atis PROTECTION ENGINEERS GROUP

HUNTSVILLE, AL - MARCH 24-26, 2015

PEG CONFERENCE

LENTON®

GROUNDING & PROTECTION OF NEWER ELEMENTS in TELECOM

Newer Element within Telecom Network inevitably mean more electronics on the roadside, on poles and structure, on roof tops and on towers.

This paper looks at

- some methods and examples of how carriers have carried out grounding bonding
- reference to GR's & ITU guidelines on how to ground these
- Possible improved methods of surge protection

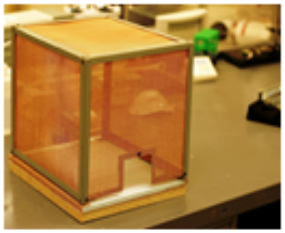
CONTENTs

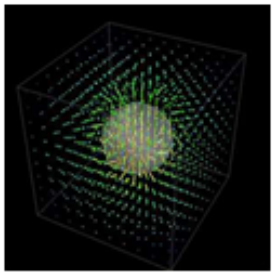
DAS Grounding

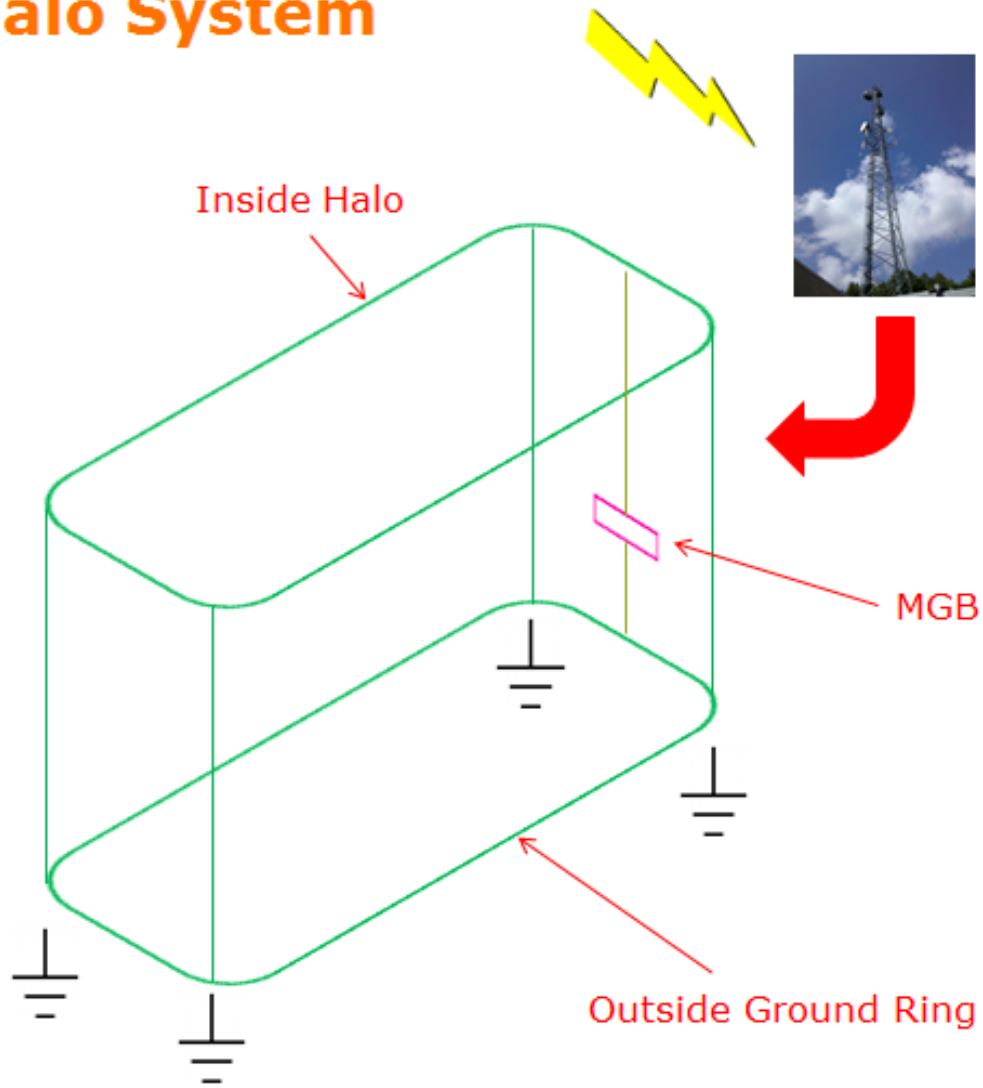
- DAS Distributed Antenna System.
- Application – eg. Stadiums, Hospitals, Tall Buildings, Hotels
- RF Source (Donor Antenna) – Distributed by fiber or cabling to local antenna. May use WiFi
- Multiple Service Provider - Input.
- Can be very large system for stadium or place like Disneyland.
- Grounding – Should it look like a cell-site with Halo Rings or Like a Central Office Or Neither.

