Signals from the Calorimeter Global Trigger via the PSB to the GTL board

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H_T added, 6+3+3 channel option,
Problem: option for 6 jets, 3 fwdJets, 3 tau not implemented

The Global Calorimeter Trigger (=GCT) data are transferred to the GT via 28 bit channel links carrying 4 trigger objects in 3 links. On the PSB module *(Prototype: by an additional GTL conversion board)* the data are converted into quadruplets of channels one channel for each object. Pairs of channels are then interlaced to 80 MHz channels and sent as parallel GTLP-signals via the GT-backplane to the GTL board. Receiver Chips convert the data back to 40 MHz channels and forward them to the Condition Chips.
There exists a proposal to send 6 Jets, 3 fwdJets and 3 tau-Jets instead of 3 quadruplets. Therefore the 12 channels of the Hadron Calorimeter will be connected to the same PSB9U board to assign the channels as required.

Format for Condition Chips on GTL board:

		16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	ie/γ _1	SY	0	Φ					η				E_T					
2	ie/γ _2	SY	0	Φ					η				E_T					
3	ie/γ _3	SY	0	Φ					η				E_T					
4	ie/γ _4	SY	0	Φ					η				E_T					
5	e/γ _1	SY	0	Φ					η				E_T					
6	e/γ _2	SY	0	Φ					η				E_T					
7	e/γ _3	SY	0	Φ					η				E_T					
8	e/γ _4	SY	0	Φ					η				E_T					
9	Jet_1	SY	0	Φ					η				E_T					
10	Jet_2	SY	0	Φ					η				E_T					
11	Jet_3	SY	0	Φ					η				E_T					
12	Jet_4	SY	0	Φ					η				E_T					
13	fwdJet_1	SY	0	Φ					η				E_T					
14	fwdJet_2	SY	0	Φ					η				E_T					
15	fwdJet_3	SY	0	Φ					η				E_T					
16	fwdJet_4	SY	0	Φ					η				E_T					
17	τ_1	SY	0	Φ					η				E_T					
18	τ _2	SY	0	Φ					η				E_T					
19	τ _3	SY	0	Φ					η				E_T					
20	τ _4	SY	0	Φ					η				E_T					
21	Total_E_T	SY	ϕ_ETM 5-3			OV	11.....Total_E_T.....0											
22	Total E_T^{miss}	SY	ϕ_ETM 2-0			OV	11.....Total E_T^{miss}.....0											
23	Jet countsA	SY	**Cnt #7**				**Cnt #6**				**Cnt #5**				**Cnt #4**			
24	Jet countsB	SY	**Cnt #3**				**Cnt #2**				**Cnt #1**				**Cnt #0**			
25	Total H_T	SY	0 0 0			OV	11.....Total H_T.....0											

1. All quantities are sent with the most significant bit in the highest numbered position.
2. The most significant bit of an η value is a pseudo-sign bit, representing which half of the detector (in Z) the candidate lies in. The η numbering system is such that 0 is nearest the centre of the barrel, and the possible values range from –6 to +6, including both +0 and –0. η range = -3.0η ...+3.0η. The scale is not linear.
3. The possible phi values are from 0 to 17; 1 count=20°; no sign bit.
4. The energy ranges of the **E_T**, **E_T_total** and **E_T_missing** scales are to be decided.
5. OV = overflow bits for E_T_total and E_T_missing.
6. JET counts = 15 = overflow.
7. For **Forward Jets** the η values cover the range from η = +3 to +4.9 and from -3 to - 4.9 according to the table below. Bit 3 is the pseudo sign bit as for the other trigger objects. Bit 2 is set to =0. *This bit arrangement allows using the same/similar logic as for the central jets.*

η bits ..forward Jets				η counts
2^3	2^2	2^1	2^0	
0	0	0	0	+7
0	0	0	1	+8
0	0	1	0	+9
0	0	1	1	+10
1	0	0	0	-7
1	0	0	1	-8
1	0	1	0	-9
1	0	1	1	-10
x	1	x	x	Not allowed

Table 1: η bits for Forward Jets

8. SY = 1...synchronisation data; SY = 0 ...trigger data. Synchronisation data will be defined later
9. Translation from external to internal names for Jetcounts:;
   Jet countsA_0 = Cnt #4..... Jet countsA_3 = Cnt #7
   Jet countsB_0 = Cnt #0..... Jet countsA_3 = Cnt #3

