# ARF53 REPEATER TECHNICAL NOTE

## Document updates

| Versions | Date | Notes |
|---|---|---|
| A2 | 28/04/2009 | Repetition can be forced using S250 register, Repeater in MODBUS topology |
| A1 | 24/04/2009 | 'Guard delay' modification, repetition size increase to 250( instead of 128) |
| A0 | 08/04/2009 | PTR, creation |
| | | |

## Reference documentation

| Date/version | Description |
|---|---|
| | |
| | |

## Notations

| | Description |
|---|---|
| | |
| | |

# SUMMARY



# Figures

# 1 INTRODUCTION

This technical note describes the ARF53 repeater feature. Illustration of this feature is performed (in this document) through a basic configuration (2 equipments + 1 repeater), but more complicated infrastructure could be deployed (see §3.3 Typical repeater topologies).

## 1.1 Repeater feature

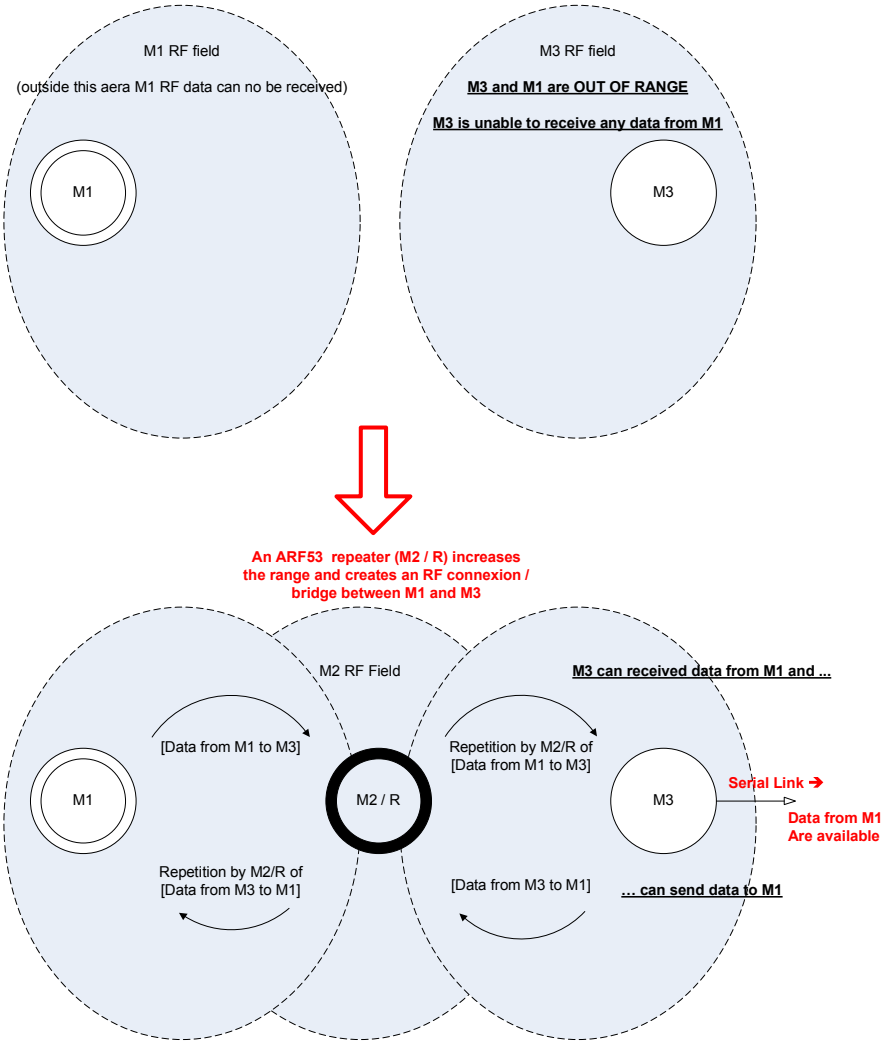



Figure 1: ARF53 repetition feature

The data sent by M1 are received by M2/R but are not available on M2/R serial link (the frame destination address is M3).