Typical Indoor Grounding at Cellsites

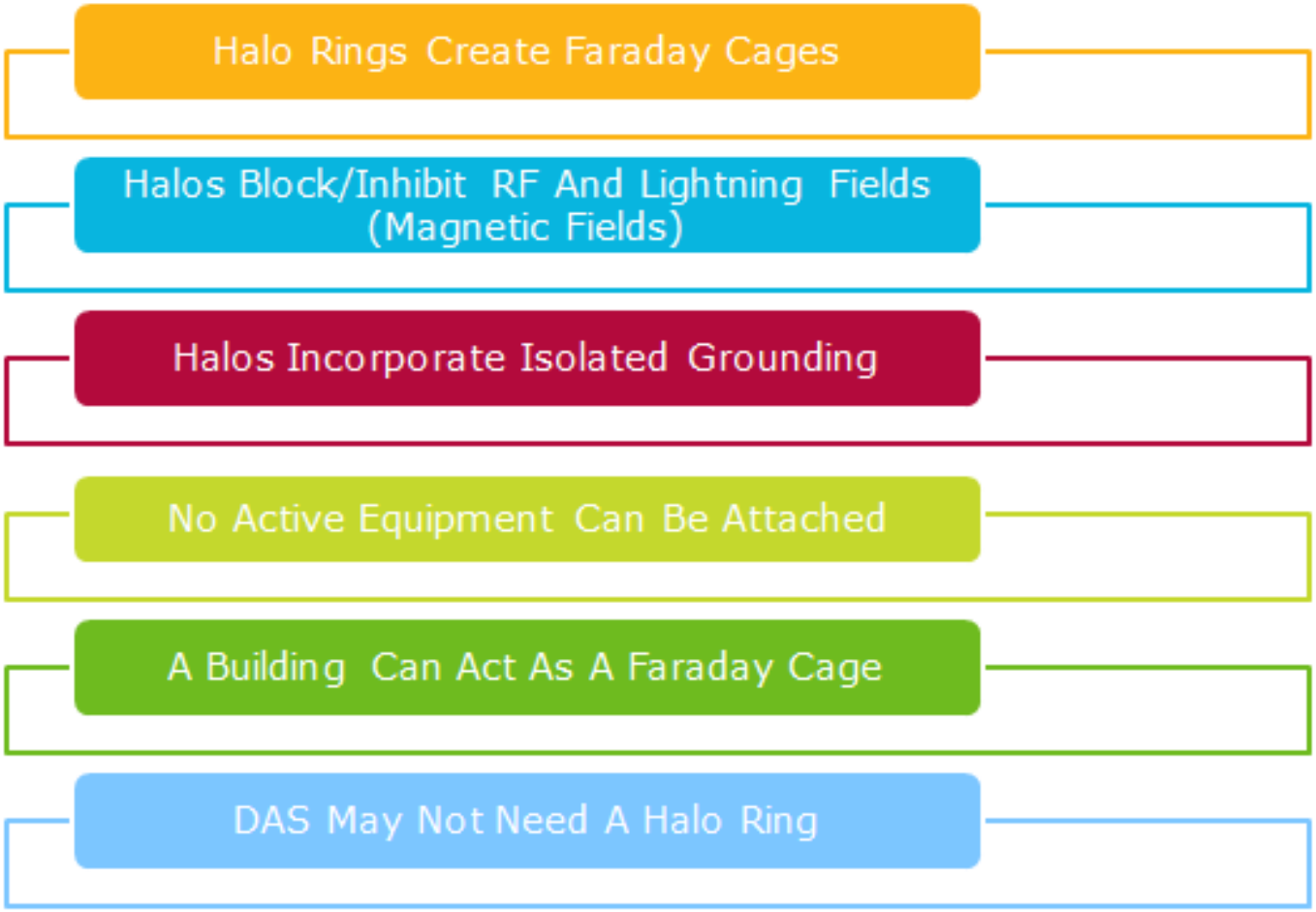
A True Halo System



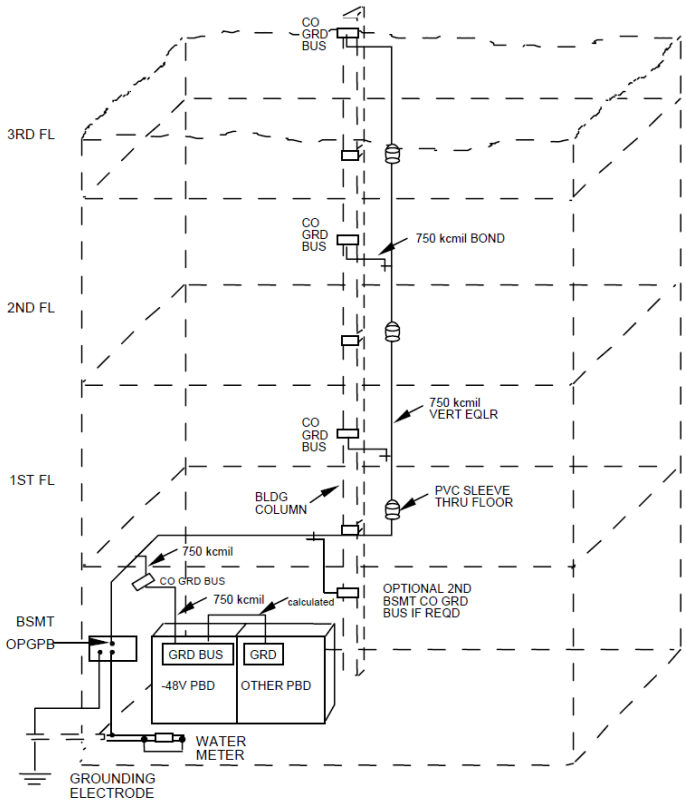


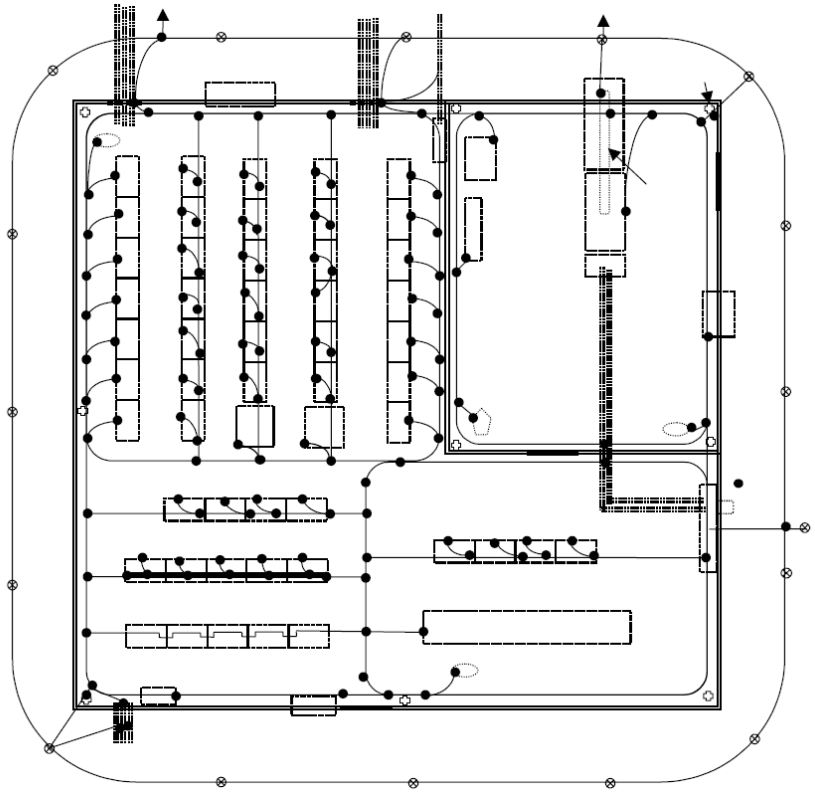


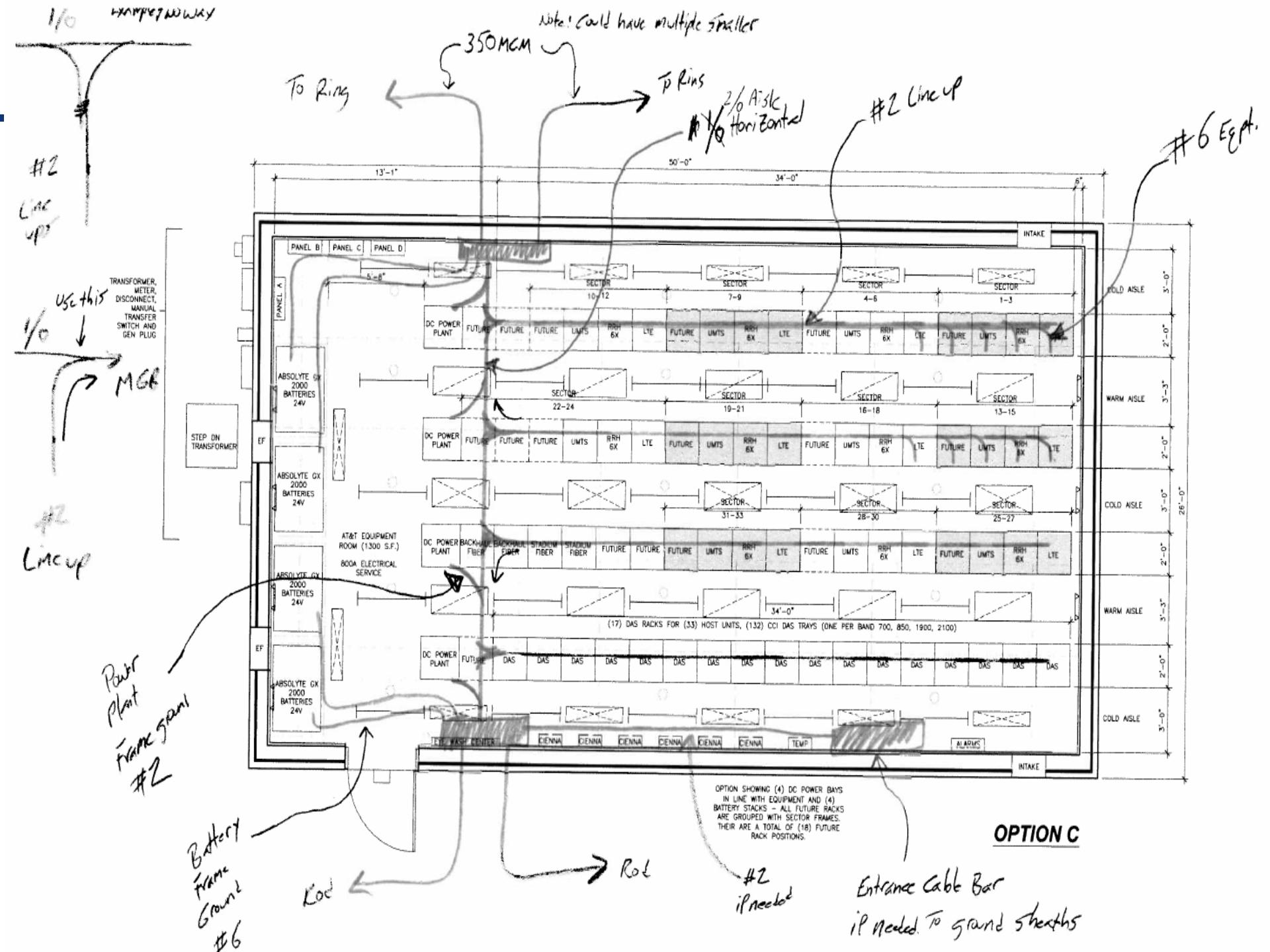
Benefits of Halo – Parallel to Building Steel



A Comparison Of Halo And COG






1/0
#2 Line up
TRANSFORMER, METER, DISCONNECT, MANUAL TRANSFER SWITCH AND GEN PLUG
Use this
1/0
MGB
#2 Line up
350MCM
Note! could have multiple smaller
