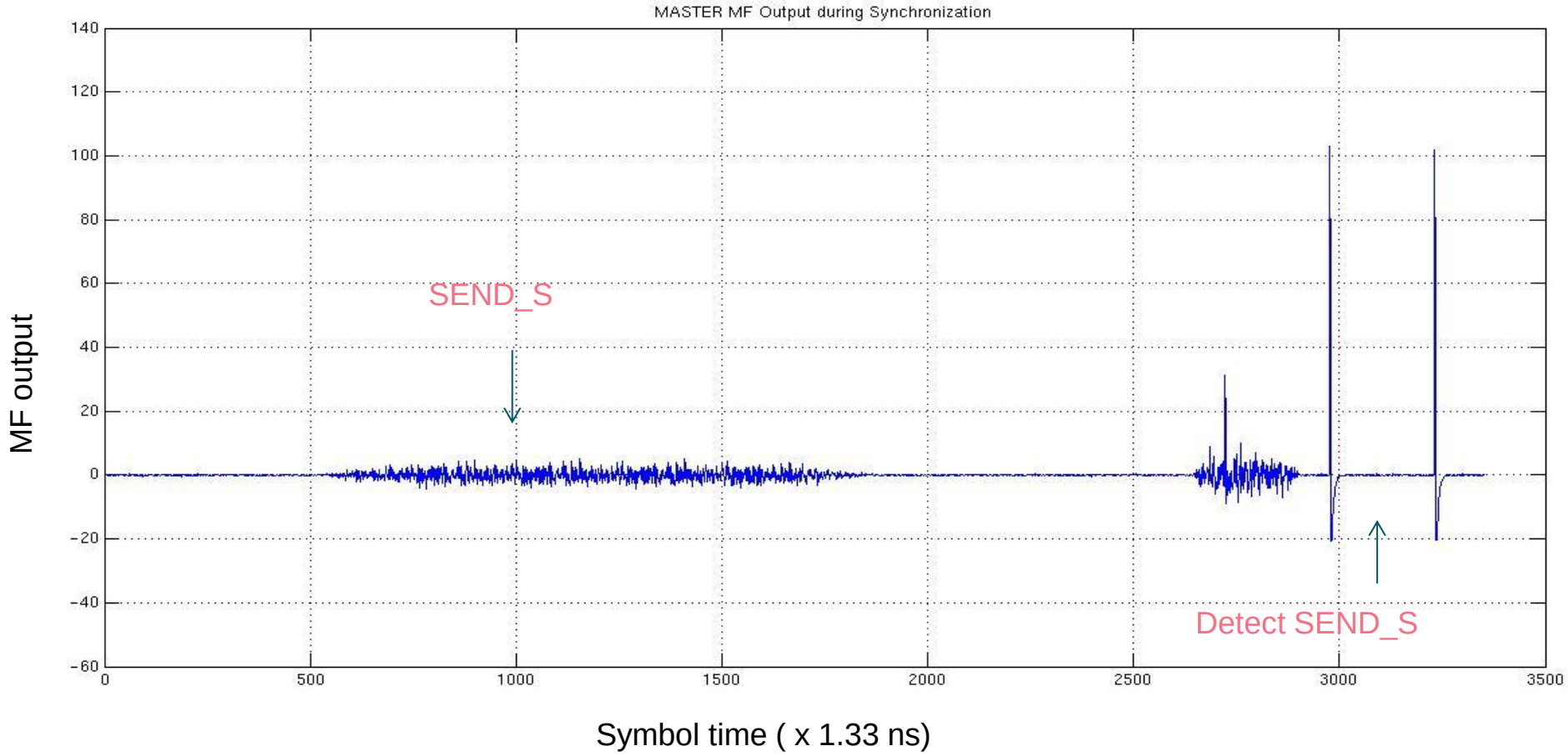
- Adopt the proposed changes shown in document tu_3bp_0215_xx.pdf for improving interoperability compatibility between autoneg and forced mode PHY.