- **RF frame repeated**:
  ➔When S250=0, an RF frame is repeated only if the RF frame is different from the repeater reception @ (S252 register) or if the RF frame is broadcasted (RF frame@=FFFF).
  ➔When S250=1 the repetition is forced even if the frame is addressed to the repeater.
- **Reception of same RF Frame**: If the same RF frame is received several times by a repeater within 10s, only the first occurrence of the RF frame is repeated.
- **Serialization for a repeater:** An RF frame is serialized on a repeater only if the RF frame@ is equal to the repeater reception @ (S252 register) or if the frame is broadcasted (RF frame@=FFFF).

CAUTION: the repeater feature is available only for firmware version ≥ V01.00.

## 1.2 Broadcast feature

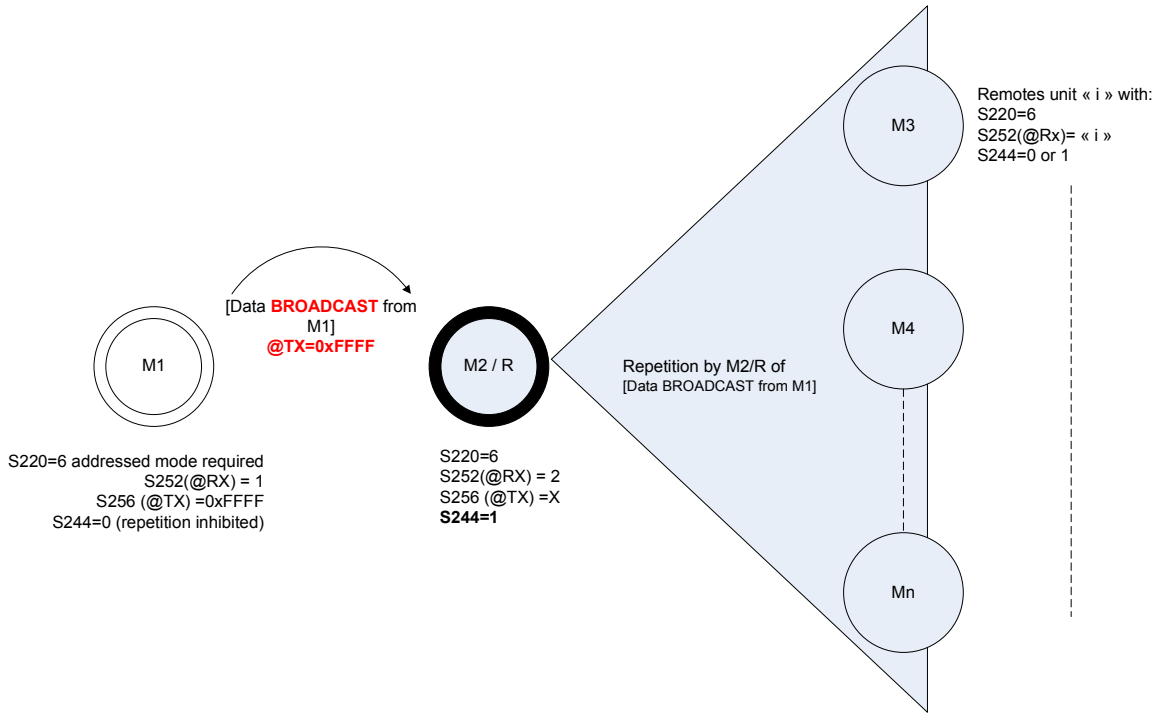



Figure 2: Message broadcast

The data broadcasted by M1 (using @TX=0xFFFF) are received (via the repeater or not) by all other units. The broadcasted data are available on all units serial link (repeater included).

CAUTION: the broadcast feature is available only for firmware version ≥ V01.00.