To Ring
To Ring
1/0 2/0 Aisle Horizontal
#2 Line up
#6 Eqpt.
50'-0"
13'-1"
34'-0"
6"
PANEL A
PANEL B
PANEL C
PANEL D
INTAKE
SECTOR 10-12
SECTOR 7-9
SECTOR 4-6
SECTOR 1-3
SECTOR 22-24
SECTOR 19-21
SECTOR 16-18
SECTOR 13-15
SECTOR 31-33
SECTOR 28-30
SECTOR 25-27
DC POWER PLANT
FUTURE
UMTS
RRH 6X
LTE
BACKHAUL FIBER
STADIUM FIBER
DAS
COLD AISLE
WARM AISLE
ABSOLYTE GX 2000 BATTERIES 24V
STEP DN TRANSFORMER
EF
AT&T EQUIPMENT ROOM (1300 S.F.)
800A ELECTRICAL SERVICE
(17) DAS RACKS FOR (33) HOST UNITS, (132) CCI DAS TRAYS (ONE PER BAND 700, 850, 1900, 2100)
CIENNA
TEMP
ALARMS
INTAKE
OPTION SHOWING (4) DC POWER BAYS IN LINE WITH EQUIPMENT AND (4) BATTERY STACKS - ALL FUTURE RACKS ARE GROUPED WITH SECTOR FRAMES. THEIR ARE A TOTAL OF (18) FUTURE RACK POSITIONS.
OPTION C
Power Plant Frame Ground #2
Battery Frame Ground #6
Rod
Rod
#2 if needed
Entrance Cable Bar if needed To ground sheaths

