

Lessons from NRAO Green Bank Visit

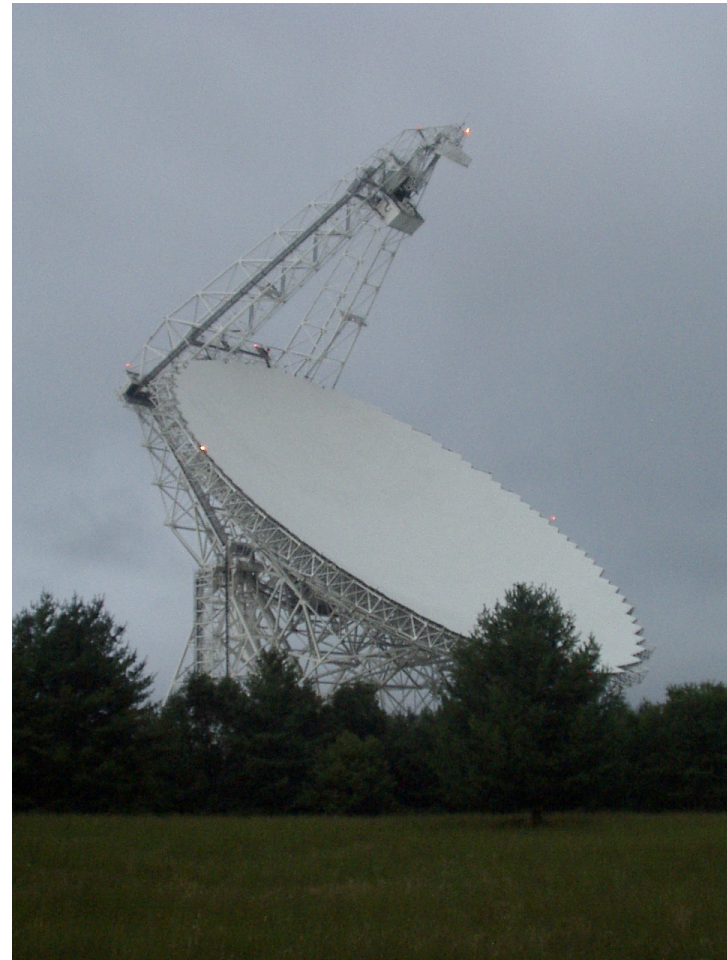
Mike and Jay

7/31/02

LIGO-G020300-00-D

GBRO

- Biggest steerable radio dish (100 m x 110 m, 1e4 tons)
- Active dish figure control --> usable BW from < 30 MHz to > 100 GHz
- Off-axis feed dramatically reduces side lobe response, BUT
- Proliferation of μ P's in modern life produces unacceptable RFI during daytime!! (even with drastic EMC measures on site)



Differences from LIGO application

- Their primary (sole?) concern: in-band RFI leakage to observing receivers at dish focus
 - Criterion; -240 dB [W/m²/Hz] at antenna feed, 30 MHz-100 GHz
 - That's ~30 pV/m/Hz^{1/2} @ horn, 100 nV/m/Hz^{1/2} @ rack 3 km off
 - We measure ~ mV/m to ~V/m near LLO racks currently
- No audio frequency concerns => grounding & power supplies conform to best **RF** practice (not 60 Hz or audio)
- Dynamic range less restrictive, no DC coupling => optical fibers can be used for all long-distance signal runs (analog & digital)
- Mostly small unit counts per function/design => custom chassis & packaging prevalent
 - Many boxes welded up or hogged out of solid aluminum on site
 - Even multcard crate assemblies appear to be custom format
 - No equivalent to “cross connect;” direct point-to-point backplanes