Backup Slides

Simulated SEND_S Detection under Full Duplex Transmission (from wang_3bp_01_1114.pdf)

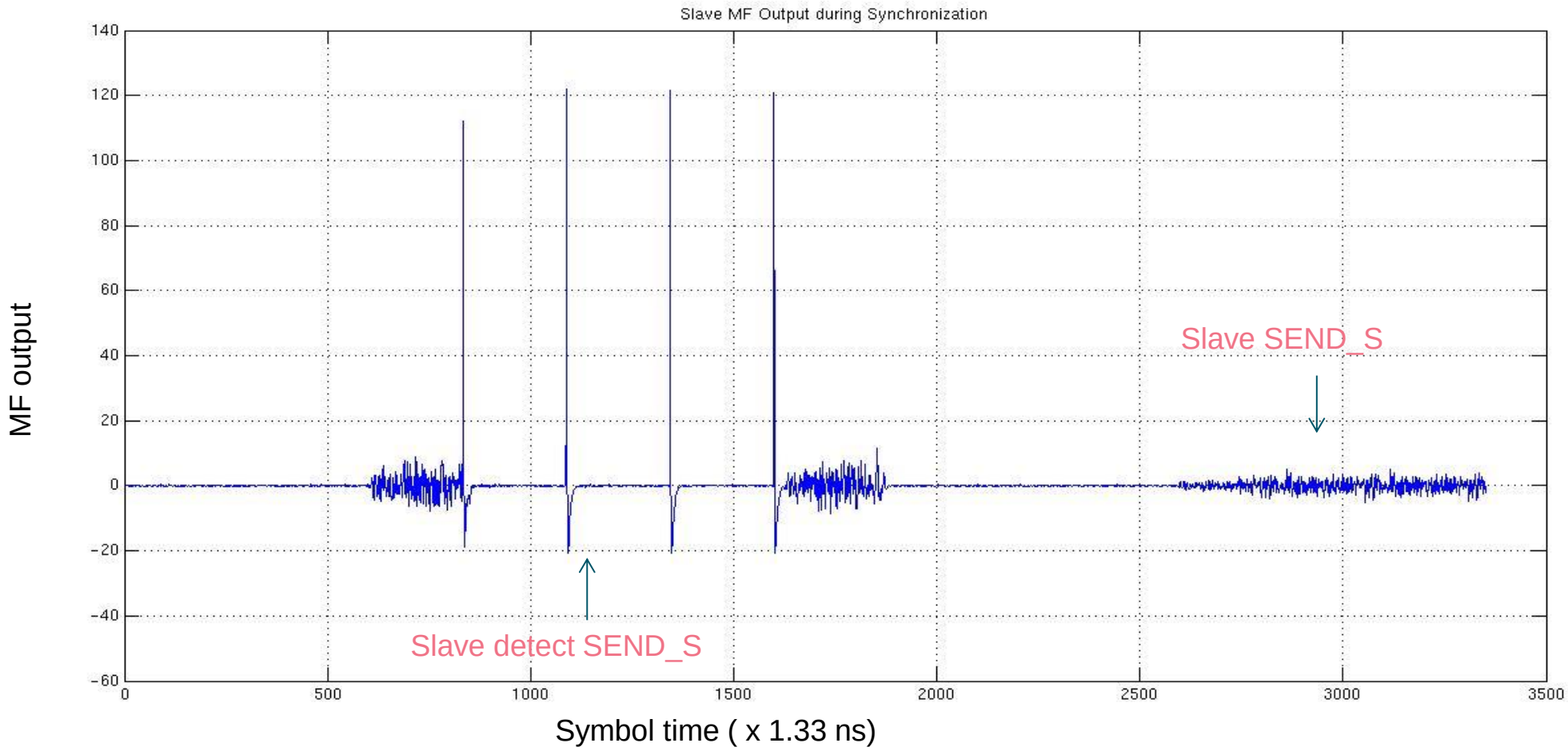
Master SEND_S Detection

- Master MF output during synchronization (without noises):



