VLCB Versatille Layout Control Bus

Opcode Specification

Version 1.2, April 2024

Compatible with CBUS ® 4.0 Rev 8j

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0.1 Table of Contents

0.2 Document History

Date	Changed by	Summary of changes
18th October 2022	Ian Hogg M.5144	Initial document
5th December 2022	Ian Hogg M.5144	Removed GSTOP
14th November 2022	Ian Hogg M.5144	Added placeholder ENACK
29th December 2022	Ian Hogg M.5144	Changed the RQSD/SD and RDGN/DGN for ServiceIndex
14 April 2023	Ian Hogg M.5144	Changed name to VLCB
15 May 2023	Ian Hogg M.5144	Allocated bit 6 of module parameter flags to support for service discovery. PNN also updated.
26 August 2023	Ian Hogg M.5144	AREQ updated to exclude short message check and NN check. EVULN, REQEV, EVLRN updated to also return GRSP.
29 August 2023	Ian Hogg M.5144	Updated Appendix C to include GRSP error codes. Updated RQSD and REQEV to align with Appendix C.
30 August 2023	Ian Hogg M.5144	Changed event being present condition for REQEV from event index to NN:EN
6 October 2023	Ian Hogg M.5144	Allow RQMN to be used in LEARN mode in addition to SETUP mode.
5 November 2023	Ian Hogg M.5144	Added a DGN response to RDGN when DiagnosticCode=0 indicating the number of following diagnostics.
23 November 2023	Ian Hogg M.5144	Added further clarification ro RDGN.
29 January 2024	Ian Hogg M.5144	Updated MODE opcode to change parameter from a mode to a command. EVLRN now returns a GRSP(ok) in addition to a WRACK. Update NNULN conditions so that NN does not need to match that of the module. Corrected REQEV errors.

12 February 2024	Ian Hogg M.5144	Added additional condition to RQSD to check for serviceIndex being valid.
26 February 2024 Released as v1.1	Ian Hogg M.5144	Changed NENRD error response for an invalid index. Updated both REVAL and REQEV for EV#0 to both return the number of EVs followed by a response for each EV.
7 April 2024	Ian Hogg M.5144	Added GRSP(OK) response in addition to WRACK for NNCLR, EVULN and NVSET.
1 September 2024	Ian Hogg M.5144	Clarified that DGN(NN,si,0,0) should be sent in response to RDGN(NN, si, 0) when the specified service does not support diagnostics.
10 March 2025	Ian Hogg M.5144	Added condition upon FCU compatibility mode for the additional responses for NVRD, RQNPN, REVAL, REQEV when requesting item 0.

1 Introduction

This document provides a detailed description of the VLCB opcodes.

2 Opcodes

2.1 Opcode bit checks

2.1.1 Message length

CBUS uses the top 3 bits of the opcode to define the number of data bytes following the opcode. Whilst on CAN this is not necessary as the CAN DLC field also contains the data length, having the length could be beneficial for other protocols if messages are not wrapped using a format which is able to indicate the message length.

VLCB opcodes have maintained the top 3 bits length format for CBUS compatible opcodes but may not comply with this for new opcodes. It is recommended that the developer makes no assumptions about the length of the message based upon the top 3 bits of the opcode.

If a module is targeted with a command message i.e. the NN matches its own node number and there are insufficient data bytes in the message then it should respond with a GRSP(Invalid Command). Otherwise if a message is received which has insufficient data bytes then it shall be ignored.

2.1.2 Event checks

If the bits of the opcode equal 1xx10000 then the message is an ON long event.
If the bits of the opcode equal 1xx10001 then the message is an OFF long event.
If the bits of the opcode equal 1xx11000 then the message is an ON short event.
If the bits of the opcode equal 1xx11001 then the message is an OFF short event.

2.1.3 Extension Checks

If the bits of the opcode equal xxx11111 with the exception of 00011111 (0x1F) then the opcode is an Extension Opcode.

2.2 Opcodes ordered by Name

Name	Value	
	Decimal	Hex
ACDAT	246	F6
ACK	0	00
ACOF	145	91
ACOF1	177	B1
ACOF2	209	D1
ACOF3	241	F1

VLCB Opcode specification

ACON	144	90
ACON1	176	B0
ACON2	208	D0
ACON3	240	F0
ALOC	67	43
ARDAT	247	F7
AREQ	146	92
AROF	148	94
AROF1	180	B4
AROF2	213	D5
AROF3	244	F4
ARON	147	93
ARON1	179	B3
ARON2	212	D4
ARON3	243	F3
ARSOF	158	9E
ARSOF1	190	BE
ARSOF2	222	DE
ARSOF3	254	FE
ARSON	157	9D
ARSON1	189	BD
ARSON2	221	DD
ARSON3	253	FD
ARST	7	07
ASOF	153	99
ASOF1	185	B9
ASOF2	217	D9

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ASOF3	249	F9
ASON	152	98
ASON1	184	B8
ASON2	216	D8
ASON3	248	F8
ASRQ	154	9A
BON	3	03
BOOTM	92	5C
CABDAT	194	C2
CANID	117	75
CMDERR	111	6F
DBG1	48	30
DDES	250	FA
DDRS	251	FB
DFLG	72	48
DFNOF	74	4A
DFNON	73	49
DFUN	96	60
DGN	199	C7
DKEEP	35	23
DSPD	71	47
DTXC	233	E9
ENACK	230	E6
ENRSP	242	F2
ENUM	93	5D
ERR	99	63
ESD	231	E7

VLCB Opcode specification

ESTOP	6	06
EVANS	211	D3
EVLRN	210	D2
EVLRNI	245	F5
EVNLF	112	70
EVULN	149	95
FCLK	207	CF
GLOC	97	61
GRSP	175	AF
HEARTB	163	AB
HLT	2	02
KCON	70	46
KLOC	33	21
MODE	118	76
NAK	1	01
NAME	226	E2
NENRD	114	72
NERD	87	57
NEVAL	181	B5
NNACK	82	52
NNCLR	85	55
NNEVN	86	56
NNLRN	83	53
NNREL	81	51
NNRSM	79	4F
NNRST	94	5E
NNULN	84	54

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NUMEV	116	74
NVANS	151	97
NVRD	113	71
NVSET	150	96
NVSETRD	142	8E
PARAMS	239	EF
PARAN	155	9B
PCON	69	45
PCVS	133	85
PLOC	225	E1
PNN	182	B6
QCON	65	41
QCVS	132	84
QLOC	34	22
QNN	13	0D
RDCC3	128	80
RDCC4	160	A0
RDCC5	192	C0
RDCC6	224	E0
RDGN	135	87
REQEV	178	B2
RESTP	10	0A
REVAL	156	9C
RLOC	64	40
RQDAT	90	5A
RQDDS	91	5B
RQEVN	88	58

RQMN	17	11
RQNN	80	50
RQNP	16	10
RQNPN	115	73
RQSD	120	78
RSTAT	12	0C
RTOF	8	08
RTON	9	09
SD	140	8C
SNN	66	42
SSTAT	76	4C
STAT	227	E3
STMOD	68	44
TOF	4	04
TON	5	05
WCVB	131	83
WCVO	130	82
WCVOA	193	C1
WCVS	162	A2
WRACK	89	59

2.3 Opcodes ordered by Value

Name	Value	
	Decimal	Hex
ACK	0	00
NAK	1	01

VLCB Opcode specification

HLT	2	02
BON	3	03
TOF	4	04
TON	5	05
ESTOP	6	06
ARST	7	07
RTOF	8	08
RTON	9	09
RESTP	10	0A
RSTAT	12	0C
QNN	13	0D
RQNP	16	10
RQMN	17	11
KLOC	33	21
QLOC	34	22
DKEEP	35	23
DBG1	48	30
RLOC	64	40
QCON	65	41
SNN	66	42
ALOC	67	43
STMOD	68	44
PCON	69	45
KCON	70	46
DSPD	71	47
DFLG	72	48
DFNON	73	49

DFNOF	74	4A
SSTAT	76	4C
NNRSM	79	4F
RQNN	80	50
NNREL	81	51
NNACK	82	52
NNLRN	83	53
NNULN	84	54
NNCLR	85	55
NNEVN	86	56
NERD	87	57
RQEVN	88	58
WRACK	89	59
RQDAT	90	5A
RQDDS	91	5B
BOOTM	92	5C
ENUM	93	5D
NNRST	94	5E
DFUN	96	60
GLOC	97	61
ERR	99	63
CMDERR	111	6F
EVNLF	112	70
NVRD	113	71
NENRD	114	72
RQNPN	115	73
NUMEV	116	74

VLCB Opcode specification

CANID	117	75
MODE	118	76
RDGN	119	77
RQSD	120	78
RDCC3	128	80
WCVO	130	82
WCVB	131	83
QCVS	132	84
PCVS	133	85
SD	140	AC
NVSETRD	142	8E
ACON	144	90
ACOF	145	91
AREQ	146	92
ARON	147	93
AROF	148	94
EVULN	149	95
NVSET	150	96
NVANS	151	97
ASON	152	98
ASOF	153	99
ASRQ	154	9A
PARAN	155	9B
REVAL	156	9C
ARSON	157	9D
ARSOF	158	9E
RDCC4	160	A0

VLCB Opcode specification

WCVS	162	A2
HEARTB	163	AB
GRSP	175	AF
ACON1	176	B0
ACOF1	177	B1
REQEV	178	B2
ARON1	179	B3
AROF1	180	B4
NEVAL	181	B5
PNN	182	B6
ASON1	184	B8
ASOF1	185	B9
ARSON1	189	BD
ARSOF1	190	BE
RDCC5	192	C0
WCVOA	193	C1
CABDAT	194	C2
DGN	199	C7
FCLK	207	CF
ACON2	208	D0
ACOF2	209	D1
EVLRN	210	D2
EVANS	211	D3
ARON2	212	D4
AROF2	213	D5
ASON2	216	D8
ASOF2	217	D9

ARSON2	221	DD
ARSOF2	222	DE
RDCC6	224	E0
PLOC	225	E1
NAME	226	E2
STAT	227	E3
ENACK	230	E6
ESD	231	E7
DTXC	233	E9
PARAMS	239	EF
ACON3	240	F0
ACOF3	241	F1
ENRSP	242	F2
ARON3	243	F3
AROF3	244	F4
EVLRNI	245	F5
ACDAT	246	F6
ARDAT	247	F7
ASON3	248	F8
ASOF3	249	F9
DDES	250	FA
DDRS	251	FB
ARSON3	253	FD
ARSOF3	254	FE

2.4 Opcodes by Mode

Not all of the opcodes are available in all modes. A limited number of opcodes are available in Setup mode as, generally the module has no node number whilst in Setup mode. Normal mode encompasses the majority of the opcodes, Learn mode adds opcodes specifically for event learning, on top of the Normal opcodes, many of which require additional parameters leaving no room for a node number.

A visual way of representing this is with a Venn diagram. The diagram below doesn't list all of the opcodes available in each mode but gives an indication of the capabilities available in each mode.
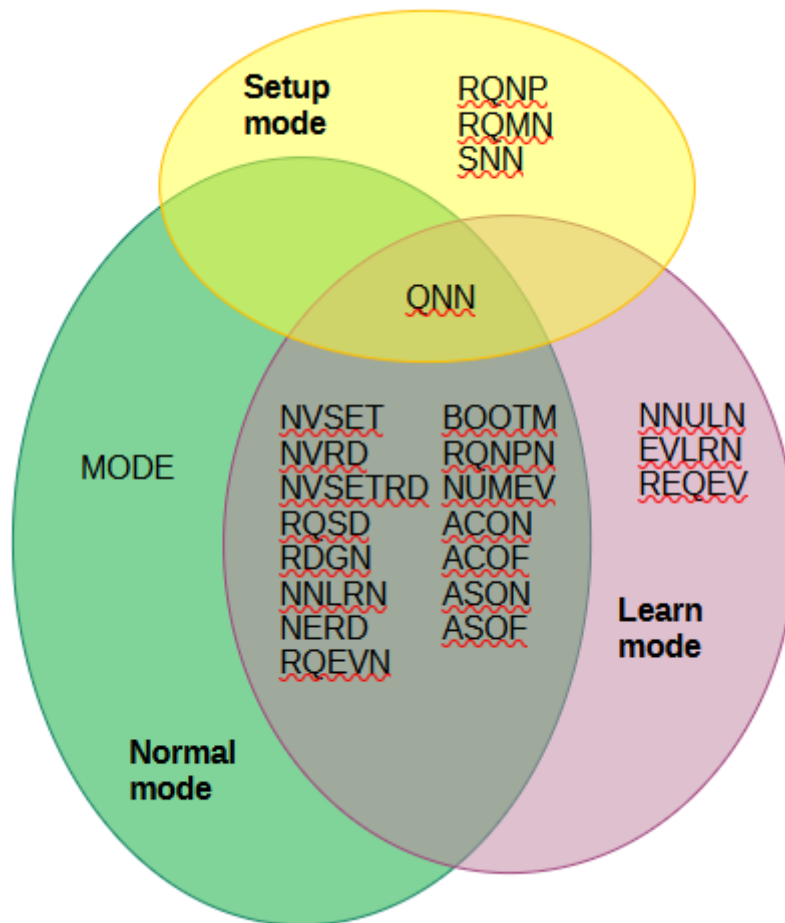
Name	Value		Modes
	Decimal	**Hex**	**Modes**
NNULN	84	54	Learn
NNCLR	85	55	Learn
EVULN	149	95	Learn
REQEV	178	B2	Learn

VLCB Opcode specification

Name	Value		Modes
	Decimal	Hex	
EVLRN	210	D2	Learn
EVANS	211	D3	Learn
EVLRNI	245	F5	Learn
ACK	0	00	Normal, Learn, NOHEARTB, ENACK
NAK	1	01	Normal, Learn, NOHEARTB, ENACK
HLT	2	02	Normal, Learn, NOHEARTB, ENACK
BON	3	03	Normal, Learn, NOHEARTB, ENACK
TOF	4	04	Normal, Learn, NOHEARTB, ENACK
TON	5	05	Normal, Learn, NOHEARTB, ENACK
ESTOP	6	06	Normal, Learn, NOHEARTB, ENACK
ARST	7	07	Normal, Learn, NOHEARTB, ENACK
RTOF	8	08	Normal, Learn, NOHEARTB, ENACK
RTON	9	09	Normal, Learn, NOHEARTB, ENACK
RESTP	10	0A	Normal, Learn, NOHEARTB, ENACK
RSTAT	12	0C	Normal, Learn, NOHEARTB, ENACK
QNN	13	0D	Normal, Learn, NOHEARTB, ENACK, Setup
KLOC	33	21	Normal, Learn, NOHEARTB, ENACK
QLOC	34	22	Normal, Learn, NOHEARTB, ENACK
DKEEP	35	23	Normal, Learn, NOHEARTB, ENACK
DBG1	48	30	Normal, Learn, NOHEARTB, ENACK
RLOC	64	40	Normal, Learn, NOHEARTB, ENACK
QCON	65	41	Normal, Learn, NOHEARTB, ENACK
ALOC	67	43	Normal, Learn, NOHEARTB, ENACK
STMOD	68	44	Normal, Learn, NOHEARTB, ENACK
PCON	69	45	Normal, Learn, NOHEARTB, ENACK

VLCB Opcode specification

Name	Value		Modes
	Decimal	Hex	
KCON	70	46	Normal, Learn, NOHEARTB, ENACK
DSPD	71	47	Normal, Learn, NOHEARTB, ENACK
DFLG	72	48	Normal, Learn, NOHEARTB, ENACK
DFNON	73	49	Normal, Learn, NOHEARTB, ENACK
DFNOF	74	4A	Normal, Learn, NOHEARTB, ENACK
SSTAT	76	4C	Normal, Learn, NOHEARTB, ENACK
NNRSM	79	4F	Normal, Learn, NOHEARTB, ENACK
NNLRN	83	53	Normal, Learn, NOHEARTB, ENACK
NNEVN	86	56	Normal, Learn, NOHEARTB, ENACK
NERD	87	57	Normal, Learn, NOHEARTB, ENACK
RQEVN	88	58	Normal, Learn, NOHEARTB, ENACK
WRACK	89	59	Normal, Learn, NOHEARTB, ENACK
RQDAT	90	5A	Normal, Learn, NOHEARTB, ENACK
RQDDS	91	5B	Normal, Learn, NOHEARTB, ENACK
BOOTM	92	5C	Normal, Learn, NOHEARTB, ENACK
ENUM	93	5D	Normal, Learn, NOHEARTB, ENACK
NNRST	94	5E	Normal, Learn, NOHEARTB, ENACK
DFUN	96	60	Normal, Learn, NOHEARTB, ENACK
GLOC	97	61	Normal, Learn, NOHEARTB, ENACK
ERR	99	63	Normal, Learn, NOHEARTB, ENACK
CMDERR	111	6F	Normal, Learn, NOHEARTB, ENACK
EVNLF	112	70	Normal, Learn, NOHEARTB, ENACKCANID
NVRD	113	71	Normal, Learn, NOHEARTB, ENACK
NENRD	114	72	Normal, Learn, NOHEARTB, ENACK
RQNPN	115	73	Normal, Learn, NOHEARTB, ENACK