# 2 REPEATER SETUP

The repeater setup is performed through AT commands via the registers described below.

## 2.1 Installation requirement

The following requirements are mandatory when using the repetition feature:

- **All devices MUST be configured in addressed mode** (S220=6), with default preamble value (using another preamble length will alter the repeater propagation delay calculation)
- **The size of the exchange message is limited to 250 bytes** (for example in a query / answer based exchange, the maximum length for a query or for an answer must not exceed 250 bytes)
- **The message to be repeated must not be fragmented on the air**. For preventing RF frame fragmentation see § 2.3 "Preventing RF frame fragmentation".
- The additional time introduces by the repeater MUST be taken into account in the message path.

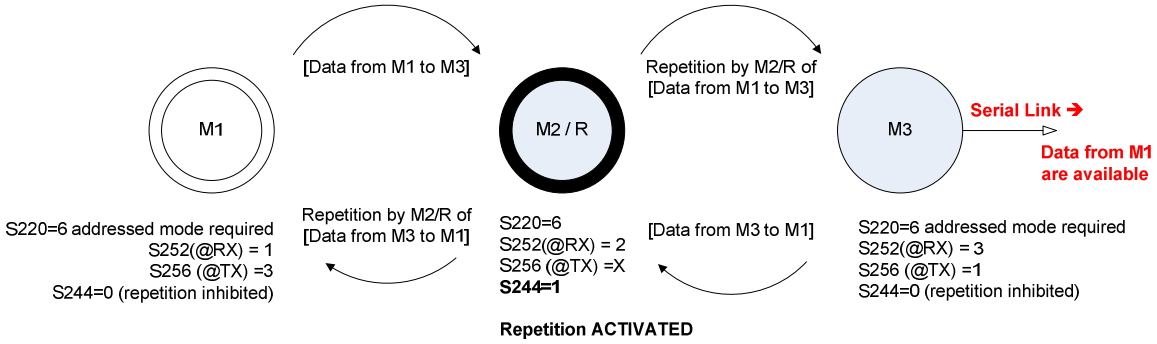



Figure 3: ARF53 typical register configuration for repetition

## 2.2 Repeater registers

Parts of the registers are already described in the unit datasheet. Default values are in **bold**.

| Register | Function | Description |
|---|---|---|
| S220 | Mode | '1' transparent mode<br>**'6'** addressed mode ➔ **required for using repeater feature** |
| S252 | Local address @RX | From 0 to FFFF<br>Reception filter (incoming RF frame will be discarded if the frame address differs from this value).<br>0xFFFF reserved for broadcast |
| S256 | Destination address @TX | From 0 to FFFF<br>@ used for sending an RF frame (in addressed mode) when data are received on the serial link |
| S244 | Repeater number | From **0** to 100.<br>**0** : repetition is not activated (default value)<br>1-100 ➔ repeater activated ; this value is used to determine the repeater guard delays (see § 3.1Repeater propagation delay) |
| S250 | Repetition forced | **0** ➔ conditional repetition (see §1.1Repeater feature)<br>1 ➔ unconditional repetition (all incoming RF frame are repeated, no address analysis) |

## 2.3 Preventing RF frame fragmentation (mixing Serial rate and RF rate)

The unit can operate:

- With two different air rate: in NB the RF rates is 10 kbit/s, in WB the RF rate is 57.6 kbit/s.
- The serial rate is in the range 600 bits/s up to 57.6 kbit/s

When using an air rate (RF rate) different from the serial rate, the RF frame can be fragmented.
A repeater can operate properly only if the RF frame is not fragmented.
The S218 register can be used (as described below) for avoiding the RF frame fragmentation or data loss (due to serial underrun).