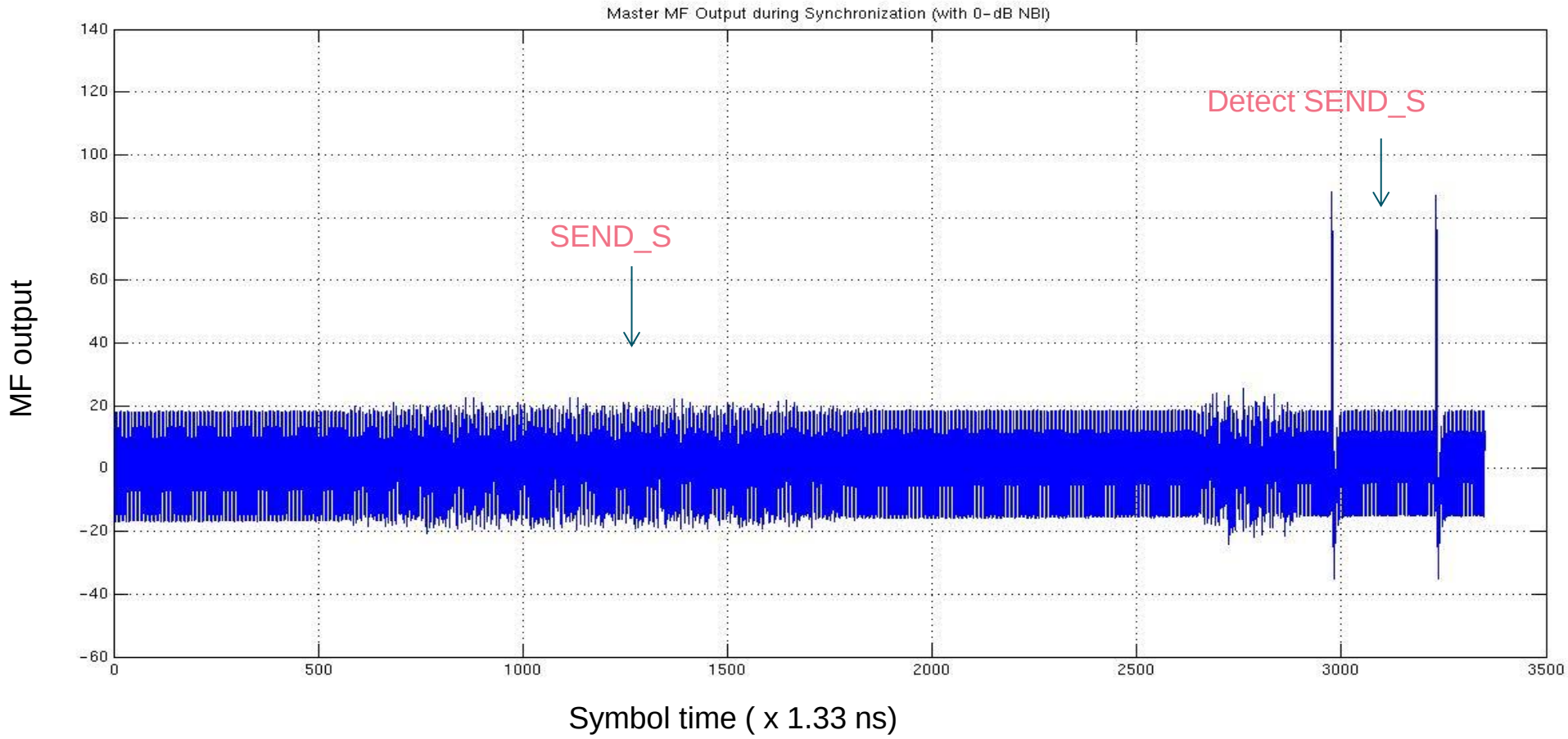
Slave SEND_S Detection

- Slave MF output during synchronization (without noises):