Similar to TIA 607

Relevant to Customer Premises Grounding

(As opposed to Carrier Network Grounding)

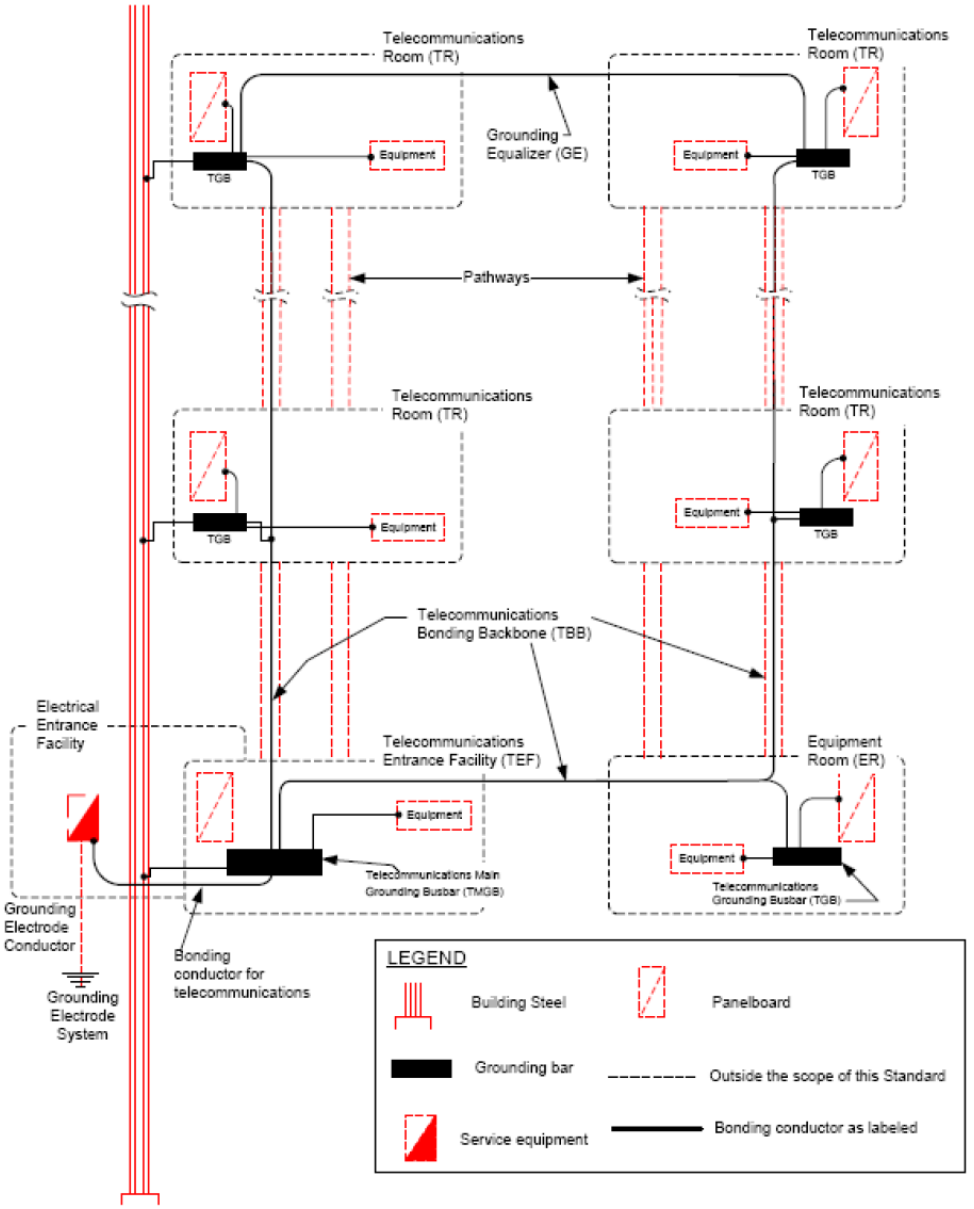
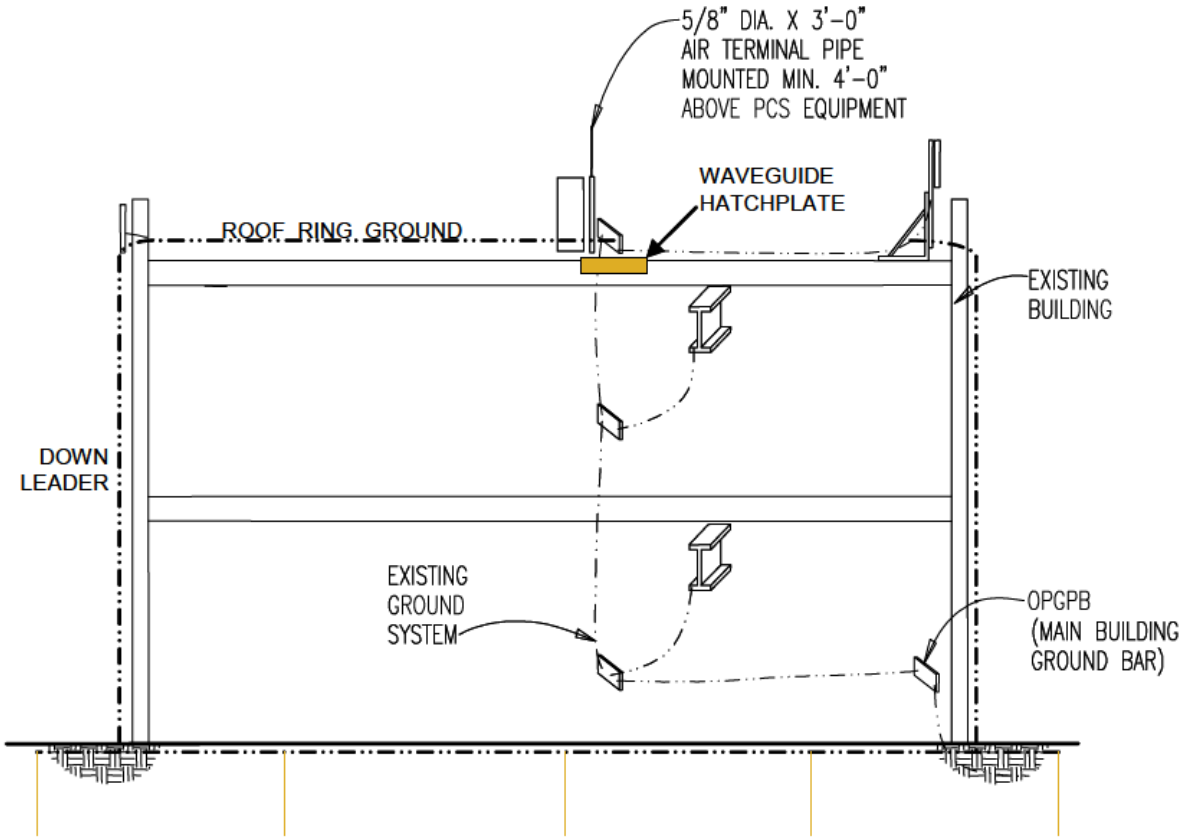
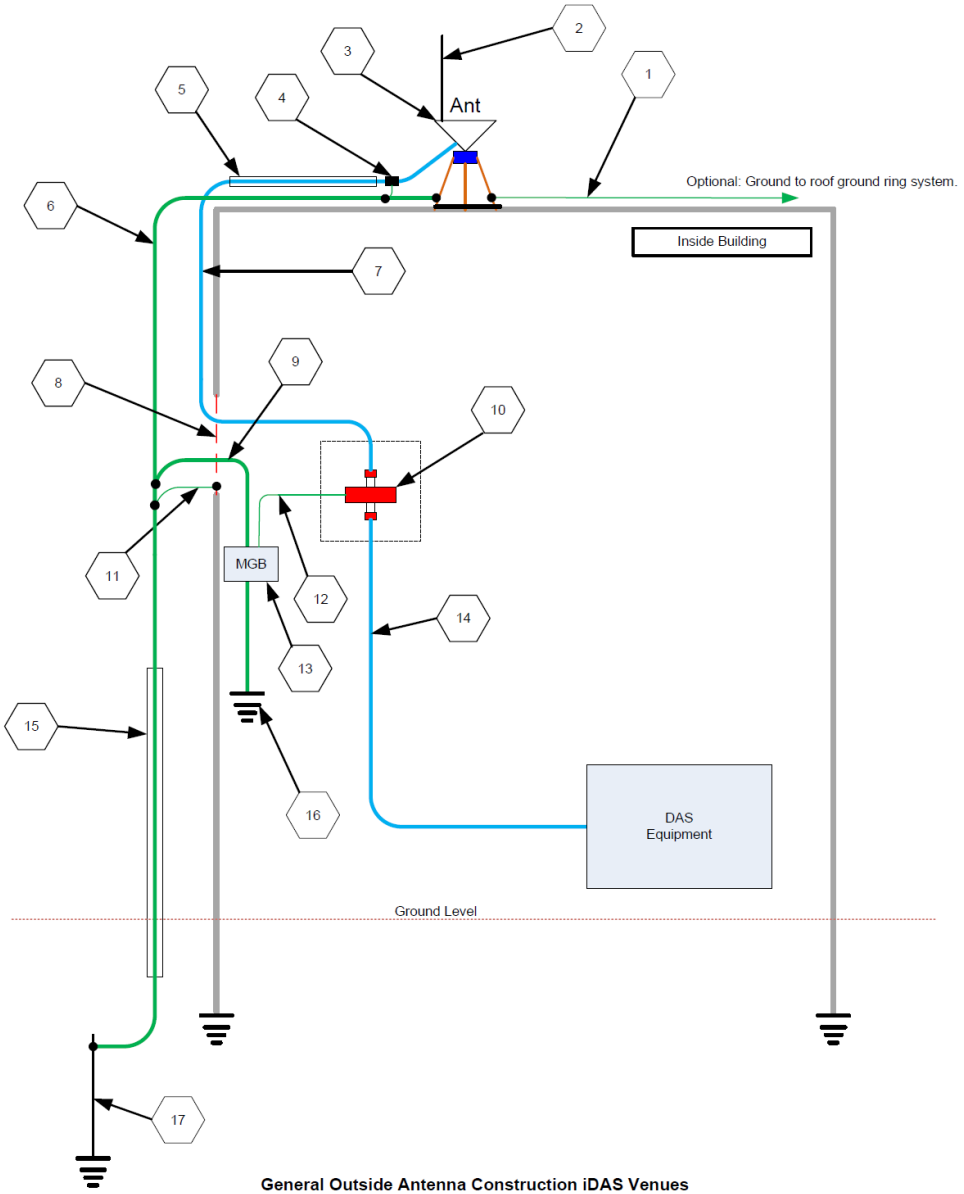