| RF rate | Serial Rate (bit/s) range | Required configuration for S218 register | Note |
|---|---|---|---|
| | | | |
| NB (10 kbit/s) | [4800-57600] | ≥ Default (128) | |
| NB (10kbit/s) | [600-2400] | S218=240 | |
| | | | |
| WB (57.6 kbit/s) | [38400-57600] | ≥ Default (128) | |
| WB (57.6 kbit/s) | [2400-19200] | S218=240 | |
| WB (57.6 kbit/s) | [600-1200] | S218=240 | With these slow baud rates the message size is restricted to 240 bytes |

Reminder: NB is used when the RF channel, S200 register **≥** 14
WB is used when the RF channel, S200 register < 14

# 3 ADDITIONAL FEATURES

## 3.1 Repeater propagation delay

### 3.1.1 Guard delay

When a RF frame is received by a repeater, **the repetition is performed after a predefined guard delay**. This guard delay starts when the RF frame reception is completed. The guard delay (Tgd) is directly linked to the repeater number (S244 register):

- **Guard Delay in ms = S244 value x 30 ms**

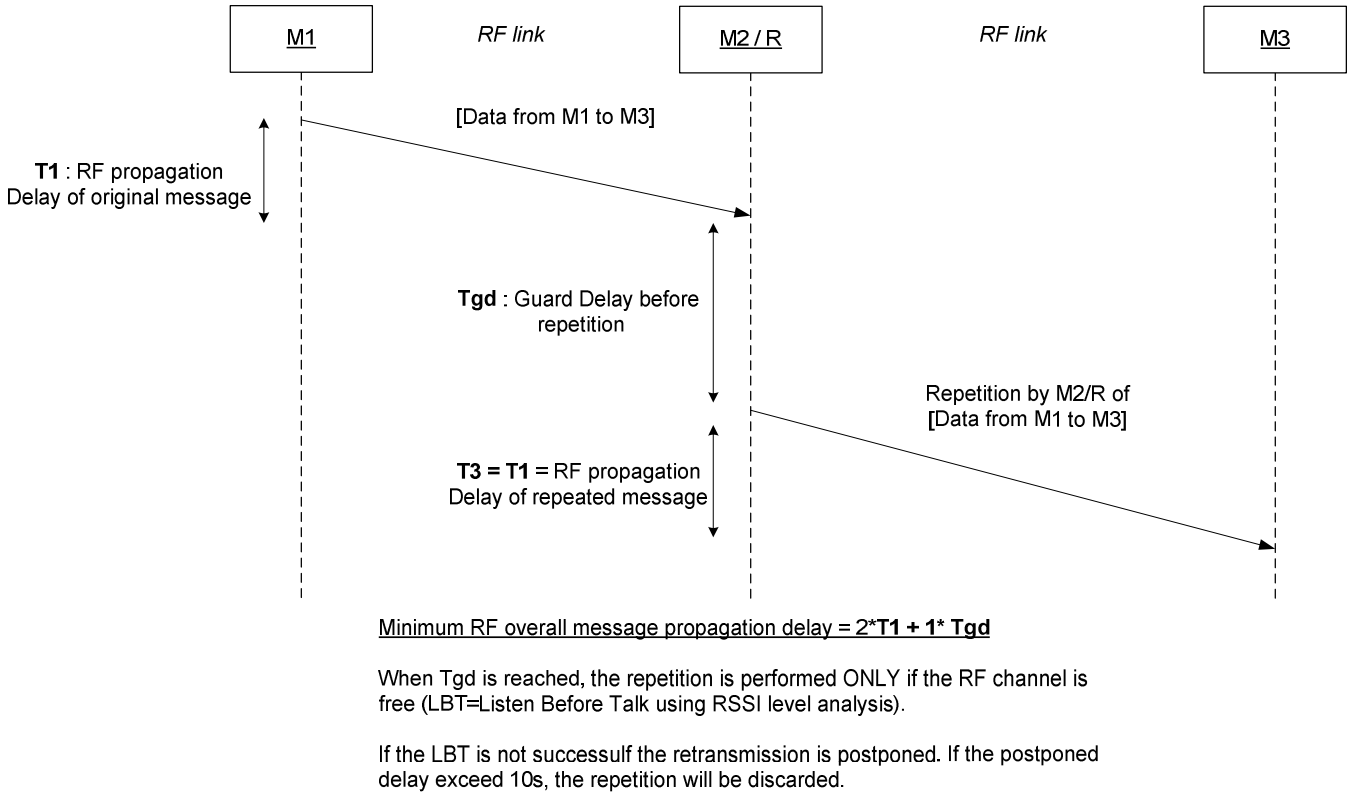



Figure 4: Repeater RF propagation delay