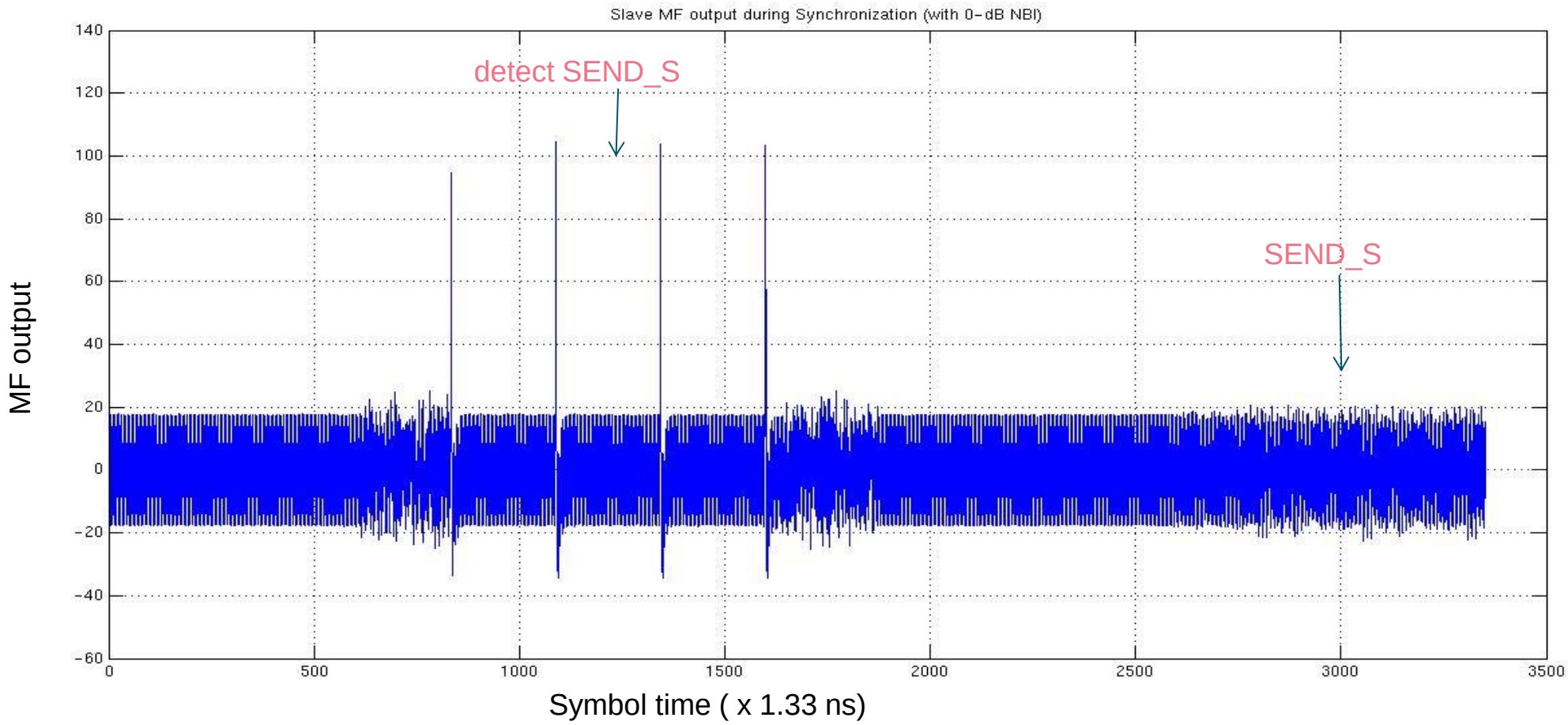
Master NBI Performance

- Master MF output during synchronization (with 0 dB NBI):