VLCB Opcode specification

Name	Value		Modes
	Decimal	Hex	
NUMEV	116	74	Normal, Learn, NOHEARTB, ENACK
CANID	117	75	Normal, Learn, NOHEARTB, ENACK
RQSD	120	78	Normal, Learn, NOHEARTB, ENACK
RDCC3	128	80	Normal, Learn, NOHEARTB, ENACK
WCVO	130	82	Normal, Learn, NOHEARTB, ENACK
WCVB	131	83	Normal, Learn, NOHEARTB, ENACK
QCVS	132	84	Normal, Learn, NOHEARTB, ENACK
PCVS	133	85	Normal, Learn, NOHEARTB, ENACK
RDGN	135	87	Normal, Learn, NOHEARTB, ENACK
SD	140	8C	Normal, Learn, NOHEARTB, ENACK
NVSETRD	142	8E	Normal, Learn, NOHEARTB, ENACK
ACON	144	90	Normal, Learn, NOHEARTB, ENACK
ACOF	145	91	Normal, Learn, NOHEARTB, ENACK
AREQ	146	92	Normal, Learn, NOHEARTB, ENACK
ARON	147	93	Normal, Learn, NOHEARTB, ENACK
AROF	148	94	Normal, Learn, NOHEARTB, ENACK
NVSET	150	96	Normal, Learn, NOHEARTB, ENACK
NVANS	151	97	Normal, Learn, NOHEARTB, ENACK
ASON	152	98	Normal, Learn, NOHEARTB, ENACK
ASOF	153	99	Normal, Learn, NOHEARTB, ENACK
ASRQ	154	9A	Normal, Learn, NOHEARTB, ENACK
PARAN	155	9B	Normal, Learn, NOHEARTB, ENACK
REVAL	156	9C	Normal, Learn, NOHEARTB, ENACK
ARSON	157	9D	Normal, Learn, NOHEARTB, ENACK
ARSOF	158	9E	Normal, Learn, NOHEARTB, ENACK

VLCB Opcode specification

Name	Value		Modes
	Decimal	Hex	
RDCC4	160	A0	Normal, Learn, NOHEARTB, ENACK
WCVS	162	A2	Normal, Learn, NOHEARTB, ENACK
HEARTB	163	AB	Normal, Learn, NOHEARTB, ENACK
GRSP	175	AF	Normal, Learn, NOHEARTB, ENACK
ACON1	176	B0	Normal, Learn, NOHEARTB, ENACK
ACOF1	177	B1	Normal, Learn, NOHEARTB, ENACK
ARON1	179	B3	Normal, Learn, NOHEARTB, ENACK
AROF1	180	B4	Normal, Learn, NOHEARTB, ENACK
NEVAL	181	B5	Normal, Learn, NOHEARTB, ENACK
PNN	182	B6	Normal, Learn, NOHEARTB, ENACK
ASON1	184	B8	Normal, Learn, NOHEARTB, ENACK
ASOF1	185	B9	Normal, Learn, NOHEARTB, ENACK
ARSON1	189	BD	Normal, Learn, NOHEARTB, ENACK
ARSOF1	190	BE	Normal, Learn, NOHEARTB, ENACK
RDCC5	192	C0	Normal, Learn, NOHEARTB, ENACK
WCVOA	193	C1	Normal, Learn, NOHEARTB, ENACK
CABDAT	194	C2	Normal, Learn, NOHEARTB, ENACK
DGN	199	C7	Normal, Learn, NOHEARTB, ENACK
FCLK	207	CF	Normal, Learn, NOHEARTB, ENACK
ACON2	208	D0	Normal, Learn, NOHEARTB, ENACK
ACOF2	209	D1	Normal, Learn, NOHEARTB, ENACK
ARON2	212	D4	Normal, Learn, NOHEARTB, ENACK
AROF2	213	D5	Normal, Learn, NOHEARTB, ENACK
ASON2	216	D8	Normal, Learn, NOHEARTB, ENACK
ASOF2	217	D9	Normal, Learn, NOHEARTB, ENACK

VLCB Opcode specification

Name	Value		Modes
	Decimal	Hex	
ARSON2	221	DD	Normal, Learn, NOHEARTB, ENACK
ARSOF2	222	DE	Normal, Learn, NOHEARTB, ENACK
RDCC6	224	E0	Normal, Learn, NOHEARTB, ENACK
PLOC	225	E1	Normal, Learn, NOHEARTB, ENACK
STAT	227	E3	Normal, Learn, NOHEARTB, ENACK
ESD	231	E7	Normal, Learn, NOHEARTB, ENACK
DTXC	233	E9	Normal, Learn, NOHEARTB, ENACK
ACON3	240	F0	Normal, Learn, NOHEARTB, ENACK
ACOF3	241	F1	Normal, Learn, NOHEARTB, ENACK
ENRSP	242	F2	Normal, Learn, NOHEARTB, ENACK
ARON3	243	F3	Normal, Learn, NOHEARTB, ENACK
AROF3	244	F4	Normal, Learn, NOHEARTB, ENACK
ACDAT	246	F6	Normal, Learn, NOHEARTB, ENACK
ARDAT	247	F7	Normal, Learn, NOHEARTB, ENACK
ASON3	248	F8	Normal, Learn, NOHEARTB, ENACK
ASOF3	249	F9	Normal, Learn, NOHEARTB, ENACK
DDES	250	FA	Normal, Learn, NOHEARTB, ENACK
DDRS	251	FB	Normal, Learn, NOHEARTB, ENACK
ARSON3	253	FD	Normal, Learn, NOHEARTB, ENACK
ARSOF3	254	FE	Normal, Learn, NOHEARTB, ENACK
QNN	13	0D	Normal, Learn, NOHEARTB, ENACK, Setup
MODE	118	76	Normal
ENACK	230	E6	ENACK
NNREL	81	51	Setup
RQNP	16	10	Setup

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Name	Value		Modes
	Decimal	Hex	
RQMN	17	11	Learn, Setup
SNN	66	42	Setup
RQNN	80	50	Setup
NNACK	82	52	Setup
NAME	226	E2	Setup
PARAMS	239	EF	Setup

2.5 Opcodes by Service

Name	Value		Implement when service included
	Decimal	**Hex**	
ACK	0	00	
NAK	1	01	
HLT	2	02	
BON	3	03	
ARST	7	07	
DBG1	48	30	
RQDAT	90	5A	
RQDDS	91	5B	
NNRST	94	5E	
FCLK	207	CF	
ACDAT	246	F6	
ARDAT	247	F7	
BOOTM	92	5C	Boot
CABDAT	194	C2	CABDAT
ENUM	93	5D	CAN
CANID	117	75	CAN
TOF	4	04	DCC_CAB or DCC_CMD
TON	5	05	DCC_CAB or DCC_CMD
ESTOP	6	06	DCC_CAB or DCC_CMD
RTOF	8	08	DCC_CAB or DCC_CMD
RTON	9	09	DCC_CAB or DCC_CMD
RESTP	10	0A	DCC_CAB or DCC_CMD

RSTAT	12	0C	DCC_CAB or DCC_CMD
KLOC	33	21	DCC_CAB or DCC_CMD
QLOC	34	22	DCC_CAB or DCC_CMD
DKEEP	35	23	DCC_CAB or DCC_CMD
RLOC	64	40	DCC_CAB or DCC_CMD
QCON	65	41	DCC_CAB or DCC_CMD
ALOC	67	43	DCC_CAB or DCC_CMD
STMOD	68	44	DCC_CAB or DCC_CMD
PCON	69	45	DCC_CAB or DCC_CMD
KCON	70	46	DCC_CAB or DCC_CMD
DSPD	71	47	DCC_CAB or DCC_CMD
DFLG	72	48	DCC_CAB or DCC_CMD
DFNON	73	49	DCC_CAB or DCC_CMD
DFNOF	74	4A	DCC_CAB or DCC_CMD
SSTAT	76	4C	DCC_CAB or DCC_CMD
DFUN	96	60	DCC_CAB or DCC_CMD
GLOC	97	61	DCC_CAB or DCC_CMD
ERR	99	63	DCC_CAB or DCC_CMD
RDCC3	128	80	DCC_CAB or DCC_CMD
WCVO	130	82	DCC_CAB or DCC_CMD
WCVB	131	83	DCC_CAB or DCC_CMD
QCVS	132	84	DCC_CAB or DCC_CMD
PCVS	133	85	DCC_CAB or DCC_CMD
RDCC4	160	A0	DCC_CAB or DCC_CMD
WCVS	162	A2	DCC_CAB or DCC_CMD
RDCC5	192	C0	DCC_CAB or DCC_CMD
WCVOA	193	C1	DCC_CAB or DCC_CMD

VLCB Opcode specification

RDCC6	224	E0	DCC_CAB or DCC_CMD
PLOC	225	E1	DCC_CAB or DCC_CMD
STAT	227	E3	DCC_CAB or DCC_CMD
DDES	250	FA	DCC_CAB or DCC_CMD
DDRS	251	FB	DCC_CAB or DCC_CMD
ACON	144	90	Producer or Consumer
ACOF	145	91	Producer or Consumer
AREQ	146	92	Producer
ARON	147	93	Producer
AROF	148	94	Producer
ASON	152	98	Producer or Consumer
ASOF	153	99	Producer or Consumer
ASRQ	154	9A	Producer
ARSON	157	9D	Producer
ARSOF	158	9E	Producer
ACON1	176	B0	Producer or Consumer
ACOF1	177	B1	Producer or Consumer
ARON1	179	B3	Producer
AROF1	180	B4	Producer
ASON1	184	B8	Producer or Consumer
ASOF1	185	B9	Producer or Consumer
ARSON1	189	BD	Producer
ARSOF1	190	BE	Producer
ACON2	208	D0	Producer or Consumer
ACOF2	209	D1	Producer or Consumer
ARON2	212	D4	Producer
AROF2	213	D5	Producer

ASON2	216	D8	Producer or Consumer
ASOF2	217	D9	Producer or Consumer
ARSON2	221	DD	Producer
ARSOF2	222	DE	Producer
ACON3	240	F0	Producer or Consumer
ACOF3	241	F1	Producer or Consumer
ARON3	243	F3	Producer
AROF3	244	F4	Producer
ASON3	248	F8	Producer or Consumer
ASOF3	249	F9	Producer or Consumer
ARSON3	253	FD	Producer
ARSOF3	254	FE	Producer
ENACK	230	E6	Consumer and EventAck
QNN	13	0D	MNS
NNRSM	79	4F	MNS
RQNPN	115	73	MNS
RQSD	120	78	MNS
RDGN	135	87	MNS
SD	140	8C	MNS
DGN	199	C7	MNS
PARAN	155	9B	MNS
HEARTB	163	AB	MNS
GRSP	175	AF	MNS
PNN	182	B6	MNS
ESD	231	E7	MNS
MODE	118	76	MNS
NNREL	81	51	MNS

RQNP	16	10	MNS
RQMN	17	11	MNS
SNN	66	42	MNS
RQNN	80	50	MNS
NNACK	82	52	MNS
NAME	226	E2	MNS
PARAMS	239	EF	MNS
CMDERR	111	6F	MNS or Teach or NV
NVRD	113	71	NV
NVSETRD	142	8E	NV
NVSET	150	96	NV
NVANS	151	97	NV
DTXC	233	E9	Stream
NNLRN	83	53	Teach
NNULN	84	54	Teach
NNCLR	85	55	Teach
NNEVN	86	56	Teach
NERD	87	57	Teach
RQEVN	88	58	Teach
EVNLF	112	70	Teach
NENRD	114	72	Teach
NUMEV	116	74	Teach
EVULN	149	95	Teach
REVAL	156	9C	Teach
REQEV	178	B2	Teach
NEVAL	181	B5	Teach
EVLRN	210	D2	Teach

EVANS	211	D3	Teach
ENRSP	242	F2	Teach
EVLRNI	245	F5	Teach
WRACK	89	59	Teach or NV

2.6 Opcodes Extending CBUS

Name	Value		Description
	Decimal	Hex	
MODE	118	76	Set Mode
RQSD	120	78	Request Service Discovery
RDGN	135	87	Request Diagnostics
SD	140	8C	Service Discovery Response
NVSETRD	142	8E	Set and Read NV
HEARTB	163	AB	Heartbeat
GRSP	175	AF	General Response
DGN	199	C7	Diagnostic Data
ESD	231	E7	Extended Service Discovery Response
ENACK	230	E6	Event Acknowledge

3 Opcode detail

Each opcode in Section 3 contains a table with the following information.

Name		A short name for the opcode's operation
Value	**Decimal**	The decimal (base 10) number of the opcode
	Hex	The hexadecimal (base 16) number of the opcode
Priority		Priority of the specific opcode (Low, Normal, Above Normal or High). Each transport (e.g. CAN) will detail the mapping to the message encoding
Description		A brief explanation of the opcode's operation
Comment		An explanation of the opcode's operation including any associated opcodes, parameter usage and points to note.
Direction		The normal direction for the opcode: ● To module - is usually sent from a configuration tool to a module. ● From module - usually sent as a response to a configuration command. ● To command station - usually sent by a configuration tool or Cab to a DCC command station. ● Blank - communications between modules.
States/Modes		The set of states that the module must be in in order for the opcode's message to be recognised.
Services		The Service which the module must support in order for the opcode's message to be processed
Parameters		The ordered list of parameters for the opcode. 16bit (2 byte) values are sent highest byte first.
Conditions		An ordered list of conditions for the module to process the opcode's message. Each condition is described as a failure condition with the failure result. If none of the conditions match then the successful processing of the message continues. I.e. Pre-conditions.
Result		The result of successfully processing the message. I.e. post-conditions.
History		Origin and changes for the opcode definition

3.1 OPCODES with 0 additional bytes

3.1.1 [00] ACK - General Acknowledgement

Name		ACK
Value	**Decimal**	0
	Hex	00
Priority		Normal
Description		General Acknowledgement.
Comment		Positive response to query/ request performed or report of availability on-line.
Direction		
States / Modes		Normal, Learn, NOHEARTB
Services		
Parameters		
Conditions		
Result		
History		No change from CBUS revision 4 ver 8j

3.1.2 [01] NAK - General No Ack

Name		NAK
Value	**Decimal**	1
	Hex	01
Priority		Normal
Description		General No Ack.
Comment		Negative response to query/ request denied.
Direction		
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		
Parameters		
Conditions		
Result		
History		No change from CBUS revision 4 ver 8j

3.1.3 [02] HLT - Bus Halt

Name		HLT
Value	**Decimal**	2
	Hex	02
Priority		High
Description		Bus Halt.
Comment		Commonly broadcasted to all nodes to indicate CBUS is not available and no further packets should be sent until a BON or ARST is received.
Direction		Both
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		
Parameters		
Conditions		Opcode is supported
Result		If conditions are met then disable transmission of all messages on all interfaces otherwise ignore the request.
History		No change from CBUS revision 4 ver 8j

3.1.4 [03] BON - Bus ON

Name		BON
Value	**Decimal**	3
	Hex	03
Priority		Above Normal.
Description		Bus ON
Comment		Commonly broadcasted to all nodes to indicate CBUS is available following a [HLT](#).
Direction		Both
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		
Parameters		
Conditions		Opcode is supported
Result		If conditions are met then enable transmission of all messages on all interfaces otherwise ignore the request.
History		No change from CBUS revision 4 ver 8j

3.1.5 [04] TOF - Track OFF

Name		TOF
Value	**Decimal**	4
	Hex	04
Priority		Above Normal
Description		Track OFF.
Comment		Commonly broadcasted to all nodes by a command station to indicate track power is off and no further command packets should be sent, except inquiries.
Direction		From command station
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		DCC_CAB or DCC_CMD
Parameters		
Conditions		
Result		
History		No change from CBUS revision 4 ver 8j

3.1.6 [05] TON - Track ON

Name		TON
Value	**Decimal**	5
	Hex	05
Priority		Above Normal
Description		Track ON.
Comment		Commonly broadcasted to all nodes by a command station to indicate track power is on.
Direction		From command station
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		DCC_CAB or DCC_CMD
Parameters		
Conditions		
Result		
History		No change from CBUS revision 4 ver 8j

3.1.7 [06] ESTOP - Emergency Stop

Name		ESTOP
Value	**Decimal**	6
	Hex	06
Priority		Above Normal
Description		Emergency Stop.
Comment		Commonly broadcast to all nodes by a command station to indicate all engines have been emergency stopped.
Direction		From command station
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		DCC_CAB or DCC_CMD
Parameters		
Conditions		
Result		
History		No change from CBUS revision 4 ver 8j

3.1.8 [07] ARST - System Reset

Name		ARST
Value	**Decimal**	7
	Hex	07
Priority		High
Description		System Reset.
Comment		Commonly broadcasted to all nodes to indicate a full system reset. Similar to NNRST which directs a single node to be reset.
Direction		
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		
Parameters		
Conditions		Opcode is supported
Result		If conditions are met then perform a module reset as if power on has just been performed otherwise ignore request.
History		No change from CBUS revision 4 ver 8j

3.1.9 [08] RTOF - Request Track OFF

Name		RTOF
Value	**Decimal**	8
	Hex	08
Priority		Above Normal
Description		Request Track OFF.
Comment		Sent to request change of track power state to "off".
Direction		Cab to command station
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		DCC_CAB or DCC_CMD
Parameters		
Conditions		
Result		
History		No change from CBUS revision 4 ver 8j

3.1.10 [09] RTON - Request Track ON

Name		RTON
Value	**Decimal**	9
	Hex	09
Priority		Above Normal
Description		Request Track ON.
Comment		Sent to request change of track power state to "on".
Direction		Cab to command station
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		DCC_CAB or DCC_CMD
Parameters		
Conditions		
Result		
History		No change from CBUS revision 4 ver 8j

3.1.11 [0A] RESTP - Request Emergency Stop All

Name		RESTP
Value	**Decimal**	10
	Hex	0A
Priority		High
Description		Request Emergency Stop ALL.
Comment		Sent to request an emergency stop to all trains . Does not affect accessory control.
Direction		Cab to command station
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		DCC_CAB or DCC_CMD
Parameters		
Conditions		
Result		
History		No change from CBUS revision 4 ver 8j

3.1.12 [0C] RSTAT - Request Command Station Status

Name		RSTAT
Value	**Decimal**	12
	Hex	0C
Priority		Normal
Description		Request Command Station Status.
Comment		Sent to query the status of the command station. See description of (STAT) for the response from the command station.
Direction		Cab to command station
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		DCC_CAB or DCC_CMD
Parameters		
Conditions		
Result		
History		No change from CBUS revision 4 ver 8j

