5 Switching

This chapter deals with messages which are required for switching accessory decoders ("Accessory Decoder" according RP-9.2.1, e.g. decoder for turnouts, ...).

The visualization of the turnout number on the user interface is differently solved in some DCC systems and can significantly differ from the real DCC accessory decoder address plus port actually used in the track signal. According to DCC, there are four ports with two outputs each per accessory decoder address. One turnout can be connected per port. Usually one of the following options is used to visualize the turnout number:

1. Numbering from 1 with DCC address at 1 starting with 4 ports each (ESU, Uhlenbrock, ...)
   Switch #1: DCC-Addr=1 Port=0; Switch #5: DCC-Addr=2 Port=0; Switch #6: DCC-Addr=2 Port=1

2. Numbering from 1 with DCC address at 0 starting with 4 ports each (Roco)
   Switch #1: DCC-Addr=0 Port=0; Switch #5: DCC-Addr=1 Port=0; Switch #6: DCC-Addr=1 Port=1

3. Virtual switch number with freely configurable DCC address and port (Twin Center)

4. Displaying real DCC-address and port number (Zimo)

None of these visualization options can be described as “wrong” due to lack of specification in RP-9.2.1, where the visualization to the user is not mentioned at all. For the user, however, this can mean in consequence getting used to the fact that one and the same turnout at an ESU control panel is controlled under number 1, while it is switched on the Roco multiMaus and Z21 under number 5 ("shift by 4").

In order to be able to implement the visualization of your choice in your application, it helps to know how the Z21 converts the input parameters for the switching commands (**FAdr_MSB**, **FAdr_LSB**, **A**, **P**, see below) into the corresponding DCC accessory command:

DCC basic accessory decoder packet format: {preamble} 0 10AAAAAA 0 1aaaCDDd 0 EEEEEEEE 1

UINT16 *FAdr* = (**FAdr_MSB** << 8) + **FAdr_LSB;**
UINT16 *Dcc_Addr* = *FAdr* >> 2;

aaaAAAAAA = (~*Dcc_Addr* & 0x1C0) | (*Dcc_Addr* & 0x003F); // DCC Address
C = **A**; // Activate or deactivate output
DD = *FAdr* & 0x03; // Port
d = **P**; // Switch to the left or to the right

Example:
FAdr=0 equals DCC-Addr=0 Port=0;
FAdr=3 equals DCC-Addr=0 Port=3;
FAdr=4 equals DCC-Addr=1 Port=0; etc.

On the other hand, for MM Format note: FAdr starts with 0, i.e. FAdr=0: MM-Addr=1; FAdr=1: MM-Addr=2; ...

A client can subscribe to accessory info in order to be automatically notified of changes to accessory decoders caused by other clients or handsets. For this purpose, the corresponding broadcast must be activated for the client, see ***2.16*** *LAN_SET_BROADCASTFLAGS,* Flag 0x00000001.

The actual position of the turnout depends on the cabling and possibly also on the configuration in the client's application. The command station cannot know anything about this, and that is why the following description deliberately omits the terms "*straight*" and "*branching*". Instead we will speak about “output 1” and “output 2”.

5.1 LAN_X_GET_TURNOUT_INFO

The following command can be used to poll the status of a turnout (or any accessory function).

Request to Z21:

DataLen		Header		Data			
				X-Header	DB0	DB1	XOR-Byte
0x08	0x00	**0x40**	0x00	**0x43**	**FAdr_MSB**	**FAdr_LSB**	XOR-Byte

Note: Function address = (**FAdr_MSB** << 8) + **FAdr_LSB**

Reply from Z21:
see *5.3* LAN_X_TURNOUT_INFO

5.2 LAN_X_SET_TURNOUT

A turnout (or any accessory function) can be switched with the following command.

Request to Z21:

DataLen		Header		Data				
				X-Header	DB0	DB1	DB2	XOR-Byte
0x09	0x00	**0x40**	0x00	**0x53**	**FAdr_MSB**	**FAdr_LSB**	10**Q**0**A**00**P**	XOR-Byte

Note: Function address = (**FAdr_MSB** << 8) + **FAdr_LSB**

1000**A**00**P** **A**=0 ... Deactivate turnout output
A=1 ... Activate turnout output
P=0 ... Select output 1 of the turnout
P=1 ... Select output 2 of the turnout
Q=0 … Execute command immediately
Q=1 … **From Z21 FW V1.24**: Insert turnout command into the queue of Z21 and deliver it as soon as possible to the track.

