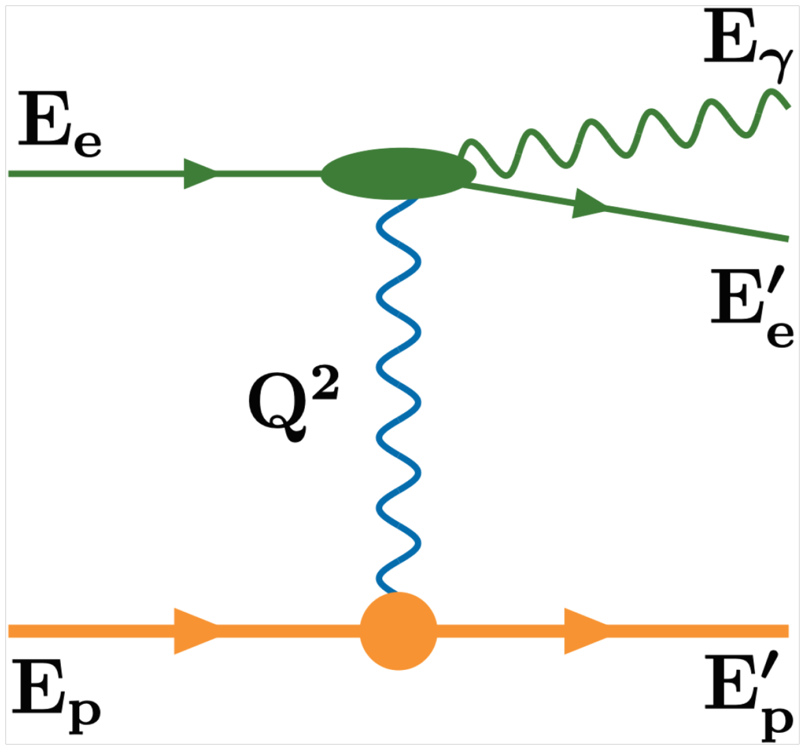
FarBackward DAQ discussion
(starting point)