Format of Calorimeter Global Trigger data on 28 bit Channel Links

		Channel Link bits							
objects	**cable**	27	26...24	23..21	20	19.....16	15.....10	9.....6	5.....0
4 e/γ (1...4)	1	S	P2,1,0	B2,1,0	0	**η1**	**E_T1**	**η0**	**E_T0**
	2	S	P2,1,0	B2,1,0	0	**η3**	**E_T3**	**η2**	**E_T2**
	3	S	P2,1,0	B2,1,0	0	*19..**ϕ3**..15*	*14..**ϕ2**..10*	*9....**ϕ1**....5*	*4....**ϕ0**....0*
4 isolated e/γ	4	S	P2,1,0	B2,1,0	0	**η1**	**E_T1**	**η0**	**E_T0**
	5	S	P2,1,0	B2,1,0	0	**η3**	**E_T3**	**η2**	**E_T2**
	6	S	P2,1,0	B2,1,0	0	*19..**ϕ3**..15*	*14..**ϕ2**..10*	*9....**ϕ1**....5*	*4....**ϕ0**....0*
4 Jets	7	S	P2,1,0	B2,1,0	0	**η1**	**E_T1**	**η0**	**E_T0**
	8	S	P2,1,0	B2,1,0	0	**η3**	**E_T3**	**η2**	**E_T2**
	9	S	P2,1,0	B2,1,0	0	*19..**ϕ3**..15*	*14..**ϕ2**..10*	*9....**ϕ1**....5*	*4....**ϕ0**....0*
4 forward Jets	10	S	P2,1,0	B2,1,0	0	**η1**	**E_T1**	**η0**	**E_T0**
	11	S	P2,1,0	B2,1,0	0	**η3**	**E_T3**	**η2**	**E_T2**
	12	S	P2,1,0	B2,1,0	0	*19..**ϕ3**..15*	*14..**ϕ2**..10*	*9....**ϕ1**....5*	*4....**ϕ0**....0*
4 Tau Jets	13	S	P2,1,0	B2,1,0	0	**η1**	**E_T1**	**η0**	**E_T0**
	14	S	P2,1,0	B2,1,0	0	**η3**	**E_T3**	**η2**	**E_T2**
	15	S	P2,1,0	B2,1,0	0	*19..**ϕ3**..15*	*14..**ϕ2**..10*	*9....**ϕ1**....5*	*4....**ϕ0**....0*
E_T_total, Jet counts		27	26...24	23..21	*20*	*19...16*	*15...12*	*11.....0*	
	16	S	P2,1,0	B2,1,0	**OV**	**Cnt #7**	**Cnt #6**	**E_T_total**	
E_T_miss,		27	26...24	23..21	*20*	*19...16*	*15...12*	*11.....0*	

Jet counts	17	S	P2,1,0	B2,1,0	**OV**	**Cnt #5**	**Cnt #4**	**E_T_missing**		
ϕE_T_miss,		27	26...24	23..21	20	*19...16*	*15-12*	*11- 8*	*7 - 4*	*3 - 0*
Jet counts	18	S	P2,1,0	B2,1,0	**ϕETmiss**		**Cnt #3**	**Cnt #2**	**Cnt #1**	**Cnt #0**
H_T_total		27	26...24	23..21	*20*	*19...16*	*15...12*	*11.....0*		
	16	S	P2,1,0	B2,1,0	**0**	0000	0000	**H_T_total**		

Table 2: GCT to GT Channel Links

CONVERSION from
3 GCT 28 bit Channel Link cables
to 4 Calo channels
done by CV2..5 chip and later by PSB-SYNC chip

		Channel Link bits							
object	**cable**	27	26...24	23..21	20	19.....16	15.....10	9.....6	5.....0
4 e/γ (1...4)	1	S **ch1_16**	P2,1,0 xxx	B2,1,0 xxx	0 x	**η1 ch2_[9:6]**	**E_T1 ch2_[5:0]**	**η0 ch1_[9:6]**	**E_T0 ch1_[5:0]**
calo quadruplets	2	S **ch2_16**	P2,1,0 xxx	B2,1,0 xxx	0 x	**η3 ch4_[9:6]**	**E_T3 Ch4_[5:0]**	**η2 ch3_[9:6]**	**E_T2 Ch3_[5:0]**
	3	S **ch3_16**	P2,1,0 xxx	B2,1,0 xxx	0 x	*19..***ϕ3***..15* **ch4_[14:10]**	*14..***ϕ2***..10* **ch3_[14:10]**	*9....***ϕ1***....5* **ch2_[14:10]**	*4....***ϕ0***....0* **ch1_[14:10]**
xxx = not transferred to GTL board									
E_T_total, Jet counts		27	26...24	23..21	*20*	*19...16*	*15...12*	*11.....0*	
	1	S **ch1_16**	P2,1,0 xxx	B2,1,0 xxx	**OV ch1_12**	**Cnt #7 ch3_[15:12]**	**Cnt #6 ch3_[11:8]**	**E_T_total ch1_[11:0]**	
E_T_miss, Jet counts		27	26...24	23..21	*20*	*19...16*	*15...12*	*11.....0*	
	2	S **ch2_16**	P2,1,0 xxx	B2,1,0 xxx	**OV ch2_12**	**Cnt #5 ch3_[7:4]**	**Cnt #4 ch3_[3:0]**	**E_T_missing ch2_[11:0]**	
ϕE_T_miss, Jet counts		27	26...24	23..21	20	*19 18 17 16*	*15-12*	*11- 8*	*7 - 4*	*3 - 0*
	3	S **ch3_16**	P2,1,0 xxx	B2,1,0 xxx	**ϕEtmiss[4:0] ch1_[15:13], ch2_[15:13]**		**Cnt #3 ch4_[15:12]**	**Cnt #2 ch4_[11:8]**	**Cnt #1 ch4_[7:4]**	**Cnt #0 ch4_[3:0]**

Optional bit assignment for 3-JETs on two 28 bit Channel Links

Hadron calorimeter trigger data

		Channel Link bits																										
objects	cable	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
3 fwdJet, 3tau_jets	1	S	P2	P1	P0	**η2**				**ϕ2**					**η0**				**ϕ0**					**E_T0**					
	2	S	P2	P1	P0	B2	B1	B0	**E_T2**						**η1**				**ϕ1**					**E_T1**					

For 6 Jets use 4 cables with same bit assignment.

Bit assignment for Quadruplets on three 28 bit Channel Links

Electromagnetic calorimeter trigger data

		Channel Link bits																										
objects	cable	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
4 e/γ , 4i_e/γ	1	S	P2	P1	P0	B2	B1	B0	0	**η1**					**E_T1**					**η0**				**E_T0**					
	2	S	P2	P1	P0	B2	B1	B0	0	**η3**					**E_T3**					**η2**				**E_T2**					
	3	S	P2	P1	P0	B2	B1	B0	0	**ϕ3**					**ϕ2**					**ϕ1**					**ϕ0**				