Reply from Z21:
No standard answer, *5.3* LAN_X_TURNOUT_INFO to subscribed clients.

From Z21 FW V1.24 the Q flag ("Queue") was introduced.

5.2.1 LAN_X_SET_TURNOUT with Q=0

With **Q=0** the Z21 behaves compatible to the previous versions: the turnout switching command is immediately sent on the track by being mixed into the running loco driving commands. **The Activate (A=1) is output until the LAN client sends the corresponding Deactivate. Only one switching command may be active at the same time**. This behavior corresponds, for example, to pressing and releasing the multiMaus key.

Please note that with Q=0 the correct sequence of the switching commands (i.e. Activate followed by Deactivate) must be observed strictly. Otherwise, undefined end positions may occur depending on the turnout decoder used.

The LAN client is responsible for the correct serialization and the timing of the switching duration!

Wrong:
Activate turnout #5/A2 (4,0x89); Activate turnout #6/A2 (5,0x89);
Activate turnout #3/A1 (2,0x88); Deactivate turnout #3/A1 (2,0x80);
Deactivate turnout #5/A2 (4,0x81); Deactivate turnout #6/A2 (5,0x81);

Correct:
Activate turnout #5/A2 (4,0x89); wait 100ms; deactivate turnout #5/A2 (4,0x81); wait 50ms;
Activate turnout #6/A2 (5,0x89); wait 100ms; deactivate turnout #6/A2 (5,0x81); wait 50ms;
Activate turnout #3/A1 (2,0x88); wait 100ms; deactivate turnout #3/A1 (2,0x80); wait 50ms;