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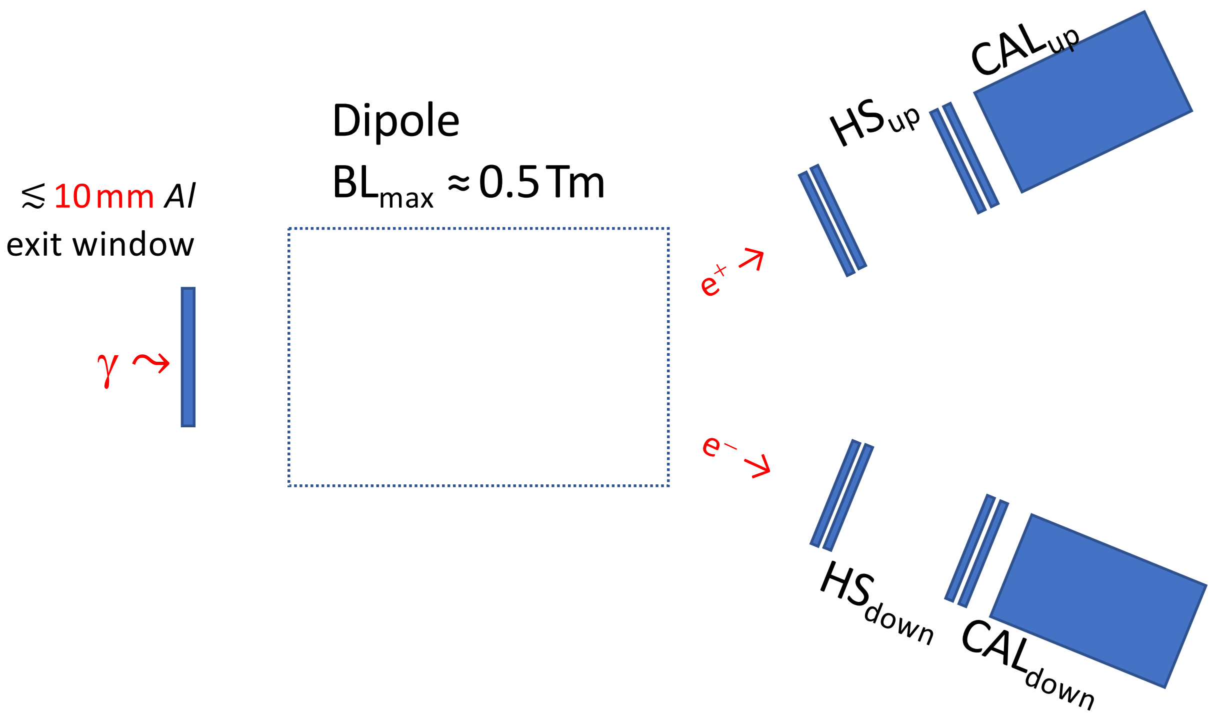
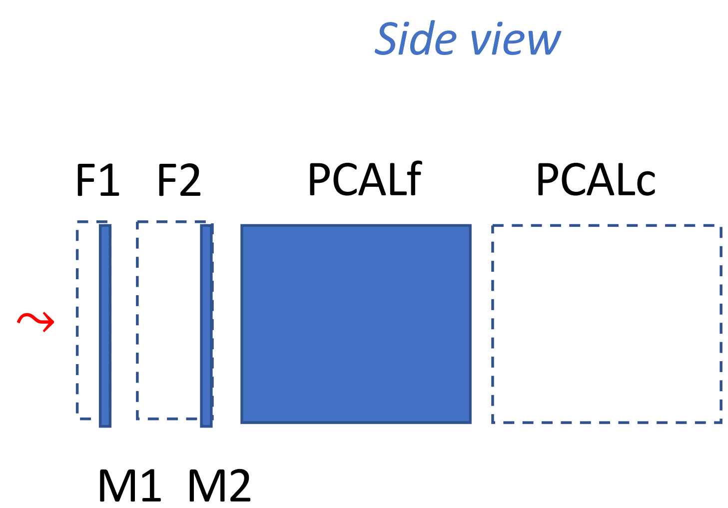
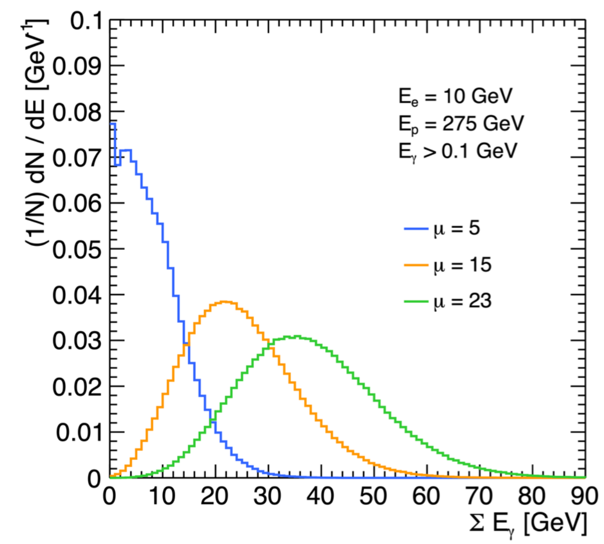
Three luminosity methods

Three largely complementary **bremsstrahlung** measurements:

1. *Reference* measurement – photon counting with a (movable) calorimeter PCALc, only at *low L* – but with the bremsstrahlung event rates up to 100 MHz
2. Photon conversion **counting** using $CAL_{up/down}$ + $HS_{up/down}$ (outside SR fan) – with the event rates above 100 MHz for *eAu* collisions
3. Photon **energy flow**, or $\langle E_{PCALf} \rangle$, using a movable calorimeter PCALf, with SR filters/monitors in front