Caution: even if the repeater has a Listen Before Talk feature, the LBT can not prevent all RF frame collision. For avoiding repeater collision see §3.1.2 Guard delay calculation when using several repeaters.

### 3.1.2 Guard delay calculation when using several repeaters

If several repeaters are **located in the same RF range**, theirs respective **guard delays MUST be different for avoiding RF frame collision.** The guard delay must be ≥ to the RF propagation delay.

The following formula can be used for (T1) RF propagation delay calculation:

- In NB, T1 in ms = 22ms + (nbData * 1ms). For a frame of 10 bytes, T1 = 42ms
- In WB, T1 in ms = 6ms + (nbData * 0.18ms). For a frame of 10 bytes, T1 = 8ms

Example: if the maximum frame size is 250 bytes:

- In NB, T1 in ms = 272ms. S244 can be assigned to 1 for the first repeater and to 11 for the second…
- In WB, T1 in ms = 61 ms. S244 can be assigned to 1 for the first repeater and to 4 for the second…

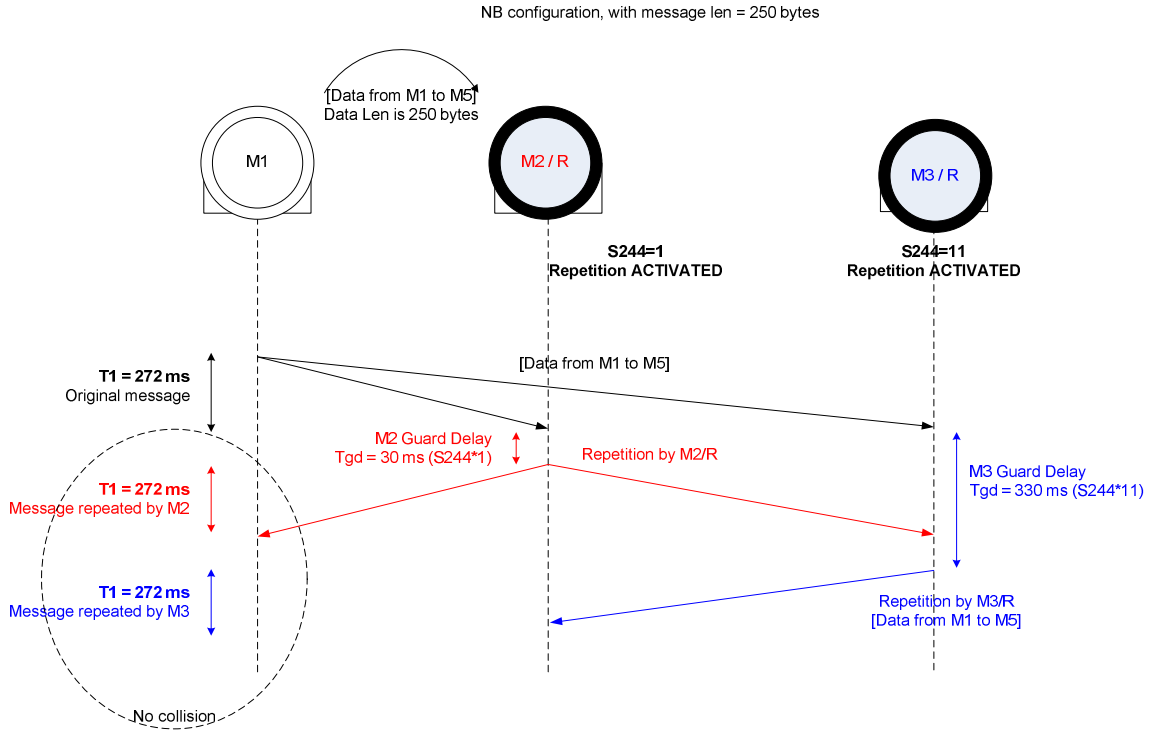
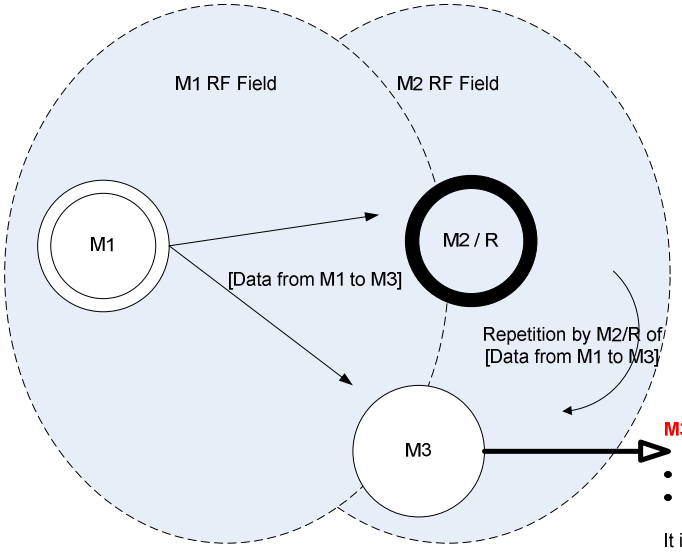