Example:
Activate turnout #7 / A2 (6,0x89); wait 150ms; deactivate turnout #7 / A2 (6,0x81)

```
DCC  preamble=16  LOCO address=3 ss128=0 fwd Speed=Stop
DCC  preamble=16  LOCO address=3 FG1 (0-4) F=Loooo
DCC  preamble=16  LOCO address=3 FG2 (5-8) F=o7oo
DCC  preamble=16  ACESSORY raw data AA=1 DD=5 C=1 , "Roco_lenz f=7 out=A  ACTIVE"
DCC  preamble=16  LOCO address=3 ss128=0 fwd Speed=Stop
DCC  preamble=16  ACESSORY raw data AA=1 DD=5 C=1 , "Roco_lenz f=7 out=A  ACTIVE"
DCC  preamble=16  LOCO address=3 FG1 (0-4) F=Loooo
DCC  preamble=16  ACESSORY raw data AA=1 DD=5 C=1 , "Roco_lenz f=7 out=A  ACTIVE"
DCC  preamble=16  LOCO address=3 FG2 (5-8) F=o7oo
DCC  preamble=16  ACESSORY raw data AA=1 DD=5 C=1 , "Roco_lenz f=7 out=A  ACTIVE"
DCC  preamble=16  LOCO address=3 ss128=0 fwd Speed=Stop
DCC  preamble=16  ACESSORY raw data AA=1 DD=5 C=1 , "Roco_lenz f=7 out=A  ACTIVE"
DCC  preamble=16  LOCO address=3 FG1 (0-4) F=Loooo
DCC  preamble=16  ACESSORY raw data AA=1 DD=5 C=1 , "Roco_lenz f=7 out=A  ACTIVE"
DCC  preamble=16  LOCO address=3 FG2 (5-8) F=o7oo
DCC  preamble=16  ACESSORY raw data AA=1 DD=5 C=1 , "Roco_lenz f=7 out=A  ACTIVE"
DCC  preamble=16  LOCO address=3 ss128=0 fwd Speed=Stop
DCC  preamble=16  ACESSORY raw data AA=1 DD=5 C=1 , "Roco_lenz f=7 out=A  ACTIVE"
DCC  preamble=16  LOCO address=3 FG1 (0-4) F=Loooo
DCC  preamble=16  ACESSORY raw data AA=1 DD=5 C=1 , "Roco_lenz f=7 out=A  ACTIVE"
DCC  preamble=16  LOCO address=3 FG2 (5-8) F=o7oo
DCC  preamble=16  ACESSORY raw data AA=1 DD=5 C=1 , "Roco_lenz f=7 out=A  ACTIVE"
DCC  preamble=16  LOCO address=3 ss128=0 fwd Speed=Stop
DCC  preamble=16  ACESSORY raw data AA=1 DD=5 C=1 , "Roco_lenz f=7 out=A  ACTIVE"
DCC  preamble=16  LOCO address=3 FG1 (0-4) F=Loooo
DCC  preamble=16  ACESSORY raw data AA=1 DD=5 C=1 , "Roco_lenz f=7 out=A  ACTIVE"
DCC  preamble=16  LOCO address=3 FG2 (5-8) F=o7oo
DCC  preamble=16  ACESSORY raw data AA=1 DD=5 C=1 , "Roco_lenz f=7 out=A  ACTIVE"
DCC  preamble=16  LOCO address=3 ss128=0 fwd Speed=Stop
DCC  preamble=16  ACESSORY raw data AA=1 DD=5 C=1 , "Roco_lenz f=7 out=A  ACTIVE"
DCC  preamble=16  LOCO address=3 FG1 (0-4) F=Loooo
DCC  preamble=16  ACESSORY raw data AA=1 DD=5 C=0 , "Roco_lenz f=7 out=A  INACTIVE"
DCC  preamble=16  LOCO address=3 FG2 (5-8) F=o7oo
DCC  preamble=16  ACESSORY raw data AA=1 DD=5 C=0 , "Roco_lenz f=7 out=A  INACTIVE"
DCC  preamble=16  LOCO address=3 ss128=0 fwd Speed=Stop
DCC  preamble=16  ACESSORY raw data AA=1 DD=5 C=0 , "Roco_lenz f=7 out=A  INACTIVE"
DCC  preamble=16  LOCO address=3 FG1 (0-4) F=Loooo
DCC  preamble=16  ACESSORY raw data AA=1 DD=5 C=0 , "Roco_lenz f=7 out=A  INACTIVE"
DCC  preamble=16  LOCO address=3 FG2 (5-8) F=o7oo
DCC  preamble=16  LOCO address=3 ss128=0 fwd Speed=Stop
DCC  preamble=16  LOCO address=3 FG1 (0-4) F=Loooo
```

Figure 3 DCC Sniff on track with Q=0

5.2.2 LAN_X_SET_TURNOUT with Q=1

If **Q=1**, the following behavior occurs: in the Z21 the switching command is first put into an internal queue (FIFO). When generating the track signal, this queue is constantly checked whether a switching command is available for output. This switching command is then taken out of the queue and is written four times onto the track. This liberates the LAN client from the obligation of strict serialization, i.e. the switching commands may be sent mixed to the Z21 with Q=1 (very useful routes!). The LAN client only needs to take care of the Deactivate timing. Depending on the DCC decoder, the Deactivate may even be omitted. With MM you should not do without Deactivate, because e.g. the k83 and some older turnout decoders do not have an automatic shut-off.