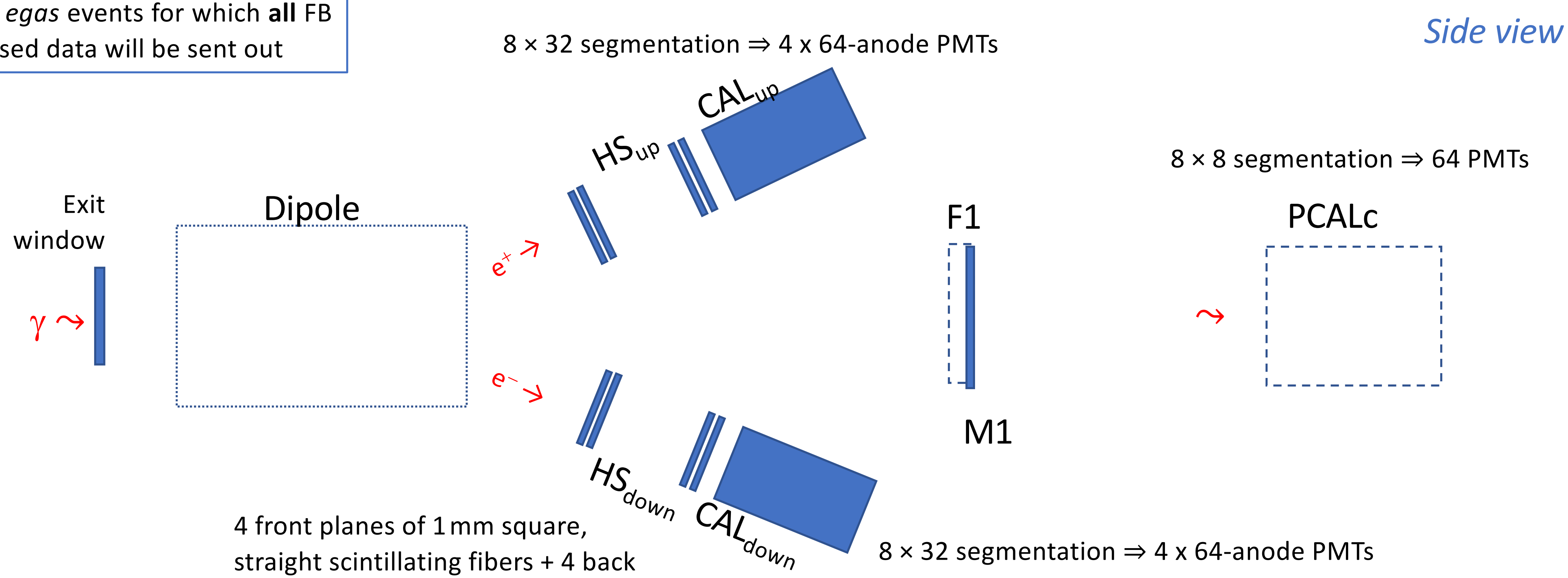
FarBackward: $CAL_{up/down}$ + PCALc + PCALf

$CAL_{up/down}$ and $HS_{up/down}$ *ep* event rate will reach 10 MHz – **all zero-suppressed data** will be sent to the central DAQ system to build full spectrometer events, with the data stream of about 2 × (80 b + 120 b) × 10 MHz = 4 Gbps (it becomes about 60 Gbps for *eAu*)

For PCALc the maximal rates will be similar, so its (unsuppressed) data stream = 64 × 10 b × 10 MHz = 6.4 Gbps

"By construction" PCALf and M1/M2 see (multiple) events every bunch-crossing – except for the FB calibration events**, **all** its data needs to be processed = 80 × 10 b × 100 MHz = 80 Gbps , but only **very large number of histograms** will be sent out.

) mostly small rate *egas* events for which **all FB detectors' unsuppressed data will be sent out