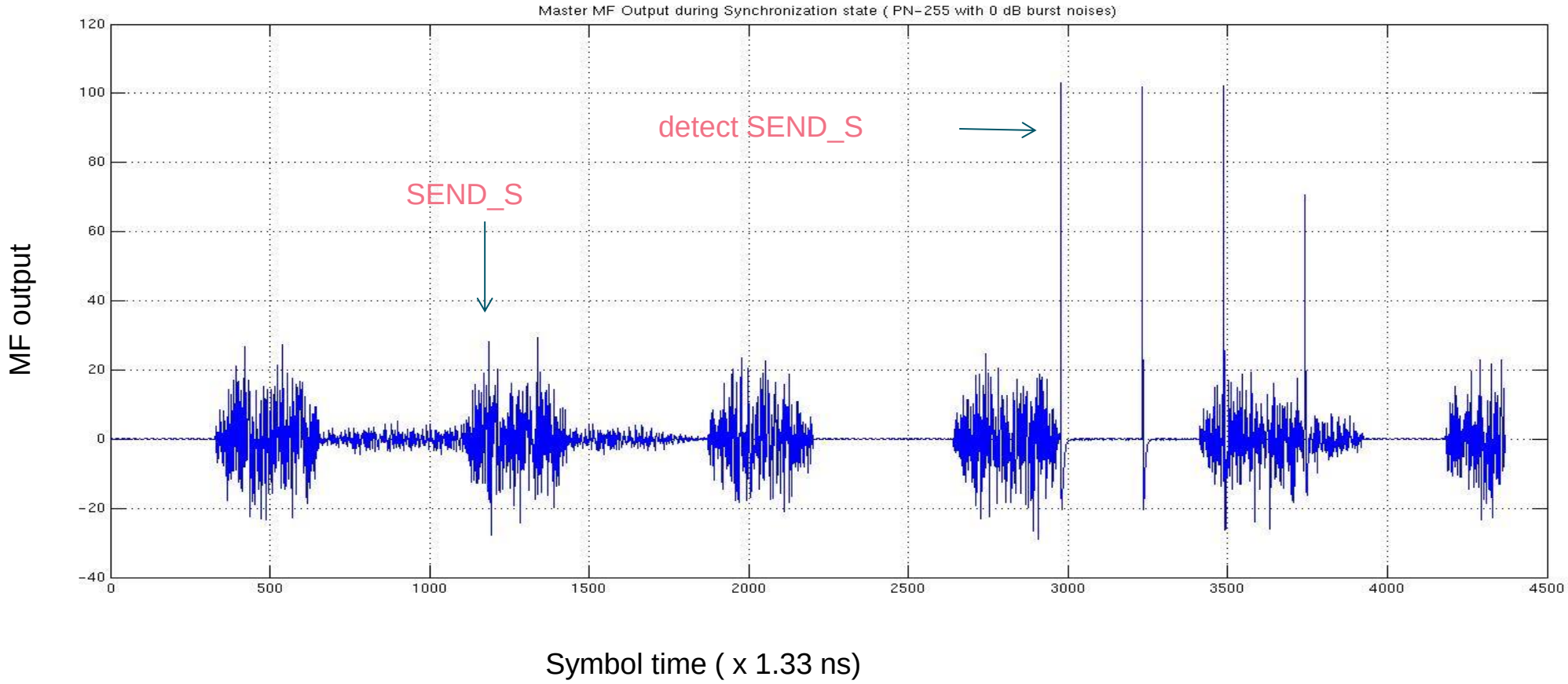
Slave NBI Performance

- Slave MF output during synchronization (with 0 dB NBI):