3.1.13 [0D] QNN - Query Node Number

Name		QNN
Value	**Decimal**	13
	Hex	0D
Priority		Low
Description		Query node number.
Comment		Requests a PNN reply from each node on the bus. Can be used by management software to obtain a list of nodes on the network.
Direction		To module
States/Modes		Setup, Normal, Learn, NOHEARTB, ENACK
Services		MNS
Parameters		
Conditions		
Result		A PNN response is sent.
History		No change from CBUS revision 4 ver 8j

3.1.14 [10] RQNP - Request Node Parameters

Name		RQNP
Value	**Decimal**	16
	Hex	10
Priority		Low
Description		Request node parameters.
Comment		Sent to a node while in Setup mode to read its parameter set. Used when initially configuring a node.
Direction		To module
States/Modes		Setup
Services		MNS
Parameters		
Conditions		If the module is not in setup mode then ignore the message.
Result		If conditions are met then send a PARAMS message.
History		No change from CBUS revision 4 ver 8j

3.1.15 [11] RQMN - Request Module Name

Name		RQMN
Value	**Decimal**	17
	Hex	11
Priority		Normal
Description		Request module name.
Comment		Sent by a node to request the name of the type of module that is in setup mode or Learn mode. The module in setup mode or learn mode will reply with opcode NAME. Note if there is a module in setup mode and a module in Learn mode then both will respond.
Direction		To module
States/Modes		Learn, Setup
Services		MNS
Parameters		
Conditions		If the module is not in Setup mode or Learn mode then the message is ignored.
Result		If conditions are met then send a NAME message otherwise.
History		No change from CBUS revision 4 ver 8j

3.2 OPCODES with 1 additional bytes

3.2.1 [21] KLOC - Release Engine

Name		KLOC
Value	**Decimal**	33
	Hex	21
Priority		Normal
Description		Release Engine.
Comment		Sent by a CAB to the Command Station. The engine with that Session number is removed from the active engine list.
Direction		Cab to command station
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		DCC_CAB or DCC_CMD
Parameters		Session (1 bytes)
Conditions		If the module is not a DCC command station then the message is ignored. If the module does not have an active session with the specified session identifier then an ERR message is sent.
Result		If conditions are met then the loco for that session is removed from the active engine list.
History		No change from CBUS revision 4 ver 8j

3.2.2 [22] QLOC - Query Engine

Name		QLOC
Value	Decimal	34
	Hex	22
Priority		Normal
Description		Query engine.
Comment		Used to determine if the command station session is valid and to obtain information about the status of the locomotive.
Direction		Cab to command station
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		DCC_CAB or DCC_CMD
Parameters		Session (1 bytes)
Conditions		If the module is not a DCC command station then the message is ignored. If the module does not have an active session with the specified session identifier then an ERR message is sent.
Result		If conditions are met then send a PLOC message.
History		No change from CBUS revision 4 ver 8j

3.2.3 [23] DKEEP - Session Keep Alive

Name		DKEEP
Value	**Decimal**	35
	Hex	23
Priority		Normal
Description		Session keep alive.
Comment		The cab sends a keep alive at regular intervals for the active session. The interval between keep alive messages must be less than the session timeout implemented by the command station.
Direction		Cab to command station
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		DCC_CAB or DCC_CMD
Parameters		Session (1 bytes)
Conditions		If the module is not a DCC command station then the message is ignored.
Result		If conditions are met then Reset the session's keep alive timer.
History		No change from CBUS revision 4 ver 8j

3.2.4 [30] DBG1 - Debug with 1 Data Byte

Name		DBG1
Value	**Decimal**	48
	Hex	30
Priority		Normal
Description		Debug with one data byte.
Comment		Freeform status byte for debugging during CBUS module development. Not used during normal operation.
Direction		
States/Modes		
Services		
Parameters		Status (1 bytes)
Conditions		
Result		
History		No change from CBUS revision 4 ver 8j

3.2.5 [3F] EXTC - Extended Opcode 0 Additional Bytes

Name		EXTC
Value	**Decimal**	63
	Hex	3F
Priority		Low
Description		Extended opcode with zero additional bytes.
Comment		Reserved to allow the 0 additional bytes range to be extended by a further 256 opcodes.
Direction		
States/Modes		
Services		
Parameters		Ext_OPC (1 bytes) Extended opcode,
Conditions		
Result		
History		No change from CBUS revision 4 ver 8j

3.3 OPCODES with 2 additional bytes

3.3.1 [40] RLOC - Request Engine Session

Name		RLOC
Value	**Decimal**	64
	Hex	40
Priority		Normal
Description		Request engine session.
Comment		This command is typically sent by a cab to the command station following a change of the controlled decoder address. RLOC is exactly equivalent to GLOC with all flag bits set to zero, but command stations must continue to support RLOC for backwards compatibility. 7 bit addresses have (AddrH=0).14 bit addresses have bits 6,7 of AddrH set to 1.
Direction		Cab to command station
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		DCC_CAB or DCC_CMD
Parameters		Dat1 (1 bytes) AddrH of the decoder, Dat2 (1 bytes) AddrL of the decoder
Conditions		If the module is not a DCC command station then the message is ignored. If the command station does not have an available session slot an ERR (Loco stack full) message is sent. If the loco is currently assigned to another session then an ERR (Loco address Taken) is sent.
Result		If conditions are met then associate loco address to the specified session and send a PLOC message.
History		No change from CBUS revision 4 ver 8j

3.3.2 [41] QCON - Query Consist

Name		QCON
Value	**Decimal**	65
	Hex	41
Priority		Normal
Description		Query Consist.
Comment		Allows enumeration of a consist. Command station responds with PLOC if an engine exists at the specified index, otherwise responds with ERR: no more engines.
Direction		To command station
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		DCC_CAB or DCC_CMD
Parameters		ConID (1 byte) Consist ID Index (1 byte)
Conditions		If the module is not a DCC command station then the message is ignored. If an engine does not exist at the specified index then send an ERR (No session) message.
Result		If conditions are met then send a PLOC message.
History		No change from CBUS revision 4 ver 8j

3.3.3 [42] SNN - Set Node Number

Name		SNN
Value	**Decimal**	66
	Hex	42
Priority		Low
Description		Set Node Number.
Comment		Sent by a configuration tool to assign a node number to a requesting node in response to a RQNN message. The target node must be in 'setup' mode.
Direction		To module
States/Modes		Setup
Services		MNS
Parameters		NN (2 bytes) the new node number
Conditions		Module must be in setup mode otherwise the SNN message is ignored. If the message is short so that it does not contain a complete NN the message is ignored.
Result		If conditions are met then the specified node number is saved in persistent storage for use in future communications. The module shall send a NNACK message in response.
History		No change from CBUS revision 4 ver 8j

3.3.4 [43] ALOC - Allocate Loco to Activity

Name		ALOC
Value	**Decimal**	67
	Hex	43
Priority		Normal
Description		Allocate loco to activity.
Comment		
Direction		To command station
States/Modes		Normal
Services		DCC_CAB or DCC_CMD
Parameters		Session ID (1 byte) the Session ID. Allocation code (1 byte) application specific allocation code.
Conditions		If the module is not a DCC command station then ignore the request. If the module does not have an active session with the specified session identifier then send an ERR (No session) message.
Result		If conditions are met then assign the activity code to the session otherwise.
History		No change from CBUS revision 4 ver 8j

3.3.5 [44] STMOD - Set Cab Session Mode

Name		STMOD
Value	**Decimal**	68
	Hex	44
Priority		Normal
Description		Set CAB session mode.
Comment		Bits 0 –1: speed mode 00 =128 speed steps, 01 =14 speed steps, 10 =28 speed steps with interleave steps, 11 =28 speed steps Bit 2: service mode Bit 3:sound control mode
Direction		Cab to command station
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		DCC_CAB or DCC_CMD
Parameters		Session (1 bytes), mode (1 bytes)
Conditions		If the module is not a DCC command station then ignore the request. If the module does not have an active session with the specified session identifier then send an ERR (No session) message.
Result		If conditions are met then update the session information for number of speed steps, service mode and sound control mode.
History		No change from CBUS revision 4 ver 8j

3.3.6 [45] PCON - Consist Engine

Name		PCON
Value	**Decimal**	69
	Hex	45
Priority		Normal
Description		Consist Engine.
Comment		Adds a decoder specified by Session to a consist. Consist# has bit 7 set if consist direction is reversed.
Direction		Cab to command station
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		DCC_CAB or DCC_CMD
Parameters		Session (1 bytes), Consist# (1 bytes)
Conditions		If the module is not a DCC command station then ignore the request. If the module does not have an active session with id Session then send ERR (No session).
Result		If the module does not already have a consist with the specified id then the consist is created. The session is added to the specified consist.
History		No change from CBUS revision 4 ver 8j

3.3.7 [46] KCON - Remove Loco from Consist

Name		KCON
Value	**Decimal**	70
	Hex	46
Priority		Normal
Description		Removes a loco from a consist.
Comment		
Direction		To module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		DCC_CAB or DCC_CMD
Parameters		Session (1 bytes), Consist# (1 bytes)
Conditions		If the module is not a DCC command station then ignore the message. If the module does not have a session with the specified Session id then send ERR (No session). If the module does not have a consist with the specified Consist# id then ignore the message.
Result		If conditions are met then remove the specified session from the specified consist.
History		No change from CBUS revision 4 ver 8j

3.3.8 [47] DSPD - Set Engine Speed/Dir

Name		DSPD
Value	**Decimal**	71
	Hex	47
Priority		Normal
Description		Set Engine Speed/Dir.
Comment		Speed/dir value, where the most significant bit is direction and the 7ls bits are the unsigned speed value. Sent by a CAB or equivalent to request an engine speed/dir change.
Direction		Cab to command station
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		DCC_CAB or DCC_CMD
Parameters		Session (1 bytes), Speed/Dir (1 bytes)
Conditions		If the module is not a DCC command station then ignore the message. If the module does not have an active session with the specified session identifier then send ERR (No session).
Result		If conditions are met then set the speed and direction of the loco specified by the session.
History		No change from CBUS revision 4 ver 8j

3.3.9 [48] DFLG - Set Engine Flags

Name		DFLG
Value	**Decimal**	72
	Hex	48
Priority		Normal
Description		Set Engine Flags.
Comment		Bits 0-1: Speed Mode (00 =128 speed steps, 01 =14 speed steps,10 =28 speed steps with interleave steps, 11 =28 speed steps) Bit 2:Lights On/OFF Bit 3:Engine relative direction Bits 4-5: Engine state (active =0 , consisted =1, consist master=2, inactive=3) Bits 6-7: Reserved. Sent by a cab to notify the command station of a change in engine flags.
Direction		Cab to command station
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		DCC_CAB or DCC_CMD
Parameters		Session (1 bytes), SpeedMode (1 bytes)
Conditions		If the module is not a DCC command station then ignore the message. If the module does not have an active session with the specified session identifier then send an ERR (No session) message.
Result		If conditions are met then set the specified session flags.
History		No change from CBUS revision 4 ver 8j

3.3.10 [49] DFNON - Set Engine Function ON

Name		DFNON
Value	**Decimal**	73
	Hex	49
Priority		Normal
Description		Set Engine function on.
Comment		Sent by a cab to turn on a specific loco function. This provides an alternative method to DFUN for controlling loco functions. A command station must implement both methods.
Direction		To module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		DCC_CAB or DCC_CMD
Parameters		Session (1 bytes), Fnum (1 bytes)
Conditions		If the module is not a DCC command station then ignore the message. If the module does not have an active session with the specified session identifier then send an ERR (No session) message.
Result		If conditions are met then turn on the loco function on the specified session.
History		No change from CBUS revision 4 ver 8j

3.3.11 [4A] DFNOF - Set Engine Function OFF

Name		DFNOF
Value	**Decimal**	74
	Hex	4A
Priority		Normal
Description		Set Engine function off.
Comment		Sent by a cab to turn off a specific loco function. This provides an alternative method to DFUN for controlling loco functions. A command station must implement both methods.
Direction		To module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		DCC_CAB or DCC_CMD
Parameters		Session (1 bytes), Fnum (1 bytes)
Conditions		If the module is not a DCC command station then ignore the message. If the module does not have an active session with the specified session identifier then send an ERR (No session) message.
Result		If conditions are met then turn off the loco function on the specified session.
History		No change from CBUS revision 4 ver 8j

3.3.12 [4C] SSTAT - Service Mode Status

Name		SSTAT
Value	**Decimal**	76
	Hex	4C
Priority		Low
Description		Service mode status.
Comment		Status returned by command station/programmer at the end of a programming operation that does not return data. Response to QCVS to indicate no data.
Direction		From command station
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		DCC_CAB or DCC_CMD
Parameters		Session (1 bytes), Status (1 bytes)
Conditions		Response to QCVS when no data was available.
Result		
History		No change from CBUS revision 4 ver 8j

3.3.13 [4F] NNRSM - Reset to Manufacturer Settings

Name		NNRSM
Value	**Decimal**	79
	Hex	4F
Priority		Low
Description		Reset to manufacturer settings.
Comment		Reset a module back to manufacturer settings.
Direction		To module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		MNS
Parameters		NN (2 bytes) Node number
Conditions		If the message is short so that it does not contain a complete NN then the message shall be ignored. If the NN does not match the module's node number then ignore the message.
Result		If conditions are met then the module shall respond with GRSP OK and then clear all configuration and revert to a state at time of initial programming, including *Uninitialised* mode i.e. NN=0, manufacturer's default NVs and default Events. (CANID will be enumerated on the first CAN message send.)
History		CBUS specifies preservation of NN and returns to FLiM. VLCB reverts the module to NN=0 and enters Uninitialised mode.

3.3.14 [50] RQNN - Request Node Number

Name		RQNN
Value	**Decimal**	80
	Hex	50
Priority		low
Description		Request node number.
Comment		The module is requesting that it is provided with a new node number. A configuration tool should respond with SNN to provide the requesting module with an allocated node number. The NN within the message is the current node number of the module.
Direction		From module
States/Modes		Setup
Services		MNS
Parameters		NN (2 bytes) Existing Node number
Conditions		Module has been instructed to request a new node number. This may be done in a variety of ways such as holding down a push button on the module for a number of seconds. Module will not send RQNN until instructed to obtain new NN.
Result		The module enters setup mode. If the module does not receive a SNN with in 30 seconds, the module will return to its previous mode and reclaim its previous NN by issuing a NNACK.
History		No change from CBUS revision 4 ver 8j

3.3.15 [51] NNREL - Node Number Release

Name		NNREL
Value	**Decimal**	81
	Hex	51
Priority		Low
Description		Node number release.
Comment		A node signals that it no longer requires a node number by sending NNREL. The module will do this upon moving from normal mode to setup mode.
Direction		From module
States/Modes		Setup
Services		MNS
Parameters		NN (2 bytes) Node number
Conditions		Module is in the process of changing to Setup mode.
Result		Module no longer has a node number. The node number is replaced with 0 indicating 'no node number'.
History		No change from CBUS revision 4 ver 8j

3.3.16 [52] NNACK - Node Number Acknowledge

Name		NNACK
Value	**Decimal**	82
	Hex	52
Priority		Low
Description		Node number acknowledge.
Comment		This message is sent in response to SNN. A node signals that it will now use the node number specified in the SNN message.
Direction		From module
States/Modes		Setup
Services		MNS
Parameters		NN (2 bytes) the new node number to be used.
Conditions		Module will be transitioning from Setup mode to Normal mode.
Result		Module will be in Normal mode with the new node number assigned.
History		No change from CBUS revision 4 ver 8j

3.3.17 [53] NNLRN - Set Node to Learn Mode

Name		NNLRN
Value	**Decimal**	83
	Hex	53
Priority		Low
Description		Set node into learn mode.
Comment		Sent by a configuration tool to put a specific node into learn mode. Deprecated and replaced by MODE.
Direction		To module
States/Modes		Normal
Services		Teach
Parameters		NN (2 bytes) Node number
Conditions		If the module does not support event teaching then the message is ignored. If the message is short so that it does not contain a complete NN then the message shall be ignored. If the NN does NOT match the node number of the module and the module is in Learn mode then it must revert to Normal mode. If the NN does NOT match the node number of the module and the module is not in Learn mode then the message is ignored. If the NN matches the module's node number and the module supports event teaching then the module enters Learn mode. If the NN matches the module's node number and the module does not support event teaching then the message is ignored.
Result		If conditions are met then the module enters Learn mode.

History	No change from CBUS revision 4 ver 8j

3.3.18 [54] NNULN - Node Out of Learn Mode

Name		NNULN
Value	**Decimal**	84
	Hex	54
Priority		Low
Description		Release node from learn mode.
Comment		Sent by a configuration tool to take the module out of learn mode and revert to normal operation. Deprecated and replaced by MODE.
Direction		To module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		Teach
Parameters		NN (2 bytes) Node number
Conditions		If the module does not support event teaching then the message is ignored. If the message is short so that it does not contain a complete NN then the message shall be ignored. If the module is in Learn mode then the module exits Learn mode and returns to Normal mode. Note: the NN does not need to match the module's node number.
Result		If the conditions are met the module exits Learn mode and enters Normal mode.
History		No change from CBUS revision 4 ver 8j

3.3.19 [55] NNCLR - Clear All Events

Name		NNCLR
Value	**Decimal**	85
	Hex	55
Priority		Low
Description		Clear all events from a node.
Comment		Sent by a configuration tool to clear all events from a specific node. Must be in learn mode first to safeguard against accidental erasure of all events
Direction		To module
States/Modes		Learn
Services		Teach
Parameters		NN (2 bytes) Node number
Conditions		If the message is short so that it does not contain a complete NN then the message shall be ignored. If the NN does not match the module's node number then the message is ignored. If the module is not in learn mode then a CMDERR(Not Learn Mode) message and a GRSP(Not in Learn Mode) is returned. If the module does not support event teaching then the message is ignored.
Result		If conditions are met then remove all stored events and send a [WRACK](#) message and a GRSP(ok)
History		Modified from CBUS revision 4 ver 8j to also return GRSP.