Figure 2 – Illustrative example of a larger building

Small Roof Antennae on Building



General Outside Antenna Grounding



General Outside Antenna Construction iDAS Venues

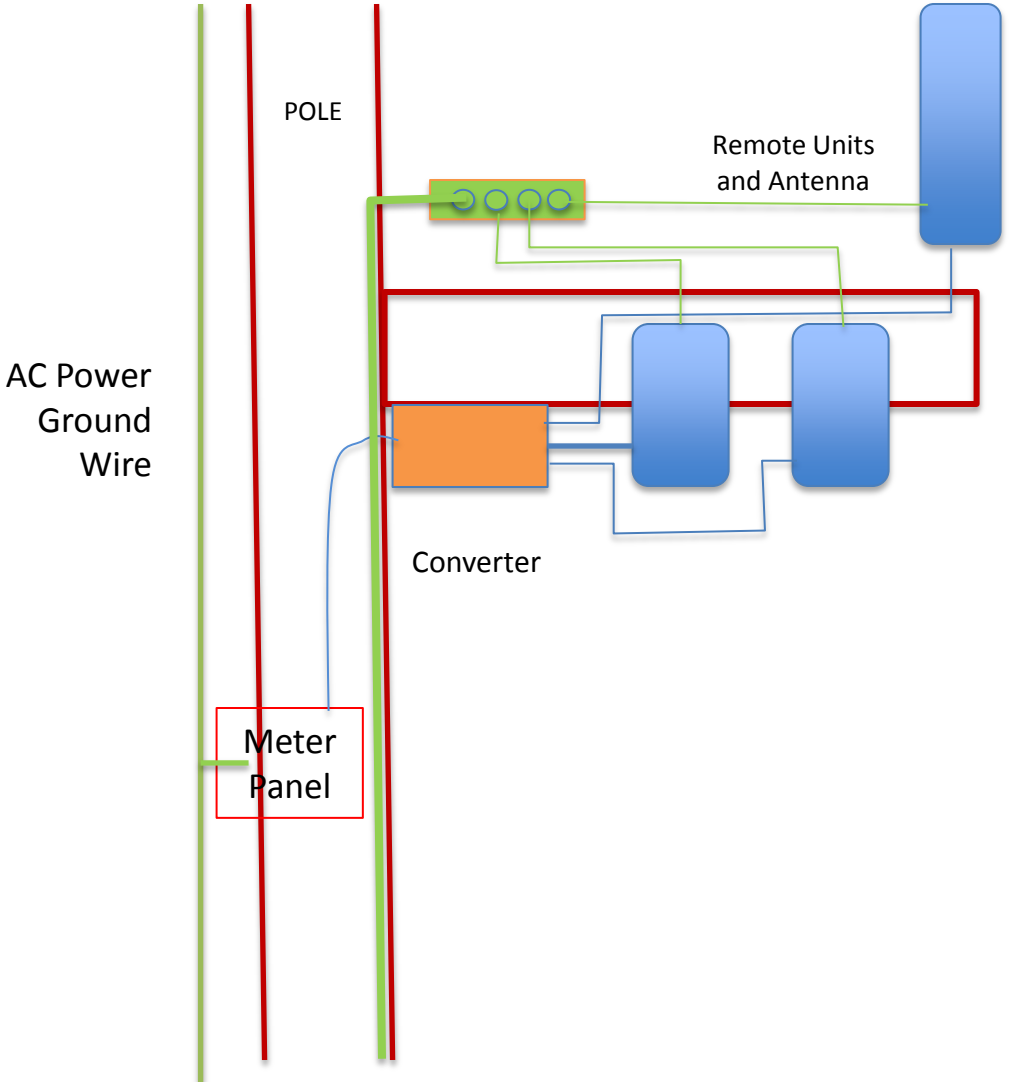
Method of Grounding of Pole Mounted Electronic