Example:
Activate turnout #25 / A2 (24, 0xA9); Activate turnout #5 / A2 (4, 0xA9);
Wait 150ms;
Deactivate turnout #25 / A2 (24, 0xA1)

```
DCC  preamble=16  LOCO address=3 ss128=0 fwd Speed=Stop
DCC  preamble=16  LOCO address=3 ss128=0 fwd Speed=Stop
DCC  preamble=16  LOCO address=3 ss128=0 fwd Speed=Stop
DCC  preamble=16  ACESSORY raw data AA=6 DD=1 C=1 , "Roco_lenz f=25 out=A  ACTIVE"
DCC  preamble=16  LOCO address=3 ss128=0 fwd Speed=Stop
DCC  preamble=16  ACESSORY raw data AA=6 DD=1 C=1 , "Roco_lenz f=25 out=A  ACTIVE"
DCC  preamble=16  LOCO address=3 ss128=0 fwd Speed=Stop
DCC  preamble=16  ACESSORY raw data AA=6 DD=1 C=1 , "Roco_lenz f=25 out=A  ACTIVE"
DCC  preamble=16  LOCO address=3 ss128=0 fwd Speed=Stop
DCC  preamble=16  ACESSORY raw data AA=6 DD=1 C=1 , "Roco_lenz f=25 out=A  ACTIVE"
DCC  preamble=16  LOCO address=3 ss128=0 fwd Speed=Stop
DCC  preamble=16  ACESSORY raw data AA=1 DD=1 C=1 , "Roco_lenz f=5 out=A  ACTIVE"
DCC  preamble=16  LOCO address=3 ss128=0 fwd Speed=Stop
DCC  preamble=16  ACESSORY raw data AA=1 DD=1 C=1 , "Roco_lenz f=5 out=A  ACTIVE"
DCC  preamble=16  LOCO address=3 ss128=0 fwd Speed=Stop
DCC  preamble=16  ACESSORY raw data AA=1 DD=1 C=1 , "Roco_lenz f=5 out=A  ACTIVE"
DCC  preamble=16  LOCO address=3 ss128=0 fwd Speed=Stop
DCC  preamble=16  ACESSORY raw data AA=1 DD=1 C=1 , "Roco_lenz f=5 out=A  ACTIVE"
DCC  preamble=16  LOCO address=3 ss128=0 fwd Speed=Stop
DCC  preamble=16  LOCO address=3 ss128=0 fwd Speed=Stop
DCC  preamble=16  LOCO address=3 ss128=0 fwd Speed=Stop
DCC  preamble=16  LOCO address=3 ss128=0 fwd Speed=Stop
DCC  preamble=16  LOCO address=3 ss128=0 fwd Speed=Stop
DCC  preamble=16  LOCO address=3 ss128=0 fwd Speed=Stop
DCC  preamble=16  LOCO address=3 ss128=0 fwd Speed=Stop
DCC  preamble=16  ACESSORY raw data AA=6 DD=1 C=0 , "Roco_lenz f=25 out=A  INACTIVE"
DCC  preamble=16  LOCO address=3 ss128=0 fwd Speed=Stop
DCC  preamble=16  ACESSORY raw data AA=6 DD=1 C=0 , "Roco_lenz f=25 out=A  INACTIVE"
DCC  preamble=16  LOCO address=3 ss128=0 fwd Speed=Stop
DCC  preamble=16  ACESSORY raw data AA=6 DD=1 C=0 , "Roco_lenz f=25 out=A  INACTIVE"
DCC  preamble=16  LOCO address=3 ss128=0 fwd Speed=Stop
DCC  preamble=16  ACESSORY raw data AA=6 DD=1 C=0 , "Roco_lenz f=25 out=A  INACTIVE"
DCC  preamble=16  LOCO address=3 ss128=0 fwd Speed=Stop
DCC  preamble=16  LOCO address=3 ss128=0 fwd Speed=Stop
DCC  preamble=16  LOCO address=3 ss128=0 fwd Speed=Stop
```

Figure 4 DCC Sniff on track with Q=1

Never mix switching commands with Q=0 and switching commands with Q=1 in your application.

5.3 LAN_X_TURNOUT_INFO

This message is sent from the Z21 to the clients in response to the command *5.1* LAN_X_GET_TURNOUT_INFO. However, it is also sent to an associated client unsolicitedly if

- the function status has been changed by one of the (other) clients or a handset controller
- and the associated client has activated the corresponding broadcast, see ***2.16*** LAN_SET_BROADCASTFLAGS, Flag 0x00000001

Z21 to Client:

DataLen		**Header**		**Data**				
				X-Header	**DB0**	**DB1**	**DB2**	**XOR-Byte**
0x09	0x00	**0x40**	0x00	**0x43**	**FAdr_MSB**	**FAdr_LSB**	000000**ZZ**	XOR-Byte