VLCB Opcode specification

3.3.20 [56] NNEVN - Number of Events Available

Name		NNEVN
Value	**Decimal**	86
	Hex	56
Priority		Low
Description		Read the number of event slots available in a node.
Comment		Sent by a configuration tool to read the number of available event slots in a node.
Direction		To module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		Teach
Parameters		NN (2 bytes) Node number
Conditions		If the message is short so that it does not contain a complete NN then the message shall be ignored. If the NN does not match the module's node number then ignore the message.
Result		If conditions are met then send EVNLF message with number of available slots in event table.
History		No change from CBUS revision 4 ver 8j

3.3.21 [57] NERD - Read All Events

Name		NERD
Value	**Decimal**	87
	Hex	57
Priority		Low
Description		Read back all stored events in a node. There MUST be no hidden events.
Comment		Sent by a configuration tool to read all the stored events in a node.
Direction		To module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		Teach
Parameters		NN (2 bytes) Node number
Conditions		If the message is short so that it does not contain a complete NN then the message shall be ignored. If the NN does not match the module's node number then ignore the message.
Result		If conditions are met then send a ENRSP message for each configured event.
History		No change from CBUS revision 4 ver 8j

3.3.22 [58] RQEVN - Read number of Stored Events

Name		RQEVN
Value	**Decimal**	88
	Hex	58
Priority		Low
Description		Request to read number of stored events.
Comment		Sent by a configuration tool to read the number of stored events in a node.
Direction		To module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		Teach
Parameters		NN (2 bytes) Node number
Conditions		If the message is short so that it does not contain a complete NN then the message shall be ignored. If the NN does not match the module's node number then ignore the message.
Result		If conditions are met then send a NUMEV message to indicate the number of stored events.
History		No change from CBUS revision 4 ver 8j

3.3.23 [59] WRACK - Write Acknowledge

Name		WRACK
Value	**Decimal**	89
	Hex	59
Priority		Low
Description		Write acknowledge.
Comment		Sent by a node to indicate the completion of a write to memory operation. All nodes must issue WRACK when a write operation to node variables, events or event variables has completed. This allows for teaching nodes where the processing time may be slow. Deprecated and replaced by GRSP.
Direction		From module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		Teach, NV
Parameters		NN (2 bytes) Node number
Conditions		The module has completed writing to non-volatile memory and is ready to accept more commands.
Result		
History		No change from CBUS revision 4 ver 8j

3.3.24 [5A] RQDAT - Request Data Event

Name		RQDAT
Value	Decimal	90
	Hex	5A
Priority		Low
Description		Request node data event.
Comment		Sent by one node to read the data event from another node.(eg: RFID data).
Direction		Both
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		
Parameters		NN (2 bytes) Node number
Conditions		If the message is short so that it does not contain a complete NN then the message shall be ignored. If the NN does not match the module's node number then ignore the message. If the module does not support RQDAT then ignore the message.
Result		If conditions are met then send an ARDAT message containing the application specific data.
History		No change from CBUS revision 4 ver 8j

3.3.25 [5B] RQDDS - Request Device Data - short mode

Name		RQDDS
Value	**Decimal**	91
	Hex	5B
Priority		Low
Description		Request device data –short mode.
Comment		To request a 'data set' from a device using the short event method where DN is the device number.
Direction		To module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		
Parameters		DN (2 bytes) Device number
Conditions		If DN is not recognised by the module then ignore the message.
Result		If conditions are met then send a DDRS message response.
History		No change from CBUS revision 4 ver 8j

3.3.26 [5C] BOOTM - Enter Bootloader Mode

Name		BOOTM
Value	**Decimal**	92
	Hex	5C
Priority		Low
Description		Put node into bootloading mode. Deprecated and replaced by MODE.
Comment		For modules with no NN then the NN of the command must be zero. For nodes in Normal mode the command must contain the NN of the target node. Sent by a configuration tool to prepare for loading a new program.
Direction		To module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		Boot
Parameters		NN (2 bytes) Node number
Conditions		If the message is short so that it does not contain a complete NN then the message shall be ignored. If NN does not match the module's node number then ignore the message.
Result		If conditions are met then enter BOOT mode. If using the standard PIC bootloader then write a 0x01 to the top EEPROM location and reset the processor. The module's PIC bootloader will be activated before the application code. Once the bootloading is complete it will pass control by to the application at the Load Address in the parameter block.
History		No change from CBUS revision 4 ver 8j

3.3.27 [5D] ENUM - Force Self Enumeration of CANID

Name		ENUM
Value	**Decimal**	93
	Hex	5D
Priority		Low
Description		Force a self enumeration cycle for use with CAN. Deprecated. Replaced with automatic self enumeration after duplicate CANID detection.
Comment		For nodes in Normal mode using CAN as a transport.. This message will force a self-enumeration cycle for the specified node. A new CAN_ID will be allocated if needed.
Direction		To module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		CAN
Parameters		NN (2 bytes) Node number
Conditions		If the message is short so that it does not contain a complete NN then the message shall be ignored. If the NN does not match the module's node number then the message will be ignored.
Result		If conditions are met then start to perform self enumeration. A RTR CAN frame is sent. The module must wait 100ms for other modules to respond with a zero length data frame containing their CANID. After 100ms the module shall select an unused CANID in the range 1..127. If no CANIDs are available then send CMDERR(7). After the enum process is complete and if a CANID has been assigned then send NNACK.
History		No change from CBUS revision 4 ver 8j

3.3.28 [5E] NNRST - Node Reset

Name		NNRST
Value	**Decimal**	94
	Hex	5E
Priority		Low
Description		Reset module's CPU.
Comment		Reset a module's microprocessor.
Direction		To module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		
Parameters		NN (2 bytes) Node number
Conditions		If the message is short so that it does not contain a complete NN then the message shall be ignored. If the NN does not match the module's node number then ignore the request.
Result		If conditions are met then perform a reset of the microprocessor.
History		No change from CBUS revision 4 ver 8j

3.3.29 [5F] EXTC1 - Extended Opcode with 1 Additional Bytes

Name		EXTC1
Value	**Decimal**	95
	Hex	5F
Priority		Low
Description		Extended opcode with 1 additional byte.
Comment		Reserved to allow the 1 additional bytes range to be extended by a further 256 opcodes.
Direction		
States/Modes		
Services		
Parameters		Ext_OPC (1 bytes) Extended opcode, Data1 (1 bytes)
Conditions		
Result		
History		No change from CBUS revision 4 ver 8j

3.4 OPCODES with 3 additional bytes

3.4.1 [60] DFUN - Set Engine Functions

Name		DFUN
Value	**Decimal**	96
	Hex	60
Priority		Normal
Description		Set Engine functions.
Comment		<Fn1>is the function range 1 is F0(FL) to F4, 2 is F5 to F8, 3 is F9 to F12, 4 is F13 to F20, 5 is F21to F28) <Fn2> is the NMRA DCC format function byte for that range in corresponding bits. A bit set to 1 turns function "on" and a cleared bit sets function "off". Sent by a CAB or equivalent to request an engine Fn state change.
Direction		Cab to command station
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		DCC_CAB or DCC_CMD
Parameters		Session (1 bytes), Fn1 (1 bytes), Fn2 (1 bytes)
Conditions		If the module is not a DCC command station then ignore the message. If the module does not have an active session with the specified session identifier then send an ERR (No session) message.
Result		If conditions are met then set the functions in the range given to the requested state.
History		No change from CBUS revision 4 ver 8j

3.4.2 [61] GLOC - Get Engine Session

Name		GLOC
Value	**Decimal**	97
	Hex	61
Priority		Normal
Description		Get engine session.
Comment		\<Flags\> contains flag bits as follows: Bit 0: Set for "Steal" mode Bit 1: Set for "Share" mode. Both bits set to 0 is exactly equivalent to an RLOC request but command stations must continue to support RLOC for backwards compatibility.
Direction		Cab to command station
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		DCC_CAB or DCC_CMD
Parameters		Addr (2 bytes), Flags (1 bytes)
Conditions		If the module is not a DCC command station then ignore the message. If the least significant two bits of Flags are both set then send an ERR (Invalid Request) message. If the loco with the specified address is taken and steal/share is disabled then send an ERR (Loco taken) message. If there is no available session slot for the steal then send an ERR (Stack full) message. If there is no current session for a share then send an ERR(No session) message.
Result		Perform the share/steal and send a PLOC message.
History		No change from CBUS revision 4 ver 8j

3.4.3 [63] ERR - Command Station Error

Name		ERR
Value	**Decimal**	99
	Hex	63
Priority		Normal
Description		Command Station Error report.
Comment		Sent in response to an error situation by a command station. See Appendix A - DCC ERR error codes for a list of error codes.
Direction		From command station to cab
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		DCC_CAB or DCC_CMD
Parameters		AddrH (1 bytes), AddrL (1 bytes), ErrorCode (1 bytes)
Conditions		Sent by a command station in response to a DCC command to report an error.
Result		See table below for the use of the Data fields.
History		No change from CBUS revision 4 ver 8j

3.4.4 [6F] CMDERR - Configuration Error

Name		CMDERR
Value	**Decimal**	111
	Hex	6F
Priority		Low
Description		Error messages from nodes during configuration.
Comment		Sent by node if there is an error when a configuration command is sent. See Appendix C - CMDERR error codes for the list of supported codes. Deprecated and replaced by GRSP. Modules should continue to support CMDERR as possible responses to CBUS compatible requests in order to maintain backwards compatibility to CBUS. In these cases a VLCB GRSP should also be reported. VLCB requests that are not in CBUS should report errors only with GRSP.
Direction		From module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		MNS, Teach, NV
Parameters		NN (2 bytes) Node number, Error (1 bytes) Error number, see CMDERR list in Appendix C
Conditions		Sent by a module to indicate an error response to a command.
Result		
History		No change from CBUS revision 4 ver 8j

3.4.5 [70] EVNLF - Number of Event Spaces Remaining

Name		EVNLF
Value	**Decimal**	112
	Hex	70
Priority		Low
Description		Event space left reply from node.
Comment		Spaces is a one byte value giving the number of available event spaces left in the node's event table. This is the maximum number of additional events that can be stored by the module.
Direction		From module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		Teach
Parameters		NN (2 bytes) Node number, Spaces(1 bytes)
Conditions		Sent in response to a NNEVN request.
Result		
History		No change from CBUS revision 4 ver 8j

3.4.6 [71] NVRD - Node Variable Read

Name		NVRD
Value	**Decimal**	113
	Hex	71
Priority		Low
Description		Request read of a node variable.
Comment		NV# is the index for the node variable value requested. Response is NVANS. Reading NV#0 shall first return a NVANS with the number of NVs followed by a NVANS for each NV.
Direction		To module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		NV
Parameters		NN (2 bytes) Node number, NV# (1 bytes) Node variable index
Conditions		If the message is short so that it does not contain a complete NN then the message shall be ignored. If NN does not match the module's node number then the message is ignored. If message is short so that it does not include the NV# then a GRSP (Invalid Command) message is returned. If NV# is not between 0 and the supported number of NVs then CMDERR (Invalid Node Variable Index) message is returned and a GRSP (Invalid Node Variable Index) message is returned.
Result		If conditions are met and NV# is 0 then send a NVANS response for NV#0 and value of the number of NVs then if not in FCU compatibility mode a sequence of NVANS for each NV. If conditions are met and NV# is greater than 0 then send a single NVANS response containing the value of the requested NV. If NV# is not between 1 and the supported number of NVs then CMDERR(Invalid Node Variable Index) message is returned and a GRSP(Invalid Node Variable Index) message is returned.

History	Modified from CBUS revision 4 ver 8j to also return GRSP and support for NV#0.

3.4.7 [72] NENRD - Read Event by Index

Name		NENRD
Value	**Decimal**	114
	Hex	72
Priority		Low
Description		Request read of stored event by event index.
Comment		EN# is the index for the stored event requested.
Direction		To module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		Teach
Parameters		NN (2 bytes) Node number, EN# (1 bytes) Event index
Conditions		If the message is short so that it does not contain a complete NN then the message shall be ignored. If NN does not match the module's node number then the message is ignored. If message is short so that it does not include the EN# then a GRSP (Invalid Command) message is returned. If EN# is not a valid event index then send CMDERR(Invalid Event Index).
Result		Send ENRSP response message.
History		In CBUS revision 4 ver 8j.

3.4.8 [73] RQNPN - Read Node Parameter By Index

Name		RQNPN
Value	**Decimal**	115
	Hex	73
Priority		Low
Description		Request read of a node parameter by index.
Comment		Para# is the index for the parameter requested. Reading Index 0 first returns a PARAN with the number of available parameters followed by a PARAN for each of those parameters. See Appendix B - Module parameters for the list of available parameters and their meaning.
Direction		To module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		MNS
Parameters		NN (2 bytes) Node number, Para# (1 bytes)
Conditions		If the message is short so that it does not contain a complete NN then the message shall be ignored. If NN does not match the module's node number then ignore the message. If message is short so that it does not include the Para# then a GRSP (Invalid Command) message is returned. If Para# is greater than the number of supported parameters the send message CMD ERR(Invalid Parameter Index) and message GRSP(Invalid Parameter Index)
Result		If conditions are met then If Para# is 0 then send a PARAN message with the number of available parameters as the value for parameter 0 and if not in FCU compatibility mode followed by a PARAN message for each of the parameters else if Para# is non zero send a single PARAN message containing the requested parameter value.
History		Modified from CBUS revision 4 ver 8j so that Para# 0 returns a PARAN for each parameter.

3.4.9 [74] NUMEV - Number of Events

Name		NUMEV
Value	**Decimal**	116
	Hex	74
Priority		Low
Description		Number of events stored by node.
Comment		Response to request RQEVN
Direction		From module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		Teach
Parameters		NN (2 bytes) Node number, No. of events (1 bytes) Number of events
Conditions		Sent in response to a RQEVN request.
Result		
History		No change from CBUS revision 4 ver 8j

3.4.10 [75] CANID - Set CANID

Name		CANID
Value	**Decimal**	117
	Hex	75
Priority		Low
Description		Set the CAN_ID in the node. Deprecated. Replaced with Self-enumeration.
Comment		Used to force a specified CAN_ID into a node. Value range is from 1 to 0x63 (99 decimal). This OPC must be used with care as duplicate CAN_IDs are not allowed.
Direction		To module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		CAN
Parameters		NN (2 bytes) Node number, CAN_ID (1 bytes) CAN identifier
Conditions		If the message is short so that it does not contain a complete NN then the message shall be ignored. If NN does not match the module's node number then ignore the message. If the message is short so that it does not include the CAN_ID then a GRSP (Invalid Command) message is returned. If CANID is not between 1 (inclusive) and 99 (inclusive) then send message CMDERR(Invalid Event) and message GRSP(Invalid command parameter)
Result		If conditions are met then store the CAN_ID to be used in subsequent CAN message transmission. Send message WRACK and GRSP(ok).
History		Modified from CBUS revision 4 ver 8j to include GRSP responses.

3.4.11 [76] MODE - Set Operating Mode

Name		MODE
Value	**Decimal**	118
	Hex	76
Priority		Low
Description		Request a change to a module's operating mode.
Comment		Request to change the operational mode of the module.
Direction		To module
States/Modes		Normal and other modes defined by services.
Services		MNS
Parameters		NN (2 bytes) Node number, Mode (1 bytes) Mode Command. • Mode command = 0 is a request to transition to Setup Mode • Mode command = 1 is a request to transition to Normal Mode. Please refer to service specific documentation for other Mode Command definitions.
Conditions		If the message is short so that it does not contain a complete NN then the message shall be ignored. If the module has a non zero node number and NN does not match the module's node number then ignore the message. Note that if the module is in Setup mode or Uninitialised mode then the module's NN should be zero. If the message is short so that it does not include the Mode Command then a GRSP (Invalid Command) message is returned.If the module is in Setup or Uninitialised modes and the message NN is non zero then ignore the message.If the module's services do not recognise the specified Mode Command then send a GRSP(invalid mode) message.
Result		If requested Mode Command is supported by the module's services then send GRSP(ok). Any change to the module's current mode is services' dependent.
History		New for VLCB

3.4.12 [78] RQSD - Request Service Discovery

Name		RQSD
Value	**Decimal**	120
	Hex	78
Priority		Low
Description		Request service discovery.
Comment		Request service data from a module. If the ServiceIndex is zero then the module responds with a SD response for each service supported. If ServiceIndex is non zero then the module will respond with a single ESD message. Similar to other requests for data with an index of 0 (e.g. NVRD and REQEV) the first response shall return the number of responses followed by a response for each data item. The first response will have a ServiceIndex=0, ServiceType=0 and Version field to contain the number of services.
Direction		To module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		MNS
Parameters		NN (2 bytes) Node number, ServiceIndex (1 bytes) Index into the list of services.
Conditions		If the message is short so that it does not contain a complete NN then the message shall be ignored. If NN does not match the module's node number then ignore the message. If the message is short so that it does not include the ServiceIndex then a GRSP (Invalid Command) message is returned. If ServiceIndex does not reference a valid service then send a GRSP(Invalid service) message. If ServiceIndex is greater than the number of supported services then send a GRSP(Invalid service) message.
Result		If ServiceIndex is zero a SD(0,0, number of services) message is sent followed by a SD message for each implemented service, otherwise send an ESD message for the specified service.
History		New for VLCB

3.4.13 [7F] EXTC2 - Extended Opcode with 2 Additional Bytes

Name		EXTC2
Value	**Decimal**	127
	Hex	7F
Priority		Low
Description		Extended opcode with 2 additional bytes.
Comment		Reserved to allow the 2 additional bytes range to be extended by a further 256 opcodes.
Direction		
States/Modes		
Services		
Parameters		Ext_OPC (1 bytes) Extended opcode, Data1 (1 bytes) Data2 (1 bytes)
Conditions		
Result		
History		No change from CBUS revision 4 ver 8j