Figure 5: Guard delay for several repeaters in NB

## 3.2 Module reached by the sender and the repeater




**M3 Serial Link ➔ Data from M1 are available twice**

- first time when the original frame is received (directly from M1)
- second time when the repetition (from M2) is received

It is the end user responsibility to ignore this data duplication

**M3 can be reached either by M1 and by the repeater**

## 3.3 Typical repeater topologies

### 3.3.1 **Low density topology**

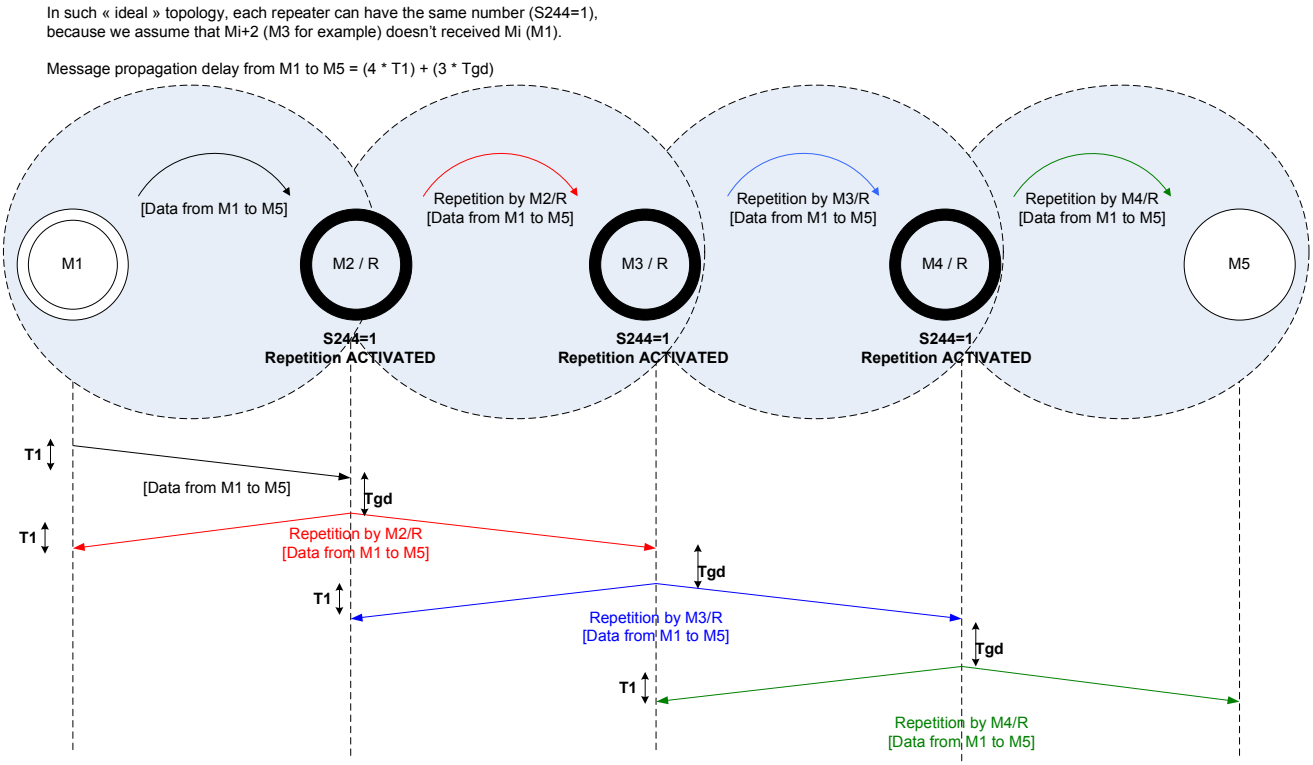



Figure 6: Low density topology

### 3.3.2 **High density topology**

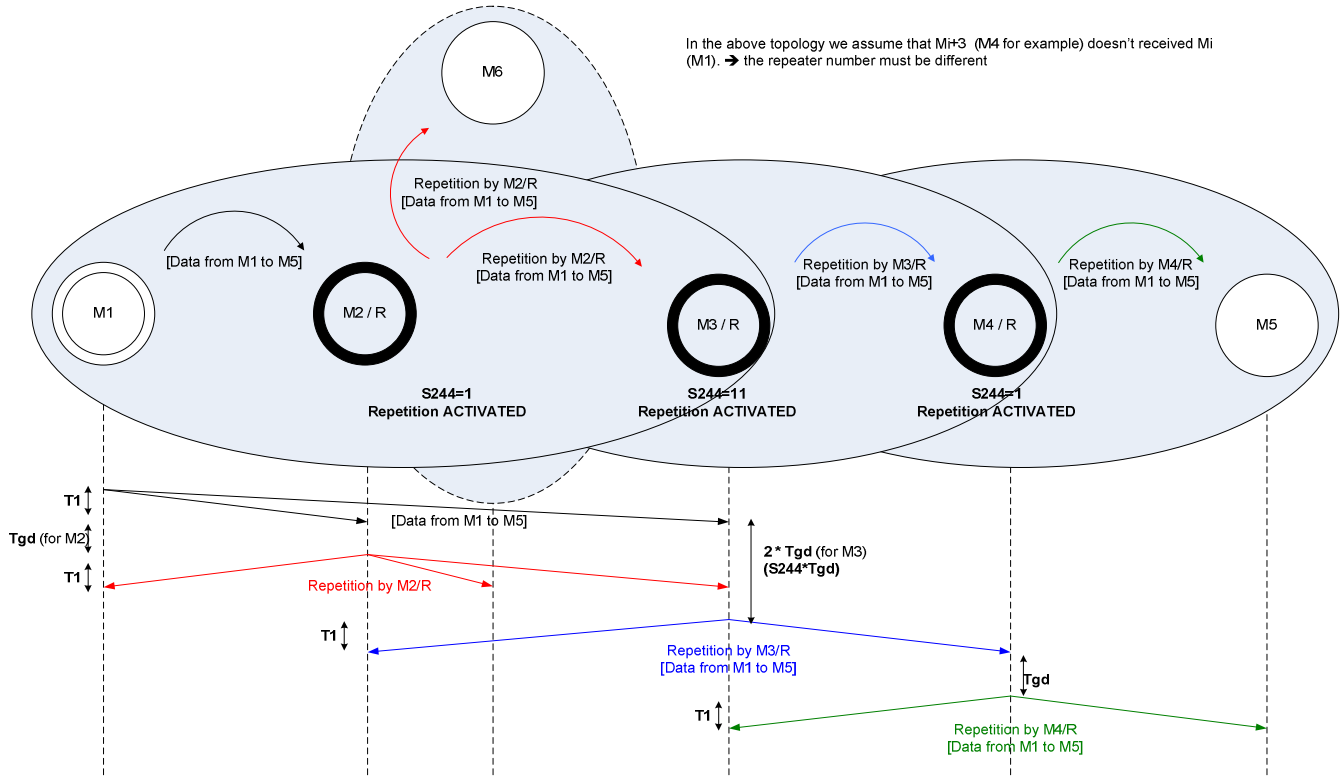