Note: Function address = (**FAdr_MSB** << 8) + **FAdr_LSB**

000000**ZZ** **ZZ**=00 ... Turnout not switched yet
ZZ=01 ... Turnout is in position according to switching command "P=0", see *5.2* LAN_X_SET_TURNOUT
ZZ=10 ... Turnout is in position according to switching command "P=1", see *5.2* LAN_X_SET_TURNOUT
ZZ=11 ... Invalid combination

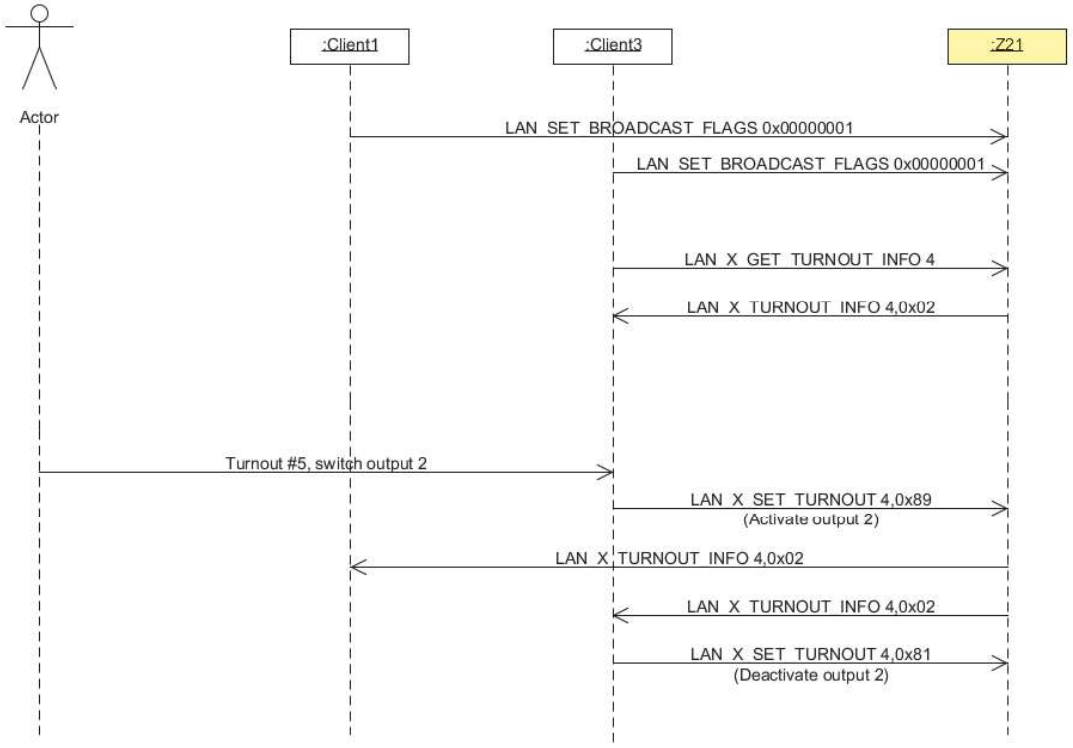

Figure 5 Example Sequence: Turnout switching

5.4 LAN_X_SET_EXT_ACCESSORY

From Z21 FW V1. 40, a DCC command in the "**extended accessory decoder package format**" (DCCext) can be sent to an **extended accessory decoder** with the following request. It allows to send even switching times for turnouts or complex signal aspects with just one single command. See also RCN-213 (Section 2.3).

Request to Z21:

DataLen		Header		Data					
				X-Header	DB0	DB1	DB2	DB3	XOR-Byte
0x0A	0x00	**0x40**	0x00	**0x54**	**Adr_MSB**	**Adr_LSB**	DDDDDDDD	0x00	XOR-Byte

Note: **RawAddress** = (**Adr_MSB** << 8) + **Adr_LSB**

RawAddress The RawAddress for the first extended accessory decoder is 4 according to RCN-213. This address is usually displayed as "Address 1" in user interfaces. The address calculation is strictly compliant with RCN-213, i.e. there is no longer any different address calculation compared with other compliant systems.

DDDDDDDD 256 different states can be transmitted via bits 0 to 7 in DB2.
The content is transferred to the decoder on the track in the ***extended accessory decoder package format*** according to RCN-213.