3.5 OPCODES with 4 additional bytes

3.5.1 [80] RDCC3 - Request 3 bytes DCC Packet

Name		RDCC3
Value	**Decimal**	128
	Hex	80
Priority		Normal
Description		Request 3-byte DCC Packet.
Comment		Allows a CAB or equivalent to request a 3 byte DCC packet to be sent to the track. The packet is sent <REP> times and is not refreshed on a regular basis. Note: a 3 byte DCC packet is the minimum allowed.
Direction		Cab to common station
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		DCC_CAB or DCC_CMD
Parameters		Rep (1 bytes), Byte1 (1 bytes), Byte2 (1 bytes), Byte3 (1 bytes)
Conditions		If the module is not a command station then ignore the message.
Result		If conditions are met then the DCC command stations shall send the requested DCC packet <REP> times.
History		No change from CBUS revision 4 ver 8j

3.5.2 [82] WCVO - Write CV byte in OPS mode

Name		WCVO
Value	**Decimal**	130
	Hex	82
Priority		Normal
Description		Write CV (byte) in OPS mode.
Comment		Sent to the command station to write a DCC CV byte in OPS mode to a specific loco (on the main).
Direction		To command station
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		DCC_CAB or DCC_CMD
Parameters		Session (1 bytes), CV (2 bytes), Value (1 bytes)
Conditions		If the module is not a DCC command station then ignore the message. If the command station does not have an active session with the specified session identifier then send a message ERR(No session).
Result		If conditions are met then the DCC command stations shall write the specified value to the specified CV.
History		No change from CBUS revision 4 ver 8j

3.5.3 [83] WCVB - Write CV Bit in OPS Mode

Name		WCVB
Value	**Decimal**	131
	Hex	83
Priority		Normal
Description		Write CV (bit) in OPS mode.
Comment		Sent to the command station to write a DCC CV in OPS mode to specific loco (on the main). The format for Value is that specified in RP 9.2.1 for OTM bit manipulation in a DCC packet. This is '111CDBBB' where C here is always 1 as only 'writes' are possible OTM (unless some loco ACK scheme like RailCom is used). D is the bit value, either 0 or 1 and BBB is the bit position in the CV byte. 000 to 111 for bits 0 to 7.
Direction		To command station
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		DCC_CAB or DCC_CMD
Parameters		Session (1 bytes), CV (2 bytes), Value (1 bytes)
Conditions		If the module is not a DCC command station then ignore the message. If the command station does not have an active session with the specified session identifier then send a message ERR(No session).
Result		If conditions are met then the DCC command stations shall write the specified value to the specified CV in bit mode.
History		No change from CBUS revision 4 ver 8j

3.5.4 [84] QCVS - Read CV

Name		QCVS
Value	**Decimal**	132
	Hex	84
Priority		Normal
Description		Read CV.
Comment		This command is used exclusively with service mode. Sent by the cab to the command station in order to read a CV value.
Direction		Cab to command station
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		DCC_CAB or DCC_CMD
Parameters		Session (1 bytes), CV (2 bytes), Mode (1 bytes)
Conditions		If the module is not a DCC command station then ignore the message. If the command station does not have an active session with the specified session identifier then send a message ERR(No session). If the CV value cannot be read then send a SSTAT message with the reason for failure.
Result		If conditions are met then send a PVCS message with CV value.
History		No change from CBUS revision 4 ver 8j

3.5.5 [85] PCVS - Report CV

Name		PCVS
Value	**Decimal**	133
	Hex	85
Priority		Normal
Description		Report CV.
Comment		This command is used exclusively with service mode. Sent by the command station to report a read CV in response to QCVS.
Direction		From command station
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		DCC_CAB or DCC_CMD
Parameters		Session (1 bytes), CV (2 bytes), Value (1 bytes)
Conditions		
Result		Response to QCVS to report the CV value.
History		No change from CBUS revision 4 ver 8j

3.5.6 [87] RDGN - Request Diagnostic Data

Name		RDGN
Value	**Decimal**	135
	Hex	87
Priority		Low
Description		Request diagnostic data.
Comment		Request diagnostic data from a module. If the requested diagnostic data is zero then a response for all diagnostic data is returned.
Direction		To module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		MNS
Parameters		NN (2 bytes) Node number, ServiceIndex (1 bytes) Index into the list of services, DiagnosticCode (1 bytes) Diagnostic data code
Conditions		If the message is short so that it does not contain a complete NN then the message shall be ignored. If NN does not match the module's node number then ignore the message. If the message is short so that it does not include the specified parameters then a GRSP (Invalid Command) message is returned. If ServiceIndex references an unsupported service then send a GRSP(Invalid service) message. If ServiceIndex references a valid service and DiagnosticCode is zero but the service does not support diagnostics then DGN(NN, si, 0,0) should be returned. If DiagnosticCode references an invalid or unsupported diagnostic number then send a GRSP(INVALID_DIAGNOSTIC) message.
Result		If ServiceIndex is zero then for each service send a DGN message indicating the number of DiagnosticCodes for that service followed by a DGN message for each diagnostic code. Note that DiagnosticCode in

	the RDGN request is ignored in this scenario. Note that if a service does not support diagnostics then it should return DGN(nn, si, 0,0). If ServiceIndex is non zero and references a valid service and DiagnosticCode is zero then send a DGN message with DiagnosticCode of zero with the DiagnosticVal field containing the number of other DiagnosticCodes. Otherwise send a DGN response containing the requested diagnostic data for the service specified.
History	New for VLCB

3.5.8 [8E] NVSETRD - Set NV with Read

Name		NVSETRD
Value	**Decimal**	144
	Hex	8E
Priority		Low
Description		Set a NV value with read back.
Comment		Sets a NV value and additionally responds with the new value. The new value may not be the value which was requested to be written.
Direction		To module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		NV
Parameters		NN (2 bytes) Node number, NV# (1 bytes) Node variable index NVvalue (1 byte) Node variable value
Conditions		If the message is short so that it does not contain a complete NN then the message shall be ignored. If the NN does not match the module's node number then ignore the message. If the message is short so that it does not include the specified parameters then a GRSP (Invalid Command) message is returned. If the NV# is zero or greater than the number of NVs available then send message GRSP(Invalid node variable index).
Result		Update the value of the NV, taking into account any module specific limitations and constraints on NV value. Send a single NVANS message containing the NV value.
History		New for VLCB

3.5.9 [90] ACON - Accessory ON Event

Name		ACON
Value	**Decimal**	144
	Hex	90
Priority		Low
Description		Accessory ON long event.
Comment		Indicates an 'ON' event using the full event number of 4 bytes (long event). An event is sent by a module when it detects a change of state. Modules may consume the event and perform actions.
Direction		
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		Producer or Consumer
Parameters		NN (2 bytes) Node number, EN (2 bytes) Event number
Conditions		If the module has not been taught the event nor has the event by default then the event message is ignored.
Result		If the module has the event configured to be sent when there is a change of state and that object changes to state ON then send this event. If the module has been configured to consume the event then perform the actions associated with the ON event.
History		No change from CBUS revision 4 ver 8j

3.5.10 [91] ACOF - Accessory OFF Event

Name		ACOF
Value	**Decimal**	145
	Hex	91
Priority		Low
Description		Accessory OFF long event.
Comment		Indicates an 'OFF' event using the full event number of 4 bytes (long event). An event is sent by a module when it detects a change of state. Modules may consume the event and perform actions.
Direction		
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		Producer or Consumer
Parameters		NN (2 bytes) Node number, EN (2 bytes) Event number
Conditions		If the module has not been taught the event nor has the event by default then the event message is ignored.
Result		If the module has the event configured to be sent when there is a change of state and that object changes to state ON then send this event. If the module has been configured to consume the event then perform the actions associated with the OFF event.
History		No change from CBUS revision 4 ver 8j

3.5.11 [92] AREQ - Accessory Request Event

Name		AREQ
Value	**Decimal**	146
	Hex	92
Priority		Low
Description		Accessory Request Event.
Comment		Indicates a 'request' event using the full event number of 4 bytes (long event). A request event is used to elicit a status response from a producer when it is required to know the 'state' of the producer without producing an ON or OFF event.
Direction		To module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		Producer
Parameters		NN (2 bytes) Node number, EN (2 bytes) Event number
Conditions		If the message is short so that it does not include the specified parameters then the message shall be ignored. If the module does not have the event provisioned then ignore the message.
Result		If conditions are met and the 'Current status is ON' then send an AREON message otherwise send an AROF message.
History		No change from CBUS revision 4 ver 8j

3.5.12 [93] ARON - Accessory Response ON Event

Name		ARON
Value	**Decimal**	147
	Hex	93
Priority		Low
Description		Accessory Response Event.
Comment		Indicates an 'ON' response. A response is a reply to a status request (AREQ) without producing an ON or OFF event.
Direction		From module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		Producer
Parameters		NN (2 bytes) Node number, EN (2 bytes) Event number
Conditions		The module has the event defined and the current state of the event is ON.
Result		
History		No change from CBUS revision 4 ver 8j

3.5.13 [94] AROF - Accessory Response OFF Event

Name		AROF
Value	**Decimal**	148
	Hex	94
Priority		Low
Description		Accessory Response Event (AROF).
Comment		Indicates an 'OFF' response. A response is a reply to a status request (AREQ) without producing an ON or OFF event.
Direction		From module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		Producer
Parameters		NN (2 bytes) Node number, EN (2 bytes) Event number
Conditions		The module has the event defined and the current state of the event is OFF.
Result		
History		No change from CBUS revision 4 ver 8j

3.5.14 [95] EVULN - Event Unlearn

Name		EVULN
Value	**Decimal**	149
	Hex	95
Priority		Low
Description		Unlearn an event in learn mode.
Comment		Sent by a configuration tool to remove an event from a node.
Direction		To module
States/Modes		Learn
Services		Teach
Parameters		NN (2 bytes) Node number, EN (2 bytes) Event number
Conditions		If the module is not in Learn mode ignore the message. If the message is short so that it does not include the specified parameters then a GRSP (Invalid Command) message is returned. If the module does not currently have the event configured then send a CMDERR(Invalid Event) message and a GRSP(Invalid Event) message.
Result		If conditions are met then remove the event matching the specified event from the configuration and send WRACK and GRSP(ok).
History		Modified from CBUS revision 4 ver 8j to also return GRSP.

3.5.15 [96] NVSET - NV Set

Name		NVSET
Value	**Decimal**	150
	Hex	96
Priority		Low
Description		Set a node variable.
Comment		Sent by a configuration tool to set a node variable. NV# is the NV index number. Deprecated and replaced by NVSETRD.
Direction		To module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		NV
Parameters		NN (2 bytes) Node number, NV# (1 bytes) Node variable index, NV val (1 bytes) Node variable value
Conditions		If the message is short so that it does not contain a complete NN then the message shall be ignored. If NN does not match the module's node number then ignore the request. If the message is short so that it does not include the specified parameters then a GRSP (Invalid Command) message is returned. If NV# is not between 1 (inclusive) and the number of NVs)inclusive) then send a CMDERR(Invalid Node Variable Index) message. If the NVval is not valid for the type of module then send a CMDERR(Invalid Node Variable Value) message.
Result		If conditions are met then store NV value and send WRACK and GRSP(ok)
History		Modified from CBUS revision 4 ver 8j to also return GRSP.

3.5.16 [97] NVANS - NV Value Response

Name		NVANS
Value	**Decimal**	151
	Hex	97
Priority		Low
Description		Response to a request for a node variable value.
Comment		Sent by node in response to request NVRD or NVSETRD.
Direction		From module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		NV
Parameters		NN (2 bytes) Node number, NV# (1 bytes) Node variable index, NV val (1 bytes) Node variable value
Conditions		If the module Module has accepted a NVRD or NVSETRD request then NVANS is returned in response.
Result		
History		No change from CBUS revision 4 ver 8j

3.5.17 [98] ASON - Accessory ON Short Event

Name		ASON
Value	**Decimal**	152
	Hex	98
Priority		Low
Description		Accessory Short ON.
Comment		Indicates an 'ON' event using the short event number of 2 LS bytes. An event is sent by a module when it detects a change of state. Modules may consume the event and perform actions. The NN is not used to match events, the NN normally indicates the source of the event.
Direction		
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		Producer or Consumer
Parameters		NN (2 bytes) Node number, EN (2 bytes) Event number
Conditions		If the module has not been taught the event nor has the event by default then the event message is ignored.
Result		If the module has the event configured to be sent when there is a change of state and that object changes to state ON then send this event. If the module has been configured to consume the event (ignoring the NN) then perform the actions associated with the ON event.
History		No change from CBUS revision 4 ver 8j

3.5.18 [99] ASOF - Accessory OFF Short Event

Name		ASOF
Value	**Decimal**	153
	Hex	99
Priority		Low
Description		Accessory Short OFF.
Comment		Indicates an 'OFF' event using the short event number of 2 LS bytes. An event is sent by a module when it detects a change of state. Modules may consume the event and perform actions. The NN is not used to match events, the NN normally indicates the source of the event.
Direction		
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		Producer or Consumer
Parameters		NN (2 bytes) Node number, EN (2 bytes) Event number
Conditions		If the module has not been taught the event nor has the event by default then the event message is ignored.
Result		If the module has the event configured to be sent when there is a change of state and that object changes to state OFF then send this event. If the module has been configured to consume the event (ignoring the NN) then perform the actions associated with the OFF event.
History		No change from CBUS revision 4 ver 8j

3.5.19 [9A] ASRQ - Accessory Request Short Event

Name		ASRQ
Value	**Decimal**	154
	Hex	9A
Priority		Low
Description		Accessory Short Request Event.
Comment		Indicates a 'request' event using the short event number of 2 LS bytes. A request event is used to elicit a status response from a producer when it is required to know the 'state' of the producer without producing an ON or OFF event.
Direction		To module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		Producer
Parameters		NN (2 bytes) Node number, EN (2 bytes) Event number
Conditions		If the message is short so that it does not contain a complete NN then the message shall be ignored. If NN==0, then every module that produces this short-event should respond. If the NN does not match the module's node number and is non zero then ignore the message. If the module does not have the event provisioned then ignore the message.
Result		If conditions are met and the 'Current status is ON' then send an ARSON message otherwise send an ARSOF message.
History		No change from CBUS revision 4 ver 8j

VLCB Opcode specification

3.5.20 [9B] PARAN - Node Parameter Response

Name		PARAN
Value	**Decimal**	155
	Hex	9B
Priority		Low
Description		Response to request for individual node parameter RQNPN.
Comment		NN is the node number of the sending node. Para# is the index of the parameter and Para val is the parameter value. Returns a parameter value. Parameter index is the parameter number and matches that in the RQNPN request. See Appendix B - Module parameters for a list of available parameters.
Direction		From module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		MNS
Parameters		NN (2 bytes) Node number, Para# (1 bytes) Parameter index, Para val (1 bytes) Parameter value
Conditions		Response to RQNPN request
Result		The PARAN message contains the requested parameter value.
History		No change from CBUS revision 4 ver 8j

3.5.21 [9C] REVAL - Request EV Read

Name		REVAL
Value	**Decimal**	156
	Hex	9C
Priority		Low
Description		Request for read of an event variable.
Comment		This request differs from B2 (REQEV) as it doesn't need to be in learn mode but does require the knowledge of the event index to which the EV request is directed. Reading EV#0 shall first return the number of EVs followed by a series of NEVAL with the value for each EV.
Direction		To module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		Teach
Parameters		NN (2 bytes) Node number, EN# (1 bytes) Event index, EV# (1 bytes) Event variable index
Conditions		If the message is short so that it does not contain a complete NN then the message shall be ignored. If the NN does not match the module's node number then ignore the message. If the message is short so that it does not include the specified parameters then a GRSP (Invalid Command) message is returned. If the module does not have an event for the event index then send a message CMDERR(Invalid Event). If the EV# is greater than the number of EVs per event then send a message CMDERR(Invalid Event Variable Index). If the event does not have an EV with the specified EV# then send a message CMDERR(No EV).
Result		If conditions are met and EV# is non zero then then send an NEVAL message with the EV value. If conditions are met and EV# is zero then first send NEVAL for index 0 and the value containing the number of EVs and if not in FCU compatibility mode followed by a series of NEVAL with the value for each EV.
History		No change from CBUS revision 4 ver 8j

3.5.22 [9D] ARSON - Accessory Response ON Short Event

Name		ARSON
Value	**Decimal**	157
	Hex	9D
Priority		Low
Description		Accessory Short Response Event.
Comment		Indicates an 'ON' response. A response is a reply to a status request (ASRQ) without producing an ON or OFF event.
Direction		From module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		Producer
Parameters		NN (2 bytes) Node number, EN (2 bytes) Event number
Conditions		The module has the event defined and the current state of the event is ON.
Result		
History		No change from CBUS revision 4 ver 8j

3.5.23 [9E] ARSOF - Accessory Response OFF Short Event

Name		ARSOF
Value	**Decimal**	158
	Hex	9E
Priority		Low
Description		Accessory Short Response Event.
Comment		Indicates an 'OFF' response. A response is a reply to a status request (ASRQ) without producing an ON or OFF event.
Direction		From module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		Producer
Parameters		NN (2 bytes) Node number, EN (2 bytes) Event number
Conditions		The module has the event defined and the current state of the event is OFF.
Result		
History		No change from CBUS revision 4 ver 8j

3.5.24 [9F] EXTC3 - Extended Opcode with 3 Additional Bytes

Name		EXTC3
Value	**Decimal**	159
	Hex	9F
Priority		Low
Description		Extended opcode with 3 additional bytes.
Comment		Reserved to allow the 3 additional bytes range to be extended by a further 256 opcodes.
Direction		
States/Modes		
Services		
Parameters		Ext_OPC (1 bytes) Extended opcode, Data1 (1 bytes) Data2 (1 bytes) Data3 (1 bytes)
Conditions		
Result		
History		No change from CBUS revision 4 ver 8j