Figure 7: high density topology

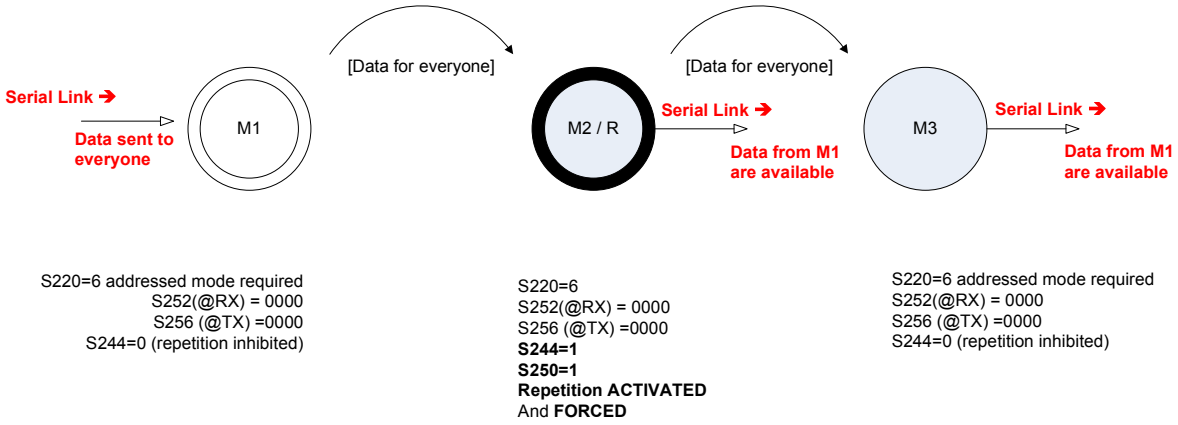
### 3.3.3 MODBUS topology

When using a protocol such as MODBUS:

- the address resolution is performed by the protocol used (and not by the RF media),
- assuming that **all devices** received **all exchanged** queries (such as an RS485 bus)

The S250 register complies with this requirement:

- S250 = 1 forces the repetition, even if the frame is addressed to the repeater.
- S252 and S256 RX@ and TX@ must be set to the same value for all point (default, 0x0000 can be used).



## 3.4 Software release and backward compatibility

CAUTION: the **repeater and broadcast features** are available only with firmware version ≥ V01.00.

**The repeater feature is backward compatible with ARF53** (firmware version < V01.00).

- ⇨ For example the out of range devices (M1 and or M3) can have a firmware version < V01.00 while M2/Repeater must have a version ≥ V01.00.

Using the **broadcast feature requires that all the ARF53 have a firmware version ≥ V01.00**. An ARF53 with a firmware version < V01.00 can be used but it will not received the broadcasted message (excepted if its local address is set to the specific value 0xFFFF).