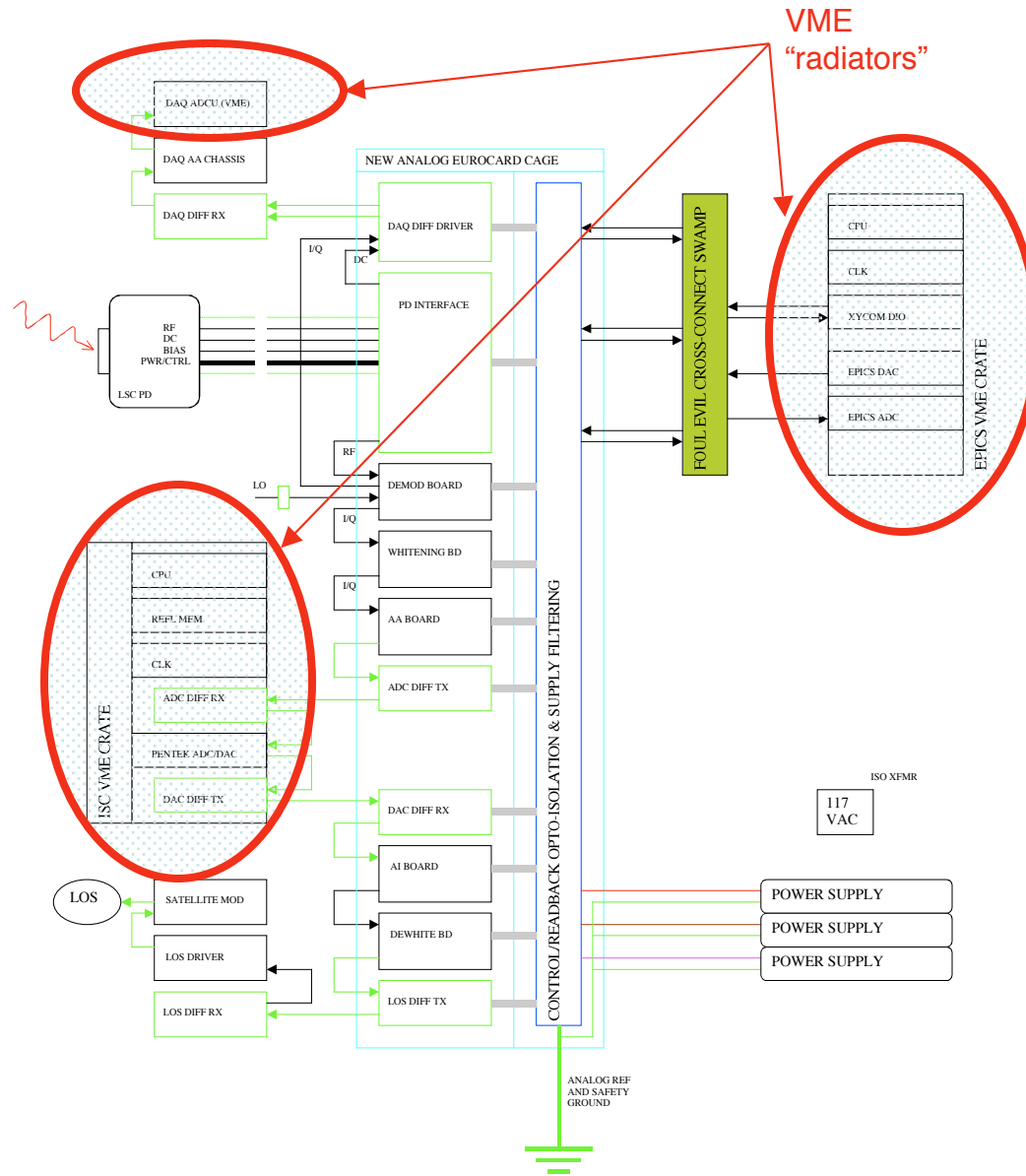
Relevant lessons

- Everything digital screams; ns TTL now found in freaking *toasters*
 - put it in a box
 - then put the box in another box
- Separate out analog ckts & other “receptors” and seal them in their own boxes
- Converters should be considered and packaged with analog stuff
 - use fibers or shielded, impedance-matched differential transmission lines to move the conversion data to/from the “dirty” world
- Use fibers wherever possible
- RFI-suppression feedthroughs on ALL conductor penetrations (waveguide tunnels beyond cutoff for fibers)
- Use RFI-minimizing board layouts & shield modules individually
- TEST EVERYTHING
 - RF anechoic chamber, analyzer, probes/antennas
 - Test criteria...?

Our RFI criteria?

- Easy part: direct 24.5/29.5 MHz and audio frequency pickup
 - shielding and “antenna gain” at least calculable
 - BUT NOTE: NRAO criteria are NOT OVERLY CONSERVATIVE in these bands for us!
- Hard part: nonlinearities & downconversion
 - diode junctions
 - asymmetrical slew rates
 - point contacts
 - converter aliasing

Rev. to plan: isolate digital crates



VME crate(& other digital equipment) containment/isolation proposal