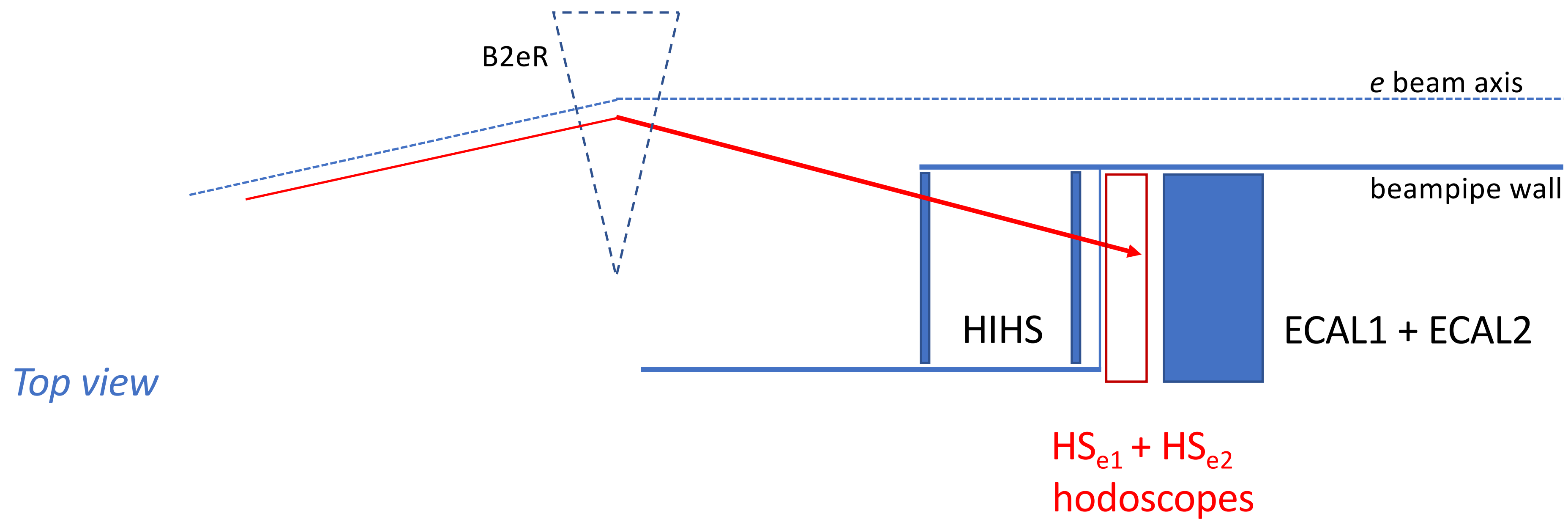


4 front planes of 1 mm square, straight scintillating fibers + 4 back planes of 2 mm fibers, all read out by SiPMs – **about 800 channels** in total.

FarBackward: Bremsstrahlung electrons & photoproduction tagging

Electron calorimeters $ECAL_{1/2}$ and HS_{e1} + HS_{e2} will see ***ep* event rates** even beyond 100 MHz at the nominal luminosity, what results in a huge (bremsstrahlung) data flow well above 2 × (80 b + 120 b) × 100 MHz = 40 Gbps.

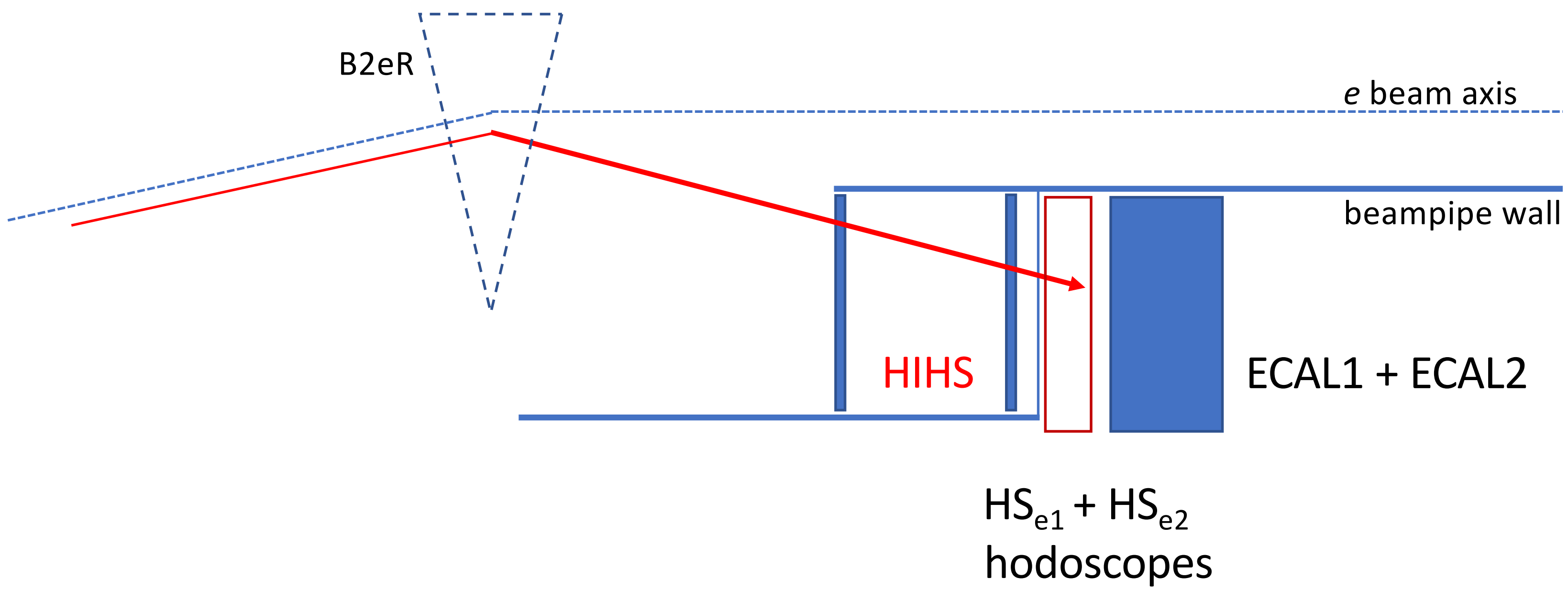
Bottom-line: a total throughput of **at least 120 Gbps is needed for (full) data streaming of the FB detectors** (with a small fraction used for sending out highly processed luminosity data) – and assuming the SR background can be neglected.