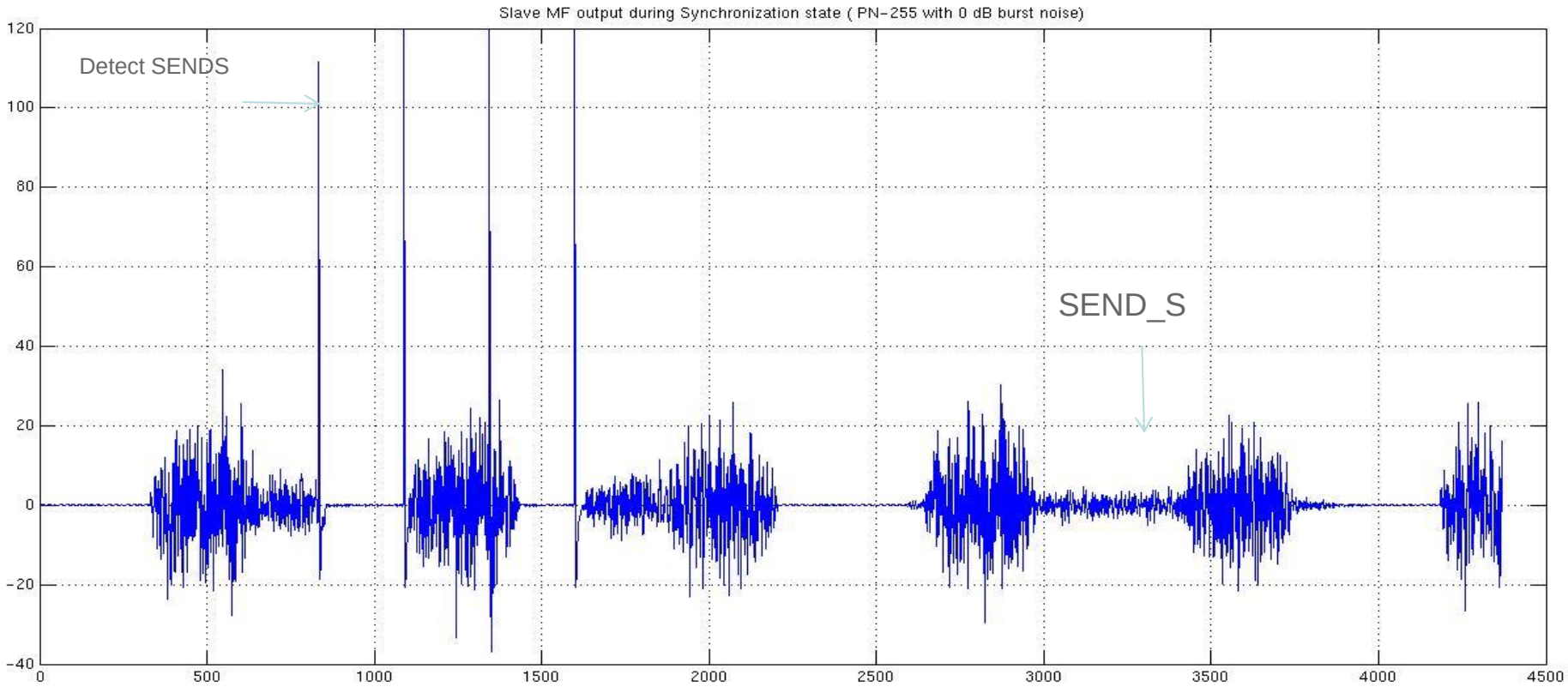
Master Burst Noise Performance

- Master MF output during synchronization (with 0 dB Burst Noise):



Slave Burst Noise Performance

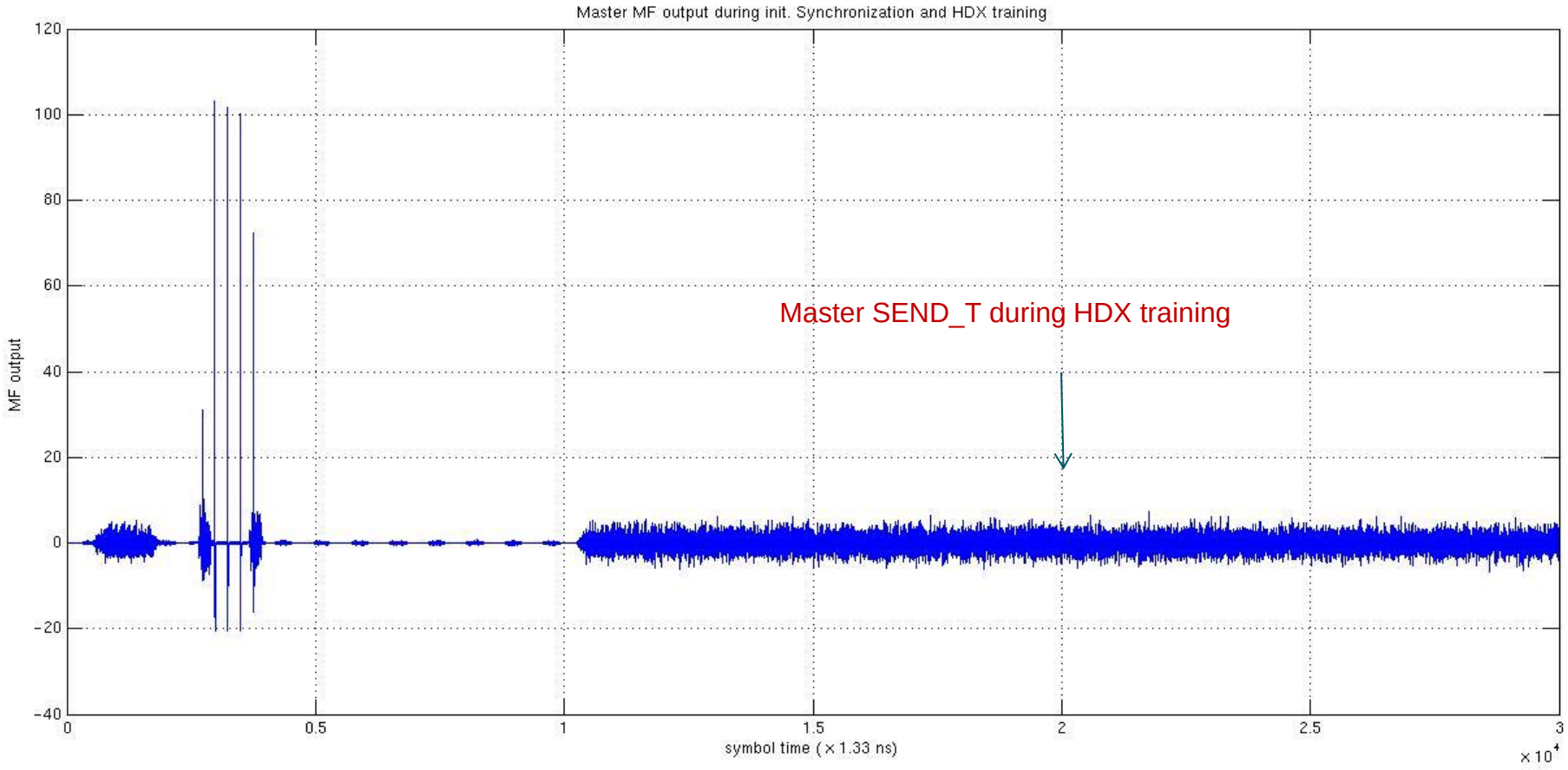
- Slave MF output during synchronization and coming into HDX training:



Symbol time (x 1.33 ns)

Master Synchronization

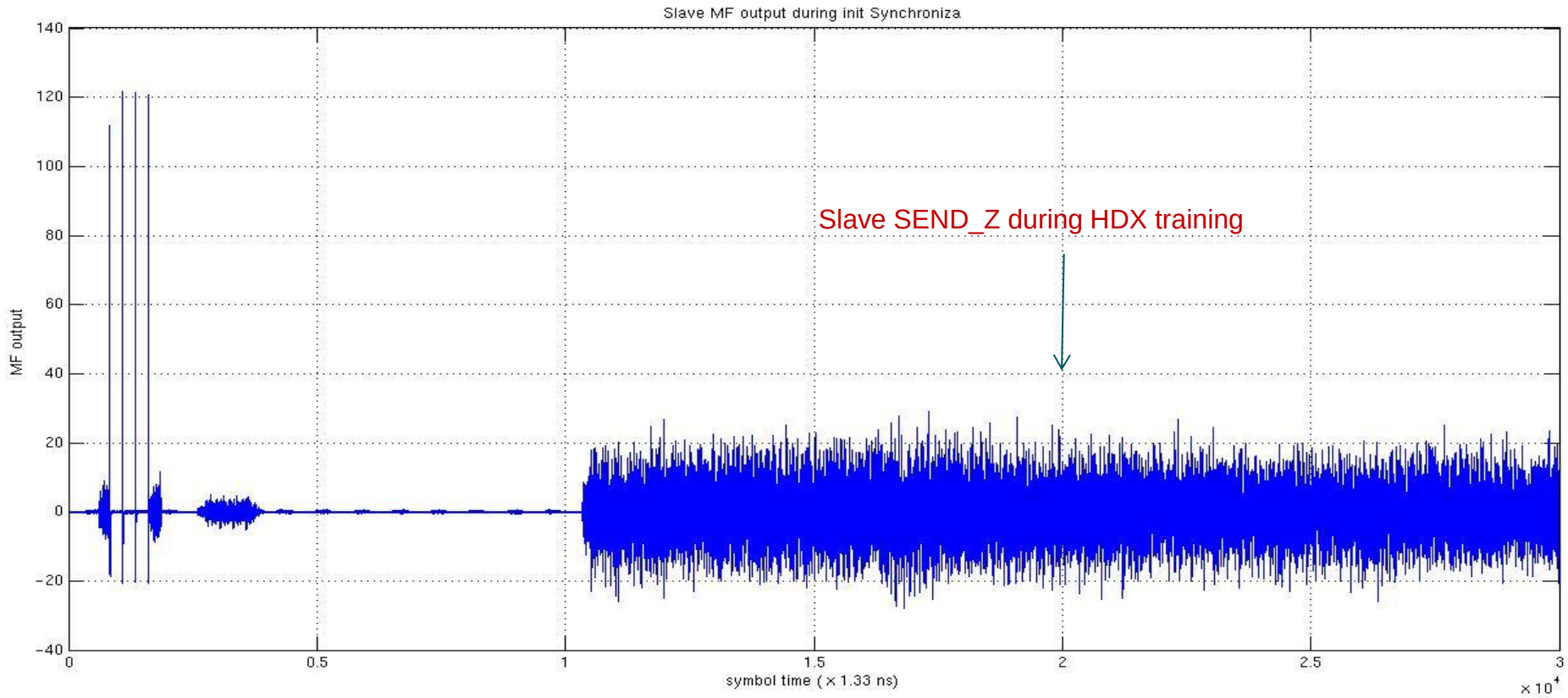
- Master MF output during synchronization and coming into HDX training:



Symbol time (x 1.33 ns)

Slave Synchronization

- Slave MF output during synchronization and coming into HDX training:



Symbol time (x 1.33 ns)