



**Figure 8.1:** Architecture of the Level-1 Trigger.

determine the highest-rank calorimeter and muon objects across the entire experiment and transfer them to the Global Trigger, the top entity of the Level-1 hierarchy. The latter takes the decision to reject an event or to accept it for further evaluation by the HLT. The decision is based on algorithm calculations and on the readiness of the sub-detectors and the DAQ, which is determined by the Trigger Control System (TCS). The Level-1 Accept (L1A) decision is communicated to the sub-detectors through the Timing, Trigger and Control (TTC) system. The architecture of the L1 Trigger is depicted in figure 8.1. The L1 Trigger has to analyze every bunch crossing. The allowed L1 Trigger latency, between a given bunch crossing and the distribution of the trigger decision to the detector front-end electronics, is  $3.2 \mu\text{s}$ . The processing must therefore be pipelined in order to enable a quasi-deadtime-free operation. The L1 Trigger electronics is housed partly on the detectors, partly in the underground control room located at a distance of approximately 90 m from the experimental cavern.

## 8.1 Calorimeter trigger

The Trigger Primitive Generators (TPG) make up the first or local step of the Calorimeter Trigger pipeline. For triggering purposes the calorimeters are subdivided in trigger towers. The TPGs sum the transverse energies measured in ECAL crystals or HCAL read-out towers to obtain the trigger tower  $E_T$  and attach the correct bunch crossing number. In the region up to  $|\eta| = 1.74$  each trigger tower has an  $(\eta, \phi)$ -coverage of  $0.087 \times 0.087$ . Beyond that boundary the towers are larger. The TPG electronics is integrated with the calorimeter read-out. The TPGs are transmitted through high-speed serial links to the Regional Calorimeter Trigger, which determines regional candidate electrons/photons, transverse energy sums,  $\tau$ -veto bits and information relevant for muons in the form of minimum-ionizing particle (MIP) and isolation (ISO) bits. The Global Calorimeter Trigger determines the highest-rank calorimeter trigger objects across the entire detector.