3.6 OPCODES with 5 additional bytes

3.6.1 [A0] RDCC4 - Request 4 Byte DCC Packet

Name		RDCC4
Value	**Decimal**	160
	Hex	A0
Priority		Normal
Description		Request 4-byte DCC Packet.
Comment		Allows a CAB or equivalent to request a 4 byte DCC packet to be sent to the track. The packet is sent <REP> times and is not refreshed on a regular basis.
Direction		To command station
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		DCC_CAB or DCC_CMD
Parameters		REP (1 bytes), Byte0 (1 bytes), Byte1 (1 bytes), Byte2 (1 bytes), Byte3 (1 bytes)
Conditions		If the NN does not match the node number of the module then ignore the message. If the module is not a DCC command station then ignore the message.
Result		If conditions are met then the requested DCC packet is sent <REP> times.
History		No change from CBUS revision 4 ver 8j

3.6.2 [A2] WCVS - Write CV in Service Mode

Name		WCVS
Value	**Decimal**	162
	Hex	A2
Priority		Normal
Description		Write CV in Service mode.
Comment		Sent to the command station to write a DCC CV in service mode.
Direction		To module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		DCC_CAB or DCC_CMD
Parameters		Session (1 bytes), CV (2 bytes), Mode (1 bytes), Value (1 bytes)
Conditions		If the NN does not match the module's node number then ignore the message. If the module is not a DCC command station then ignore the request. If the command station does not have an active session with id <Session> then send a ERR(No session) message.
Result		If conditions are met then the DCC command station shall write the specified CV.
History		No change from CBUS revision 4 ver 8j

3.6.3 [AB] HEARTB - Module Heartbeat

Name		HEARTB
Value	**Decimal**	171
	Hex	AB
Priority		Low
Description		Heartbeat from module.
Comment		Heartbeat message from module indicating that the module is alive and communicating on the bus. Sent every 5 seconds by a module to confirm it is alive and connected to the network along with an indication of module status. Sequence is a count from 0 incrementing on each message transmitted and wrapping around to zero, It facilitates detection of missing frames. Status: This is a binary representation of the module's diagnostic status as outlined in MNS Specification Section 8.3. 0x00 Shall always represent "normal" operation. StatusBits: Reserved for future expansion, set to 0x00
Direction		From module
States/Modes		Normal, Learn, ENACK
Services		MNS
Parameters		NN (2 bytes) Source Node number, Sequence (1 bytes) The message sequence number Status (1 bytes) Diagnostic status, StatusBits (1 bytes) Reserved,
Conditions		
Result		
History		New for VLCB

3.5.7 [AC] SD - Service Discovery Response

Name		SD
Value	Decimal	172
	Hex	AC
Priority		Low
Description		Service discovery response.
Comment		The version of a service supported by a module.
		Sent in response to RQSD with ServiceIndex = 0. A number of SD messages are sent by a module. The first SD response indicates the number of following SD responses, this message has ServiceIndex=0, and the number in the Version field. Then one SD response for each of the services supported by the module.
		Indicates that the originating module, defined by NN supports the service defined by Service# with the specified version
		Also see ESD.
Direction		From module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		MNS
Parameters		NN (2 bytes) Node number, ServiceIndex (1 bytes) Index into the list of services. Note that ServiceIndex values need not be contiguous due to the module possibly having internal services which are not exposed in the SD response and therefore the ServiceIndex may be greater than the number of services reported within the first response to RQSD. ServiceType (1 bytes) Service Type, Version (1 bytes) Version of the service definition, not the version of its implementation.
Conditions		
Result		Sent in response to RQSD. Contains the version of a service supported by the module.
History		New for VLCB

3.6.4 [AF] GRSP - Generic Response

Name		GRSP
Value	**Decimal**	175
	Hex	AF
Priority		Low
Description		Generic Response.
Comment		Generic response for a configuration change request. Result byte indicates ok for success or an error code in case of failure. Indicates the module is ready for further configuration. The CMDERR codes are supported and in addition service specific codes are also to be supported. The CMDERR codes are listed in Appendix C and allocated from 1 upwards, the service specific codes are allocated from 255 downwards. See the service specific documentation for the list of codes.
Direction		From module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		MNS
Parameters		NN (2 bytes) Node number, opcode (1 bytes) Request opcode, ServiceType (1 bytes) Service Type, Result (1 bytes) Result
Conditions		
Result		Sent to indicate the result of a configuration change request. Module is ready for further configuration.
History		New for VLCB

3.6.5 [B0] ACON1 - Accessory ON Event with 1 Data Byte

Name		ACON1
Value	**Decimal**	176
	Hex	B0
Priority		Low
Description		Accessory ON.
Comment		Indicates an 'ON' event using the full event number of 4 bytes with one additional data byte. An event is sent by a module when it detects a change of state. Modules may consume the event and perform actions. The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.
Direction		
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		Producer or Consumer
Parameters		NN (2 bytes) Node number, EN (2 bytes) Event number, data (1 bytes) Event data 1
Conditions		If the module has not been taught the event nor has the event by default then the event message is ignored.
Result		If the module has the event configured to be sent when there is a change of state and that object changes to state ON then send this event. If the module has been configured to consume the event then perform the actions associated with the ON event.
History		No change from CBUS revision 4 ver 8j

3.6.6 [B1] ACOF1 - Accessory OFF Event with 1 Data Byte

Name		ACOF1
Value	**Decimal**	177
	Hex	B1
Priority		Low
Description		Accessory OFF.
Comment		Indicates an 'OFF' event using the full event number of 4 bytes with one additional databyte. An event is sent by a module when it detects a change of state. Modules may consume the event and perform actions. The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.
Direction		
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		Producer or Consumer
Parameters		NN (2 bytes) Node number, EN (2 bytes) Event number, data (1 bytes) Event data 1
Conditions		If the module has not been taught the event nor has the event by default then the event message is ignored.
Result		If the module has the event configured to be sent when there is a change of state and that object changes to state OFF then send this event. If the module has been configured to consume the event then perform the actions associated with the OFF event.
History		No change from CBUS revision 4 ver 8j

3.6.7 [B2] REQEV - Read Event Variable

Name		REQEV
Value	**Decimal**	178
	Hex	B2
Priority		Low
Description		Read event variable in learn mode.
Comment		Allows a configuration tool to read stored event variables from a node. EV# is the EV variable index. NN and EN identify the event and not the module. Reading EV#0 shall first return the number of EVs followed by a series of EVANS with the value for each EV.
Direction		To module
States/Modes		Learn
Services		Teach
Parameters		NN (2 bytes) Node number of event, EN (2 bytes) Event number, EV# (1 bytes) Event variable index
Conditions		If the module is not in Learn mode then ignore the message. If the message is short so that it does not include the specified parameters then a GRSP (Invalid Command) message is returned. If the module does not have an event for the specified NN:EN then send a message CMDERR(Invalid Event) and GRSP(Invalid Event). If the EV# is greater than the number of EVs per event then send a message CMDERR(Invalid event variable index) and GRSP(Invalid event variable index). If the event does not have an EV with the specified EV# then send a message CMDERR(Invalid Event Variable Index) and GRSP(Invalid Event Variable Index).
Result		If conditions are met and EV# is non zero then send an EVANS message with the EV value. If conditions are met and EV# is zero then first send EVANS for index 0 and the value containing the number of EVs and if not in FCU compatibility mode followed by a series of EVANS with the value for each EV.
History		No change from CBUS revision 4 ver 8j

3.6.8 [B3] ARON1 - Accessory ON Response Event with 1 Data Byte

Name		ARON1
Value	**Decimal**	179
	Hex	B3
Priority		Low
Description		Accessory Response Event.
Comment		Indicates an 'ON' response with one additional data byte. A response is a reply to a status request (AREQ) without producing an ON or OFF event. The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.
Direction		From module
States/Modes		Normal
Services		Producer
Parameters		NN (2 bytes) Node number, EN (2 bytes) Event number, data (1 bytes) Event data 1
Conditions		The module has the event defined and the current state of the event is ON.
Result		
History		No change from CBUS revision 4 ver 8j

3.6.9 [B4] AROF1 - Accessory OFF Response Event with 1 Data Byte

Name		AROF1
Value	**Decimal**	180
	Hex	B4
Priority		Low
Description		Accessory Response Event.
Comment		Indicates an 'OFF' response with one additional data byte. A response is a reply to a status request (AREQ) without producing an ON or OFF event. The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.
Direction		From module
States/Modes		Normal
Services		Producer
Parameters		NN (2 bytes) Node number, EN (2 bytes) Event number, data (1 bytes) Event data 1
Conditions		The module has the event defined and the current state of the event is OFF.
Result		
History		No change from CBUS revision 4 ver 8j

3.6.10 [B5] NEVAL - Response to Read EV

Name		NEVAL
Value	Decimal	181
	Hex	B5
Priority		Low
Description		Response to request for read of EV value.
Comment		This is the response to the request to read an EV - REVAL.
Direction		From module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		Teach
Parameters		NN (2 bytes) Node number, EN# (1 bytes) Event index, EV# (1 bytes) Event variable index, EVval (1 bytes) Event variable value
Conditions		
Result		The EV value is returned in the message.
History		No change from CBUS revision 4 ver 8j

3.6.11 [B6] PNN - Presence of Node

Name		PNN
Value	**Decimal**	182
	Hex	B6
Priority		Low
Description		Response to Query Node - QNN.
Comment		Sent in response to a QNN request. The Flags byte contains bit flags as follows: ● Bit 0:Set to 1 for consumer node, ● Bit 1:Set to 1 for producer node, ● Bit 2:Set to 1 for FLiM mode (normal mode), ● Bit 3:Set to 1 for Bootloader compatible, ● Bit 4: Set if able to consume its own produced events ● Bit 5: Set to 1 if module is in Learn mode ● Bit 6: Set to 1 if module supports service discovery If a module is both a producer and a consumer then it is referred to as a "combi" node and both flags will be set. The Manufacturer Id and Module Id together make a 16bit module type identification (ManufacturerId in the upper byte). VLCB modules shall use a dedicated set of Manufacturer Ids, currently a Manufacturer Id of 250 has been assigned. When developing a new module a new identifier can be obtained with a pull request of the VLCB module Id list in Github..
Direction		From module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		MNS
Parameters		NN (2 bytes) Node number, Manufacturer Id (1 bytes) Manufacturer identifier, Module Id (1 bytes) Module identifier, Flags (1 bytes) Module flags
Conditions		
Result		Returned in response to QNN. The message contains important information about the module.
History		No change from CBUS revision 4 ver 8j

3.6.12 [B8] ASON1 - Accessory ON Event with 1 Data Byte

Name		ASON1
Value	**Decimal**	184
	Hex	B8
Priority		Low
Description		Accessory Short ON.
Comment		Indicates an 'ON' event using the short event number of 2 LS bytes with one added data byte. An event is sent by a module when it detects a change of state. Modules may consume the event and perform actions. The NN is not used to match events, the NN normally indicates the source of the event. The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.
Direction		
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		Producer or Consumer
Parameters		NN (2 bytes) Node number, EN (2 bytes) Event number, data (1 bytes) Event data 1
Conditions		If the module has not been taught the event nor has the event by default then the event message is ignored.
Result		If the module has the event configured to be sent when there is a change of state and that object changes to state ON then send this event. If the module has been configured to consume the event (ignoring the NN) then perform the actions associated with the ON event.
History		No change from CBUS revision 4 ver 8j

3.6.13 [B9] ASOF1 - Accessory OFF Event with 1 Data Byte

Name		ASOF1
Value	**Decimal**	185
	Hex	B9
Priority		Low
Description		Accessory Short OFF.
Comment		Indicates an 'OFF' event using the short event number of 2 LS bytes with one added data byte. An event is sent by a module when it detects a change of state. Modules may consume the event and perform actions. The NN is not used to match events, the NN normally indicates the source of the event. The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.
Direction		
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		Producer or Consumer
Parameters		NN (2 bytes) Node number, EN (2 bytes) Event number, data (1 bytes) Event data 1
Conditions		If the module has not been taught the event nor has the event by default then the event message is ignored.
Result		If the module has the event configured to be sent when there is a change of state and that object changes to state OFF then send this event. If the module has been configured to consume the event (ignoring the NN) then perform the actions associated with the OFF event.
History		No change from CBUS revision 4 ver 8j

3.6.14 [BD] ARSON1 - Accessory ON Response Event with 1 Data

Name		ARSON1
Value	**Decimal**	189
	Hex	BD
Priority		Low
Description		Accessory Short Response Event.
Comment		Indicates an 'ON' response with one added data byte. A response is a reply to a status request (ASRQ)without producing an ON or OFF event. The NN is not used to match events, the NN normally indicates the source of the event. The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.
Direction		From module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		Producer
Parameters		NN (2 bytes) Node number, EN (2 bytes) Event number, data (1 bytes) Event data 1
Conditions		The module has the event defined and the current state of the event is ON.
Result		
History		No change from CBUS revision 4 ver 8j

3.6.15 [BE] ARSOF1 - Accessory OFF Response Event with 1 Data

Name		ARSOF1
Value	**Decimal**	190
	Hex	BE
Priority		Low
Description		Accessory Short Response Event with one data byte.
Comment		Indicates an 'OFF' response with one added data byte. A response is a reply to a status request (ASRQ) without producing an ON or OFF event. A response event is a reply to a status request (ASRQ)without producing an ON or OFF event. The NN is not used to match events, the NN normally indicates the source of the event. The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.
Direction		From module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		Producer
Parameters		NN (2 bytes) Node number, EN (2 bytes) Event number, data (1 bytes) Event data 1
Conditions		The module has the event defined and the current state of the event is OFF.
Result		
History		No change from CBUS revision 4 ver 8j

3.6.16 [BF] EXTC4 - Extended Opcode with 4 Additional Bytes

Name		EXTC4
Value	**Decimal**	191
	Hex	BF
Priority		Low
Description		Extended opcode with 4 additional bytes.
Comment		Reserved to allow the 4 additional bytes range to be extended by a further 256 opcodes.
Direction		
States/Modes		
Services		
Parameters		Ext_OPC (1 bytes) Extended opcode, Data1 (1 bytes) Data2 (1 bytes) Data3 (1 bytes) Data4 (1 bytes)
Conditions		
Result		
History		No change from CBUS revision 4 ver 8j

3.7 OPCODES with 6 additional bytes

3.7.1 [C0] RDCC5 - Request 5 Byte DCC Packet

Name		RDCC5
Value	**Decimal**	192
	Hex	C0
Priority		Normal
Description		Request 5-byte DCC Packet.
Comment		Allows a CAB or equivalent to request a 5 byte DCC packet to be sent to the track. The packet is sent <REP> times and is not refreshed on a regular basis.
Direction		To module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		DCC_CAB or DCC_CMD
Parameters		REP (1 bytes), Byte 0 (1 bytes), Byte1 (1 bytes), Byte2 (1 bytes), Byte3 (1 bytes), Byte4 (1 bytes)
Conditions		If the NN does not match the node number of the module then ignore the message. If the module is not a DCC command station then ignore the message.
Result		If conditions are met then the requested DCC packet is sent <REP> times.
History		No change from CBUS revision 4 ver 8j

3.7.2 [C1] WCVOA - Write CV in OPS Mode by Address

Name		WCVOA
Value	**Decimal**	193
	Hex	C1
Priority		Normal
Description		Write CV (byte) in OPS mode by address.
Comment		Sent to the command station to write a DCC CV byte in OPS mode to specific loco (on the main). Used by computer based ops mode programmer that does not have a valid throttle handle.
Direction		To command station
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		DCC_CAB or DCC_CMD
Parameters		Addr (2 bytes), CV (2 bytes), Mode (1 bytes), Value (1 bytes)
Conditions		If the NN does not match the module's node number then ignore the message. If the module is not a DCC command station then ignore the request.
Result		If conditions are met then the DCC command station shall write the specified CV.
History		No change from CBUS revision 4 ver 8j

3.7.3 [C2] CABDAT - Send data to CAB

Name		CABDAT
Value	**Decimal**	194
	Hex	C2
Priority		Normal
Description		Send data to the DCC CAB which is controlling a particular loco.
Comment		addrH and addrL are the loco address in the same format as RLOC and GLOC 7 bit addresses have (addrH=0). 14 bit addresses have bits 6,7 of addrH set to 1. dataCode defines the meaning of the remaining 3 bytes. The following values for dataCod have currently been defined: • 01 - CABSIG - Transmitted by a layout control system to send signal aspects to be displayed on a cab handset as cab signalling. Parameter data1 is used for aspect1 Parameter data2 is used for aspect2 Parameter data3 is used for speed aspect1 is signalling system independent, and is defined as follows (colours in brackets correspond to UK colour light signalling, the given aspect names may be displayed differently in other signalling systems): Bits 0-1 - 2 bit aspect code 00=danger (red), 01=caution (yellow), 10=preliminary caution (double yellow), 11=proceed (green) Bit 2 - set 1 for calling on or shunt aspect (bits 0-1 would be set to 00 for danger when calling on) Bit 3 - Set 0 to indicate upper nibble is feather location, set 1 for upper nibble is theatre type route indicator Bits 4-7 - 0 - no route indicated, 1 to 6 = feather position or 1 to 16 for theatre route indication aspect1 should be set to 0xFF if no signal information is available. This can be used, for example, to indicate leaving a cab signalling area. A cab should extinguish any currently showing aspect on receipt of this code. Note that because bits 0 and 1 should be set to zero when bit 2 is set, the code 0xFF is not otherwise a valid aspect. <aspect2> may be used as required for specific signalling systems. The meaning will vary for each signalling system. For the UK 2003 rulebook, bit 0 set indicates a flashing aspect, applicable to caution, preliminary caution or proceed. For UK semaphore signalling, where there are multiple arms for

	different routes on a mast, these bits indicate which arm has been pulled off, which is equivalent to a feather on colour light signalling. speed is a speed limit indication that a cab may optionally display to the driver. If speed is not implemented by a layout control system, or whenever speed limit information is not available, this byte should be set to 0xFF (255). How this value is derived from the layout blocks, signals etc, and the range and meaning of the values in this byte, are implementation dependent, except for the requirement that the value of 0xFF must not be a valid speed.
Direction	To DCC CAB
States/Modes	Normal, Learn, NOHEARTB, ENACK
Services	DCC-CAB
Parameters	addrH (1 bytes) addrL (1 bytes) dataCode (1 bytes) data1 (1 bytes) data2 (1 bytes) data3 (1 bytes)
Conditions	
Result	
History	Defined in RFC0005