Note:
Ter **10836 Z21 switch DECODER** interprets DDDDDDDD as "switch decoder with reception of switching time" as **RZZZZZZZ**. The following applies:

- **ZZZZZZZ** defines the power-on time with a resolution of **100 ms.**
  - A value of 0 means that the output is switched off.
  - a value of 127 means that the output is switched on permanently, i.e. until the next command to this address.
- Bit 7 **R** is used to select the output within the output pair:
  - R=1 means "green" (straight).
  - R=0 means "red" (branched).

The **10837 Z21 signaldecoder** interprets DDDDDDDD as one of 256 theoretically possible signal aspects. The actual value range depends to a large extent on the signal type set in the signal decoder. Common values are, for example:

- 0 ... Stop
- 4 ... Clear with speed limit max 40 km/h
- 16 ... Clear
- 65 (0x41) ... shunting allowed
- 66 (0x42) ... turn all lights off (e.g. for distant signals)
- 69 (0x45) ... substitution (permission to pass a defect signal)

The suitable value for the desired signal aspect for a given signal can be found for the Z21 signal DECODER under https://www.z21.eu/en/products/z21-signal-decoder/signaltypen.

Reply from Z21:
No standard answer, or *5.6 LAN_X_EXT_ACCESSORY_INFO* to subscribed clients.

Example:
0x0A 0x00 0x40 0x00 0x54 0x00 0x04 0x05 0x00 0x55
meaning: "send to decoder with RawAddress=4 (this address is displayed as address 1 in user dialogs!) a value of DDDDDDDD=5."
If the receiver is a 10836 Z21 switch DECODER, then the output 1 "red" (clamp 1A) will be switched on and switched off again after 5*100ms automatically.

With this command, it is also possible to send the "emergency stop command for extended accessory decoders" according to RCN-213 (Section 2.4). This corresponds to the value 0 ("Stop") for the RawAddress=2047:
0x0A 0x00 0x40 0x00 0x54 0x07 0xFF 0x00 0x00 0xAC

5.5 LAN_X_GET_EXT_ACCESSORY_INFO

From Z21 FW V1. 40, the following request can be used to poll the last command transferred to an **extended accessory decoder**.

Request to Z21:

DataLen		Header		Data				
				X-Header	DB0	DB1	DB2	XOR-Byte
0x09	0x00	**0x40**	0x00	**0x44**	**Adr_MSB**	**Adr_LSB**	0x00	XOR-Byte

Note: **RawAddress** = (**Adr_MSB** << 8) + **Adr_LSB**

RawAddress The address of the accessory decoder according to RCN-213.
See section *5.4* LAN_X_SET_EXT_ACCESSORY

DB2 Reserved for future extensions, should remain initialized with 0 until further notice.

Reply from Z21:
see *5.6*LAN_X_EXT_ACCESSORY_INFO

5.6 LAN_X_EXT_ACCESSORY_INFO

This message is sent from the Z21 to the clients in response to command *5.5 LAN_X_GET_EXT_ACCESSORY_INFO*.
However, it is also sent to an associated client unsolicitedly if

- the accessory status has been changed by one of the (other) clients or a handset controller
- and the associated client has activated the corresponding broadcast,
  see ***2.16*** LAN_SET_BROADCASTFLAGS, Flag 0x00000001

Z21 to Client:

DataLen		Header		Data					
				X-Header	DB0	DB1	DB2	DB3	XOR-Byte
0x0A	0x00	**0x40**	0x00	**0x44**	**Adr_MSB**	**Adr_LSB**	**DDDDDDDD**	**Status**	XOR-Byte

Note: **RawAddress** = (**Adr_MSB** << 8) + **Adr_LSB**

RawAddress The address of the accessory decoder according to RCN-213.
See section *5.4*LAN_X_SET_EXT_ACCESSORY

DDDDDDDD Up to 256 possible states encoded in ***extended accessory decoder package format*** according to RCN-213.
See section *5.4* LAN_X_SET_EXT_ACCESSORY.

Status 0x00 … Data Valid
0xFF … Data Unknown