FarBackward: ePIC update

In case HIHS (= two pixel stations in vacuum) is the nominal choice, one definitely needs updating.
Electron calorimeters $ECAL_{1/2}$ and HIHS will see ***ep* event rates** even beyond 100 MHz at the nominal luminosity, what results in a huge (bremsstrahlung) data flow well above 2 × (80 b + 120 b) × 100 MHz = **40 Gbps??**

Bottom-line: a total throughput of **at least 200 Gbps is needed for (full) data streaming of the FB detectors** (with a small fraction used for sending out highly processed luminosity data) – and ~~assuming~~ the **SR background** ~~can~~ has to be ~~neglected~~ included!



Top view

Timepix4 data readout – a very simple illustration.

Here's a tracker with 3 modules, each containing 16x512x448 = 3.7M pixels. **A total of about 10M pixels**

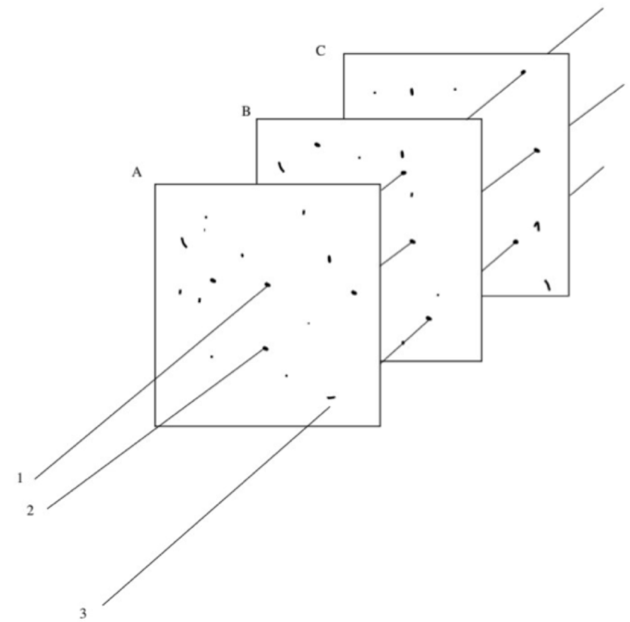
There are **many hits in each module** (not all shown):
from detector noise, from cosmics, sychrotron background, bremsstrahlung events and some from physics events
Even writing out the data for this where a small proportion of pixels have some sort of hit could be very expensive.

Let's assume track 1 is a physics event, 2 is a bremsstrahlung event, 3 is some sort of rescattering
The reject / accept is as follows:

In each module (A,B,C):
Accept only events with clusters that look like MIPS
from the approximate region of the interaction (ie straight through the layer).

That reduces us down to only clusters associated with tracks 1,2,3 in the figure.
The cluster information x,y,t,eTot is passed to the event builder.

In the event builder:
Cluster information 3*(x,y,t) (=**18 bytes**) to the DAQ for sorting out later.
OR
tracks constructed from the clusters in each module,
and knowledge of where the interaction region is
This would reject track 3, so tracks 2,3 (x,y,vx,vy,t) (=**20 bytes**) written to the DAQ.



Ken Livingston,
FB WG mtg,
13/10/22

https://indico.bnl.gov/event/17439/

In the physics analysis: Use exclusivity or kinematics to reject the brem event.

Estimate of data rate for 10 tracks per 12ns pulse: 120
Clusters: 1s/12E-9ns * 10tracks * 18bytes = **15 Gbytes/s = ~~240~~ Gbps**

Assume 2 bytes for x,y,t
(vx,vt)

Estimate of data rate for 10 tracks at 500kHz collision rate.
Clusters: 500E3 * 10tracks * 18bytes = **0.09 Gbytes = 1.44 Gbps**