3.7.4 [C7] DGN - Diagnostic Data Response

Name		DGN
Value	**Decimal**	199
	Hex	C7
Priority		Low
Description		Diagnostic data response.
Comment		Diagnostic data value from a module. Sent in response to [RDGN]().
Direction		From module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		MNS
Parameters		NN (2 bytes) Node number, ServiceIndex (1 bytes) Index into the list of services, DiagnosticCode (1 bytes) Diagnostic data code, DiagnosticVal (2 bytes) Diagnostic data value
Conditions		
Result		A response to [RDGN]() and contains diagnostic information for the requested diagnostic of the specified service.
History		New for VLCB

3.7.5 [CF] FCLK - Fast Clock

Name		FCLK
Value	**Decimal**	207
	Hex	CF
Priority		Normal
Description		Fast Clock.
Comment		Used to implement a fast clock for the layout.
Direction		
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		
Parameters		mins (1 bytes) Minutes 0-59, hrs (1 bytes) Hours 0-23, wdmon (1 bytes) Bits 0-3 define day of week (1=Sun ..7=Sat). Bits 4-7 define month (1=Jan .. 12=Dec), div (1 bytes) Divider. 0=freeze, mday (1 bytes) Day of month 1-31, temp (1 bytes) Temperature. Two's complement -127 to +127
Conditions		All the value of any parameter is out of range then send a CMDERR(Invalid Event) message.
Result		If conditions are met then update a fast clock with the specified settings.
History		No change from CBUS revision 4 ver 8j

3.7.6 [D0] ACON2 - Accessory ON Event with 2 Data Bytes

Name		ACON2
Value	**Decimal**	208
	Hex	D0
Priority		Low
Description		Accessory ON.
Comment		Indicates an 'ON' event using the full event number of 4 bytes with two additional data bytes. An event is sent by a module when it detects a change of state. Modules may consume the event and perform actions. The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.
Direction		
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		Producer or Consumer
Parameters		NN (2 bytes) Node number, EN (2 bytes) Event number, data1 (1 bytes) Event data 1, data2 (1 bytes) Event data 2
Conditions		If the module has not been taught the event nor has the event by default then the event message is ignored.
Result		If the module has the event configured to be sent when there is a change of state and that object changes to state ON then send this event. If the module has been configured to consume the event then perform the actions associated with the ON event.
History		No change from CBUS revision 4 ver 8j

3.7.7 [D1] ACOF2 - Accessory OFF Event with 2 Data Bytes

Name		ACOF2
Value	**Decimal**	209
	Hex	D1
Priority		Low
Description		Accessory OFF.
Comment		Indicates an 'OFF' event using the full event number of 4 bytes with two additional data bytes. An event is sent by a module when it detects a change of state. Modules may consume the event and perform actions. The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.
Direction		Both
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		Producer or Consumer
Parameters		NN (2 bytes) Node number, EN (2 bytes) Event number, data1 (1 bytes) Event data 1, data2 (1 bytes) Event data 2
Conditions		If the module has not been taught the event nor has the event by default then the event message is ignored.
Result		If the module has the event configured to be sent when there is a change of state and that object changes to state OFF then send this event. If the module has been configured to consume the event then perform the actions associated with the OFF event.
History		No change from CBUS revision 4 ver 8j

3.7.8 [D2] EVLRN - Teach an EV

Name		EVLRN
Value	**Decimal**	210
	Hex	D2
Priority		Low
Description		Teach an event in learn mode.
Comment		Sent by a configuration tool to a node in learn mode to teach it an event variable. Also teaches it the associated event. This command is repeated for each EV required.
Direction		To module
States/Modes		Learn
Services		Event/Teach
Parameters		NN (2 bytes) Event Node number, EN (2 bytes) Event number, EV# (1 bytes) Event variable index, (1-n) EV val (1 bytes) Event variable value
Conditions		If the module is not in Learn mode then ignore the message. If the message is short so that it does not include the specified parameters then a GRSP (Invalid Command) message is returned. If the module does not have space available for the event to be created then send a message a CMDERR(Too many events) message and a GRSP(Too many events) message. If the event variable index is zero or greater than the number of EVs per event parameter then send a CMDERR(Invalid Event Variable Index) message and a GRSP(Invalid Event Variable Index) message. The receiving module may apply specific conditions and may send a GRSP. Example: CANMIO-Universal does not allow two events with the same value of EV1.

Result		If conditions are met then
		    1. Create the event if it doesn't exist already.
		    2. Save the EV
		    3. Send a GRSP(ok) and a WRACK message.
		    4. One may need to read the specific module's specification.
		 If the NN is zero then the taught event will be considered to be a Short event. If the NN is non zero then the event will be considered to be a Long event.

History	Modified from CBUS revision 4 ver 8j to also return GRSP.

3.7.9 [D3] EVANS - EV Read Response

Name		EVANS
Value	**Decimal**	211
	Hex	D3
Priority		Low
Description		Response to a request for an EV value in a node in learn mode.
Comment		A node response to a request from a configuration tool for the EVs associated with an event (REQEV). For multiple EVs, there will be one response per request.
Direction		From module
States/Modes		Learn
Services		Teach
Parameters		NN (2 bytes) event's Node number, EN (2 bytes) Event number, EV# (1 bytes) Event variable index, EV val (1 bytes) Event variable value
Conditions		Sent in response to REQEV. If the original request was for EV# of zero then multiple EVANS will be sent, The first for EV#0 with EV val set to the number of EVs and subsequent EVANS one for each EV containing the EV value.
Result		
History		No change from CBUS revision 4 ver 8j

3.7.10 [D4] ARON2 - Accessory Response ON Event with 2 Bytes

Name		ARON2
Value	**Decimal**	212
	Hex	D4
Priority		Low
Description		Accessory Response Event.
Comment		Indicates an 'ON' response event with two added data bytes. A response is a reply to a status request (AREQ) without producing an ON or OFF event. The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.
Direction		From module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		Producer
Parameters		NN (2 bytes) Node number, EN (2 bytes) Event number, data1 (1 bytes) Event data 1, data2 (1 bytes) Event data 2
Conditions		The module has the event defined and the current state of the event is ON.
Result		
History		No change from CBUS revision 4 ver 8j

3.7.11 [D5] AROF2 - Accessory Response OFF Event with 2 Bytes

Name		AROF2
Value	**Decimal**	213
	Hex	D5
Priority		Low
Description		Accessory Response Event.
Comment		Indicates an 'OFF' response event with two added data bytes. A response is a reply to a status request (AREQ) without producing an ON or OFF event. The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.
Direction		From module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		Producer
Parameters		NN (2 bytes) Node number, EN (2 bytes) Event number, data1 (1 bytes) Event data 1, data2 (1 bytes) Event data 2
Conditions		The module has the event defined and the current state of the event is OFF.
Result		
History		No change from CBUS revision 4 ver 8j

3.7.12 [D8] ASON2 - Accessory Short ON Event with 2 Bytes

Name		ASON2
Value	**Decimal**	216
	Hex	D8
Priority		Low
Description		Accessory Short ON.
Comment		Indicates an 'ON' event using the short event number of 2 LS bytes with two added data bytes. An event is sent by a module when it detects a change of state. Modules may consume the event and perform actions. The NN is not used to match events, the NN normally indicates the source of the event. The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.
Direction		
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		Producer or Consumer
Parameters		NN (2 bytes) Node number, EN (2 bytes) Event number, data1 (1 bytes) Event data 1, data2 (1 bytes) Event data 2
Conditions		If the module has not been taught the event nor has the event by default then the event message is ignored.
Result		If the module has the event configured to be sent when there is a change of state and that object changes to state ON then send this event. If the module has been configured to consume the event (ignoring the NN) then perform the actions associated with the ON event.
History		No change from CBUS revision 4 ver 8j

3.7.13 [D9] ASOF2 - Accessory Short OFF Event with 2 Bytes

Name		ASOF2
Value	**Decimal**	217
	Hex	D9
Priority		Low
Description		Accessory Short OFF.
Comment		Indicates an 'OFF' event using the short event number of 2 LS bytes with two added data bytes. An event is sent by a module when it detects a change of state. Modules may consume the event and perform actions. The NN is not used to match events, the NN normally indicates the source of the event. The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.
Direction		
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		Producer or Consumer
Parameters		NN (2 bytes) Node number, EN (2 bytes) Event number, data1 (1 bytes) Event data 1, data2 (1 bytes) Event data 2
Conditions		If the module has not been taught the event nor has the event by default then the event message is ignored.
Result		If the module has the event configured to be sent when there is a change of state and that object changes to state OFF then send this event. If the module has been configured to consume the event (ignoring the NN) then perform the actions associated with the OFF event.
History		No change from CBUS revision 4 ver 8j

3.7.14 [DD] ARSON2 - Accessory Response ON Event with 2 Bytes

Name		ARSON2
Value	**Decimal**	221
	Hex	DD
Priority		Low
Description		Accessory Short Response Event ON with two data bytes.
Comment		Indicates an 'ON' response event with two added data bytes. A response is a reply to a status request ([ASRQ](#))without producing an ON or OFF event. The NN is not used to match events, the NN normally indicates the source of the event. The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.
Direction		From module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		Producer
Parameters		NN (2 bytes) Node number, EN (2 bytes) Event number, data1 (1 bytes) Event data 1, data2 (1 bytes) Event data 2
Conditions		The module has the event defined and the current state of the event is ON.
Result		
History		No change from CBUS revision 4 ver 8j

3.7.15 [DE] ARSOF2 - Accessory Response OFF Event with 2 Bytes

Name		ARSOF2
Value	**Decimal**	222
	Hex	DE
Priority		Low
Description		Accessory Short Response Event OFF with two data bytes.
Comment		Indicates an 'OFF' response event with two added data bytes. A response is a reply to a status request (ASRQ) without producing an ON or OFF event. A response event is a reply to a status request (ASRQ)without producing an ON or OFF event. The NN is not used to match events, the NN normally indicates the source of the event. The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.
Direction		From module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		Producer
Parameters		NN (2 bytes) Node number, EN (2 bytes) Event number, data1 (1 bytes) Event data 1, data2 (1 bytes) Event data 2
Conditions		The module has the event defined and the current state of the event is OFF.
Result		
History		No change from CBUS revision 4 ver 8j

3.7.16 [DF] EXTC5 - Extended Opcode with 5 Additional Bytes

Name		EXTC5
Value	**Decimal**	223
	Hex	DF
Priority		Low
Description		Extended opcode with 5 additional bytes.
Comment		Reserved to allow the 5 additional bytes range to be extended by a further 256 opcodes.
Direction		
States/Modes		
Services		
Parameters		Ext_OPC (1 bytes) Extended opcode, Data1 (1 bytes) Data2 (1 bytes) Data3 (1 bytes) Data4 (1 bytes) Data5 (1 bytes)
Conditions		
Result		
History		

3.8 OPCODES with 7 additional bytes

3.8.1 [E0] RDCC6 - Request 6 bytes DCC Packet

Name		RDCC6
Value	**Decimal**	224
	Hex	E0
Priority		Normal
Description		Request 6-byte DCC Packet.
Comment		Allows a CAB or equivalent to request a 6 byte DCC packet to be sent to the track. The packet is sent <REP> times and is not refreshed on a regular basis.
Direction		To module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		DCC_CAB or DCC_CMD
Parameters		REP (1 bytes), Byte0 (1 bytes), Byte1 (1 bytes), Byte2 (1 bytes), Byte3 (1 bytes), Byte4 (1 bytes), Byte5 (1 bytes)
Conditions		If the NN does not match the node number of the module then ignore the message. If the module is not a DCC command station then ignore the message.
Result		If conditions are met then the requested DCC packet is sent <REP> times.
History		No change from CBUS revision 4 ver 8j

3.8.2 [E1] PLOC - Engine Report

Name		PLOC
Value	**Decimal**	225
	Hex	E1
Priority		Normal
Description		Engine report.
Comment		A report of an engine entry sent by the command station. Sent in response to QLOC or as an acknowledgement of acquiring an engine requested by a cab (RLOC or GLOC).
Direction		From command station
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		DCC_CAB or DCC_CMD
Parameters		Session (1 bytes), Addr (2 bytes), Speed/Dir (1 bytes), Fn1 (1 bytes) Function byte F0-F4, Fn2 (1 bytes) Function byte F5-F8, Fn3 (1 bytes) Function byte F9-F12
Conditions		Sent in response to QLOC, RLOC or GLOC.
Result		
History		No change from CBUS revision 4 ver 8j

x3.8.3 [E2] NAME - Request for Name Response

Name		NAME
Value	**Decimal**	226
	Hex	E2
Priority		Low
Description		Response to request for node name string.
Comment		Returns the type name for the module in response to RQMN. Any leading "CAN" or "ETH" is not included in the response. The type is post-padded to 7 characters with spaces (0x20). The requester can subsequently add the "CAN" or "ETH" using the protocol indicated in parameter 10.
Direction		From module
States/Modes		Setup
Services		MNS
Parameters		NAME (7 bytes) Module type name in ASCII and padded on right with spaces (0x20).
Conditions		Sent in response to a RQMN message.
Result		
History		No change from CBUS revision 4 ver 8j

3.8.4 [E3] STAT - Command Station Status Report

Name		STAT
Value	**Decimal**	227
	Hex	E3
Priority		Normal
Description		Command Station status report.
Comment		Sent by the command station in response to RSTAT. <flags> is status defined by the bits below: 0 -Hardware Error (self test), 1 -Track Error 2 -Track On/ Off, 3 -Bus On/ Halted, 4 -EM. Stop all performed, 5 -Reset done, 6 -Service mode (programming) On/ Off, 7 –reserved.
Direction		From command station
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		DCC_CAB or DCC_CMD
Parameters		NN (2 bytes) Node number, CSnum (1 byte) For future expansion -set to zero at present, Flags (1 byte), Major rev (1 bytes) Major revision number, Minor rev (1 bytes) Minor revision letter, Build no (1 bytes) Build number.
Conditions		Sent in response to a RSTAT message.
Result		
History		No change from CBUS revision 4 ver 8j

3.8.5 [E6] ENACK - Event Acknowledge

Name		ENACK
Value	**Decimal**	230
	Hex	E6
Priority		Low
Description		Event Acknowledge.
Comment		Sent by a module to acknowledge the consumption of an event. Used for diagnostic purposes.
Direction		From module
States/Modes		ENACK
Services		ENACK and Consumer
Parameters		NN (2 bytes) Module's Node Number, opcode (1 bytes), The opcode of the event being acknowledged, EventNNh (1 bytes), The high byte of the event's NN, EventNNl (1 bytes), The low byte of the event's NN, EventENh (1 bytes), The high byte of the event's EN, EventENl (1 bytes), The low byte of the event's EN
Conditions		Module must be in event acknowledge mode. Module must have the specified defined as a consumed event. Sent in response to an event.
Result		
History		New for VLCB

3.8.6 [E7] ESD - Extended Service Discovery Response

Name		ESD
Value	**Decimal**	231
	Hex	E7
Priority		Low
Description		Extended service discovery response.
Comment		Detailed information about a service supported by a module. The data supplied is service specific. Sent in response to RQSD with ServiceIndex is not zero. A single ESD response message is sent by a module for the specified service. The data parameters are service specific and reference should be made to the relevant service specification. Also see SD.
Direction		From module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		MNS
Parameters		NN (2 bytes) Node number, ServiceIndex (1 bytes) Index into the list of services ServiceType (1 bytes) Service Type, Data1 (1 bytes) Service specific data, Data2 (1 bytes) Service specific data, Data3 (1 bytes) Service specific data,
Conditions		Sent in response to RQSD when the requested ServiceIndex is not zero.
Result		
History		New for VLCB

3.8.7 [E9] DTXC- Streaming protocol

Name		DTXC
Value	**Decimal**	233
	Hex	E9
Priority		Low
Description		Streaming protocol (RFC0005).
Comment		Used to transport a relatively large block of data. StreamID is a unique layout wide identifier of a particular message stream. It is the responsibility of the layout installer/module installer to ensure that any StreamIDs are unique across the installation. StreamIDs 0~20 are reserved as CBUS system wide IDs. Users would not allocate these IDs to private streams. SequenceNum is a 0x00 to 0xFF identification of the frame sequence . 0x00 is used to denote a header frame , any number != 0x00 indicates a continuation frame. MessageLen is a 16 bit size in bytes of the transmitted message , However as only 254 continuation frames are possible the Message Len is limited to a count of 1275. However private protocols may be deployed to send larger messages and the full extent of these fields can be used. A Message length of Zero is supported, albeit rather pointless. CRC16 is a standard implementation of CRC, ie $P(x) = x^{16}+x^{15}+x^2+1$. CRC fields are optional and set to 0x00 if not implemented. Continuation frames merely contain the StreamID and SequenceNum and 5 bytes of message data It is recommended that continuation frames are throttled at 1 over 20ms.
Direction		
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		

Parameters	For sequenceNum != 0 StreamID (1 bytes) Stream identifier SequenceNum (1 bytes) Sequence Number Data1 (1 bytes) Stream data Data2 (1 bytes) Stream data Data3 (1 bytes) Stream data Data4 (1 bytes) Stream data Data5 (1 bytes) Stream data For sequenceNum = 0 StreamID (1 bytes) Stream identifier 0x00 (1 bytes) Sequence Number MessageLen (2 bytes) Message Length CRC16 (2 bytes) Checksum Flags (1 bytes) flags - reserved for future use
Conditions	
Result	
History	Defined in RFC0005

3.8.8 [EF] PARAMS - Response for Node Parameters

Name		PARAMS
Value	**Decimal**	239
	Hex	EF
Priority		Low
Description		Response to request for node parameters.
Comment		Returns the first 7 parameters for the module in response to RQNP. See Appendix B - Module parameters for a list of available parameters.
Direction		From module
States/Modes		Setup
Services		MNS
Parameters		PARA 1 (1 bytes) Parameter 1, PARA 2 (1 bytes) Parameter 2, PARA 3 (1 bytes) Parameter 3, PARA 4 (1 bytes) Parameter 4, PARA 5 (1 bytes) Parameter 5, PARA 6 (1 bytes) Parameter 6, PARA 7 (1 bytes) Parameter 7
Conditions		Sent in response to RQNP.
Result		
History		No change from CBUS revision 4 ver 8j

3.8.9 [F0] ACON3 - Accessory ON Event with 3 Data Bytes

Name		ACON3
Value	**Decimal**	240
	Hex	F0
Priority		Low
Description		Accessory ON.
Comment		Indicates an 'ON' event using the full event number of 4 bytes with three additional data bytes. An event is sent by a module when it detects a change of state. Modules may consume the event and perform actions. The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.
Direction		
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		Producer or Consumer
Parameters		NN (2 bytes) Node number, EN (2 bytes) Event number, data1 (1 bytes) Event data 1, data2 (1 bytes) Event data 2, data3 (1 bytes) Event data 3
Conditions		If the module has not been taught the event nor has the event by default then the event message is ignored.
Result		If the module has the event configured to be sent when there is a change of state and that object changes to state ON then send this event. If the module has been configured to consume the event then perform the actions associated with the ON event.
History		No change from CBUS revision 4 ver 8j

3.8.10 [F1] ACOF3 - Accessory OFF Event with 3 Data Bytes

Name		ACOF3
Value	**Decimal**	241
	Hex	F1
Priority		Low
Description		Accessory OFF.
Comment		Indicates an 'OFF' event using the full event number of 4 bytes with three additional data bytes. An event is sent by a module when it detects a change of state. Modules may consume the event and perform actions. The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.
Direction		
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		Producer or Consumer
Parameters		NN (2 bytes) Node number, EN (2 bytes) Event number, data1 (1 bytes) Event data 1, data2 (1 bytes) Event data 2, data3 (1 bytes) Event data 3
Conditions		If the module has not been taught the event nor has the event by default then the event message is ignored.
Result		If the module has the event configured to be sent when there is a change of state and that object changes to state OFF then send this event. If the module has been configured to consume the event then perform the actions associated with the OFF event.
History		No change from CBUS revision 4 ver 8j

3.8.11 [F2] ENRSP - Read Event Response

Name		ENRSP
Value	**Decimal**	242
	Hex	F2
Priority		Low
Description		Response to request to read node events.
Comment		This is a response to either NERD or NENRD.
Direction		From module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		Teach
Parameters		NN (2 bytes) Node number, EN3 (1 bytes) Event Node number hi, EN2 (1 bytes) Event Node number lo, EN1 (1 bytes) Event number hi, EN0 (1 bytes) Event number lo, EN# (1 bytes) Event index.
Conditions		Sent in response to a request to read events.
Result		
History		Changed from CBUS revision 4 ver 8j

3.8.12 [F3] ARON3 - Accessory Response ON Event with 3 Data

Name		ARON3
Value	**Decimal**	243
	Hex	F3
Priority		Low
Description		Accessory Response Event.
Comment		Indicates an 'ON' response event with three added data bytes. A response is a reply to a status request (AREQ) without producing an ON or OFF event. The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.
Direction		From module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		Producer
Parameters		NN (2 bytes) Node number, EN (2 bytes) Event number, data1 (1 bytes) Event data 1, data2 (1 bytes) Event data 2, data3 (1 bytes) Event data 3
Conditions		The module has the event defined and the current state of the event is ON.
Result		
History		No change from CBUS revision 4 ver 8j

3.8.13 [F4] AROF3 - Accessory Response OFF Event with 3 Bytes

Name		AROF3
Value	**Decimal**	244
	Hex	F4
Priority		Low
Description		Accessory Response Event.
Comment		Indicates an 'OFF' response event with three added data bytes. A response is a reply to a status request ([AREQ](#)) without producing an ON or OFF event. The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.
Direction		From module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		Producer
Parameters		NN (2 bytes) Node number, EN (2 bytes) Event number, data1 (1 bytes) Event data 1, data2 (1 bytes) Event data 2, data3 (1 bytes) Event data 3
Conditions		The module has the event defined and the current state of the event is OFF.
Result		
History		No change from CBUS revision 4 ver 8j

3.8.14 [F5] EVLRNI - Teach an EV using Event Indexing

Name		EVLRNI
Value	**Decimal**	245
	Hex	F5
Priority		Low
Description		Teach an event in learn mode using event indexing.
Comment		Sent by a configuration tool to a node in learn mode to teach it an event. The event index must be known. Also teaches it the associated event variables (EVs). This command is repeated for each EV required.
Direction		To module
States/Modes		Learn
Services		Teach
Parameters		NN (2 bytes) Event Node number, EN (2 bytes) Event number, EN# (1 bytes) Event index, EV# (1 bytes) Event variable index, EV val (1 bytes) Event variable value
Conditions		If the module is not in Learn mode then ignore the message. If the message is short so that it does not include the specified parameters then a GRSP (Invalid Command) message is returned. If EN# is out of range then send a message a CMDERR(Invalid Event) message. If the event variable index is greater than the number of EVs per event parameter then send a CMDERR(Invalid Event Variable Index) message. ~~If the event variable index is zero and the module requires EVs then send a CMDERR(Invalid Event Variable Index) message.~~ If the event is zero (ie NN==0 and EN==0) then the existing event is not changed. If the event variable index is zero then no event variable is changed, and the event variable value is ignored. This opcode is used by the Slots Service, which has a set of events at fixed indexes. A specific module may specify additional conditions.

Result	If conditions are met then
	    1. save the EV
	    2. write the EV
	    3. send a WRACK message, and
	    4. GRSP(ok).
	    5. One may need to read the specific module's specification.

History	Modified from CBUS revision 4 ver 8j to also return GRSP. Modified to allow zero events and event variable number.

3.8.15 [F6] ACDAT - Accessory Data Event

Name		ACDAT
Value	**Decimal**	246
	Hex	F6
Priority		Low
Description		Accessory node data event.
Comment		Indicates an event from this node with 5 bytes of data. For example, this can be used to send the 40 bits of an RFID tag. There is no event number in order to allow space for 5 bytes of data in the packet, so there can only be one data event per node. The meaning of the event is therefore dependent upon the type and use of the module.
Direction		From module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		
Parameters		NN (2 bytes) Node number, data 1 (1 bytes), data 2 (1 bytes), data 3 (1 bytes), data 4 (1 bytes), data 5 (1 bytes)
Conditions		Sent to indicate an accessory event for this module.
Result		
History		No change from CBUS revision 4 ver 8j

3.8.16 [F7] ARDAT - Accessory Data Response

Name		ARDAT
Value	**Decimal**	247
	Hex	F7
Priority		Low
Description		Accessory node data Response.
Comment		Indicates a node data response. A response event is a reply to a status request (RQDAT) without producing a new data event. There is no event number in order to allow space for 5 bytes of data in the packet, so there can only be one data event per node. The meaning of the response is therefore dependent upon the type and use of the module.
Direction		From module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		
Parameters		NN (2 bytes) Node number, data 1 (1 bytes), data 2 (1 bytes), data 3 (1 bytes), data 4 (1 bytes), data 5 (1 bytes)
Conditions		
Result		Sent in response to a RQDAT message.
History		No change from CBUS revision 4 ver 8j

3.8.17 [F8] ASON3 - Accessory Short ON Event with 3 Bytes

Name		ASON3
Value	**Decimal**	248
	Hex	F8
Priority		Low
Description		Accessory Short ON.
Comment		Indicates an 'ON' event using the short event number of 2 LS bytes with three added data bytes. An event is sent by a module when it detects a change of state. Modules may consume the event and perform actions. The NN is not used to match events, the NN normally indicates the source of the event. The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.
Direction		
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		Producer or Consumer
Parameters		NN (2 bytes) Node number, EN (2 bytes) Event number, data1 (1 bytes) Event data 1, data2 (1 bytes) Event data 2, data3 (1 bytes) Event data 3
Conditions		If the module has not been taught the event nor has the event by default then the event message is ignored.
Result		If the module has the event configured to be sent when there is a change of state and that object changes to state ON then send this event. If the module has been configured to consume the event (ignoring the NN) then perform the actions associated with the ON event.
History		No change from CBUS revision 4 ver 8j

3.8.18 [F9] ASOF3 - Accessory Short OFF Event with 3 Bytes

Name		ASOF3
Value	**Decimal**	249
	Hex	F9
Priority		Low
Description		Accessory Short OFF.
Comment		Indicates an 'OFF' event using the short event number of 2 LS bytes with three added data bytes. An event is sent by a module when it detects a change of state. Modules may consume the event and perform actions. The NN is not used to match events, the NN normally indicates the source of the event. The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.
Direction		
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		Producer or Consumer
Parameters		NN (2 bytes) Node number, EN (2 bytes) Event number, data1 (1 bytes) Event data 1, data2 (1 bytes) Event data 2, data3 (1 bytes) Event data 3
Conditions		If the module has not been taught the event nor has the event by default then the event message is ignored.
Result		If the module has the event configured to be sent when there is a change of state and that object changes to state OFF then send this event. If the module has been configured to consume the event (ignoring the NN) then perform the actions associated with the OFF event.
History		No change from CBUS revision 4 ver 8j

3.8.19 [FA] DDES - Device Data Event (short mode)

Name		DDES
Value	**Decimal**	250
	Hex	FA
Priority		Low
Description		Device data event (short mode).
Comment		Function is the same as ACDAT but uses device addressing so it can relate data to a device attached to a node. e.g. one of several RFID readers attached to a single node. The meaning of the event and the data is dependent upon the type and use of the module.
Direction		From module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		
Parameters		DN (2 bytes) Device number, data 1 (1 bytes), data 2 (1 bytes), data 3 (1 bytes), data 4 (1 bytes), data 5 (1 bytes)
Conditions		Sent to indicate a device event for this module.
Result		
History		No change from CBUS revision 4 ver 8j

3.8.20 [FB] DDRS - Device Data Response (short mode)

Name		DDRS
Value	**Decimal**	251
	Hex	FB
Priority		Low
Description		Device data response (short mode).
Comment		The response to a RQDDS request for data from a device. The meaning of the event and the data is dependent upon the type and use of the module.
Direction		From module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		
Parameters		DN (2 bytes) Device number, data 1 (1 bytes), data 2 (1 bytes), data 3 (1 bytes), data 4 (1 bytes), data 5 (1 bytes)
Conditions		Sent in response to a RQDDS request.
Result		
History		No change from CBUS revision 4 ver 8j

3.8.21 [FC] DDWS - Device Data Write

Name		DDWS
Value	**Decimal**	252
	Hex	FC
Priority		Low
Description		Write data.
Comment		Used to write data to a device such as a RFID tag. data1 ~ data5 is data to be written to the device. RC522 devices should have data1 set to 0
Direction		To module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		
Parameters		DN (2 bytes) Device number, data 1 (1 bytes) data to be written to device, data 2 (1 bytes) data to be written to device, data 3 (1 bytes) data to be written to device, data 4 (1 bytes) data to be written to device, data 5 (1 bytes) data to be written to device
Conditions		
Result		
History		?

3.8.22 [FD] ARSON3 - Accessory Response ON Event with 3 Bytes

Name		ARSON3
Value	**Decimal**	253
	Hex	FD
Priority		Low
Description		Accessory Short Response Event.
Comment		Indicates an 'ON' response event with three added data bytes.A response is a reply to a status request (ASRQ)without producing an ON or OFF event. The NN is not used to match events, the NN normally indicates the source of the event. The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.
Direction		From module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		Producer
Parameters		NN (2 bytes) Node number, EN (2 bytes) Event number, data1 (1 bytes) Event data 1, data2 (1 bytes) Event data 2, data3 (1 bytes) Event data 3
Conditions		The module has the event defined and the current state of the event is ON.
Result		
History		No change from CBUS revision 4 ver 8j

3.8.23 [FE] ARSOF3 - Accessory Response OFF Event with 3 Bytes

Name		ARSOF3
Value	**Decimal**	254
	Hex	FE
Priority		Low
Description		Accessory Short Response Event.
Comment		Indicates an 'OFF' response event with three added data bytes. A response is a reply to a status request (ASRQ) without producing an ON or OFF event. A response event is a reply to a status request (ASRQ)without producing an ON or OFF event. The NN is not used to match events, the NN normally indicates the source of the event. The meaning of the additional data is dependent upon the application and must be agreed between the producer and consumer of the event.
Direction		From module
States/Modes		Normal, Learn, NOHEARTB, ENACK
Services		Producer
Parameters		NN (2 bytes) Node number, EN (2 bytes) Event number, data1 (1 bytes) Event data 1, data2 (1 bytes) Event data 2, data3 (1 bytes) Event data 3
Conditions		The module has the event defined and the current state of the event is OFF.
Result		
History		No change from CBUS revision 4 ver 8j

3.8.24 [FF] EXTC6 - Extended Opcode with 6 Additional Bytes

Name		EXTC6
Value	**Decimal**	255
	Hex	FF
Priority		Low
Description		Extended opcode with 6 additional bytes.
Comment		Reserved to allow the 6 additional bytes range to be extended by a further 256 opcodes.
Direction		
States/Modes		
Services		
Parameters		Ext_OPC (1 bytes) Extended opcode, Data1 (1 bytes) Data2 (1 bytes) Data3 (1 bytes) Data4 (1 bytes) Data5 (1 bytes) Data6 (1 bytes)
Conditions		
Result		
History		No change from CBUS revision 4 ver 8j

4 Appendix A - DCCERR error codes

Code	Error	Comment
1	Loco stack full	The first two bytes are the loco address, the third byte is the error number.
2	Loco address taken	The first two bytes are the loco address, the third byte is the error number.
3	Session not present	The first byte is the session id, the second byte is zero, the third byte is the error number.
4	Consist empty	The first byte is the consist id, the second byte is zero, the third byte is the error number.
5	Loco not found	The first byte is the session id, the second byte is zero, the third byte is the error number.
6	CAN bus error	The firstTwo data bytes are set to zero (not used), the third is the error number. This would be sent out in the unlikely event that the command station buffers overflow.
7	Invalid request	The first two bytes are the loco address, the third byte is an error number. Indicates an invalid or inconsistent request. For example, a GLOC request with both steal and share flags set.
8	Session cancelled	The first byte is the session id, the second byte is zero, the third byte is the error number. Sent to a cab to cancel the session when another cab is stealing that session.

5 Appendix B - Module Parameters

Code	Use	VLCB use
0	Number of parameters	
1	Manufacturer's Id. 1	Used in combination with ModulerId to create an unique 16bit module identifier. This is the high byte. See the Cbusdefs document for existing values
2	Minor Version (a character) e.g. 0x62 = 'b'	
3	Module Type Id. See the Cbusdefs document for values	Used in combination with ManufacturerId to create an unique 16bit module identifier. This is the low byte. See the Cbusdefs document for existing values
4	No. of events supported by module	
5	No of Event Variables per event	
6	No of Node Variables	
7	Major version (integer) e.g. 0x01 = 1	
8	Flags indicating module support: {table below}	Bit 3 used for Normal mode

Table for Code 8 flags:

Bit number	Bit value	Use	
0	1	Event consumer	Set to 3 for a Combi module
1	2	Event producer	
2	4	Normal mode	

	3	8	Bootable using the FCU/JMRI boot loader protocol	
	4	16	Able to consume own events	
	5	32	Learn mode	
	6	64	VLCB compliant	
9	Processor Id -defines the processor, e.g. 2480, 25K80 the firmware was built for. Set to zero for non-PIC processors. See Cbusdefs for values.			Refer to bootloader service.
10	Interface protocol -the network type that the module uses, currently either CAN or Ethernet. See Cbusdefs for values.			
11-14	The load address for the new code, this is a 4 byte little endian address, this can vary depending on the module being loaded,the normal address for all PIC processor is 0x800 except for the CANCAB language modules which are loaded above the code area. Currently only used by PIC processors, other processors should set these parameters to zero.			Refer to bootloader service.
15-18	Manufacturers processor code –this is a four byte field, only the first two bytes are used for the PIC18F processor family, this must be read directly from the hardware when requested. Currently only used by PIC processors, if implemented. If not used, the parameters must be set to zero.			Refer to bootloader service.
19	Manufacturer code –this parameter identifies the manufacturer. See Cbusdefs for values.			Refer to bootloader service.
20	Beta release code –a non-zero value specifies the beta release version, zero indicates a normal release			Used for Patch number.
21-24	Reserved for future use			

6 Appendix C - CMDERR and GRSP error codes

Code	Error	Used for CMDERR	GRSP service
0	OK		Any
1	Invalid command, command Not Supported.	✓	Any
2	Not In Learn Mode.	✓	Teach
3	Not in Setup Mode.	✓	MNS
4	Too Many Events.	✓	Teach
5	No Event.	✓	Teach
6	Invalid Event variable index.	✓	Teach
7	Invalid Event.	✓	Teach
8	Reserved.		
9	Invalid Parameter Index.	✓	MNS
10	Invalid Node Variable Index.	✓	NV
11	Invalid Event Variable Value.	✓	Teach
12	Invalid Node Variable Value.	✓	NV
13	Other in Learn mode	✓	Teach
250	Invalid mode		Any
251	Invalid command parameter		Any
252	Invalid service		Any
253	Invalid diagnostic		Any
254	Unknown NVM type		Any
255	Reserved		