eg. Small Cells, FTTN, OSP Equipment

METHOD 1

Purist

Separate
Telecom
Ground



BONDING DONE AT GROUND

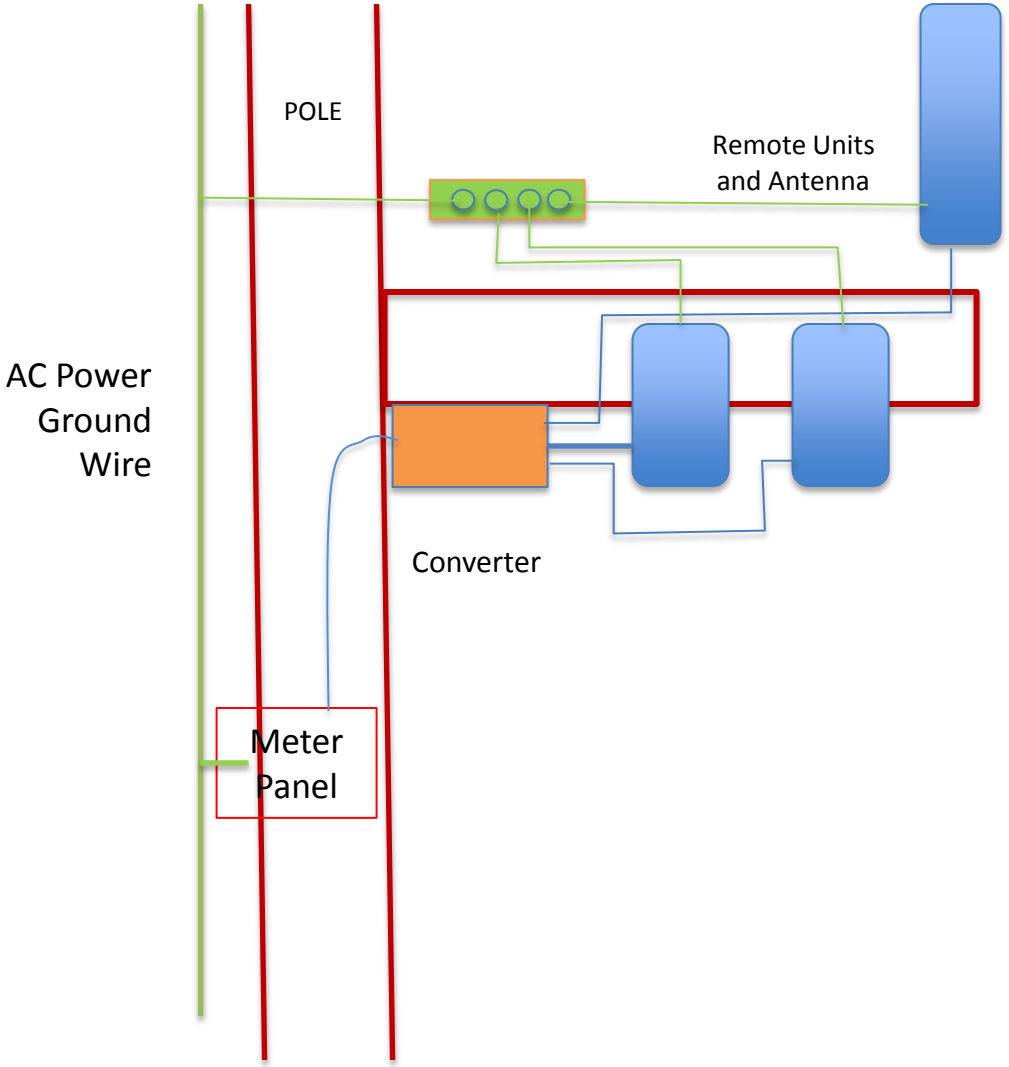
Method of Grounding of Pole Mounted Electronics

eg. Small Cells, FTTN, OSP Equipment

METHOD 2

Practical

Common AC and Telecom Ground Wire



Method of Grounding of Pole Mounted Small Cells

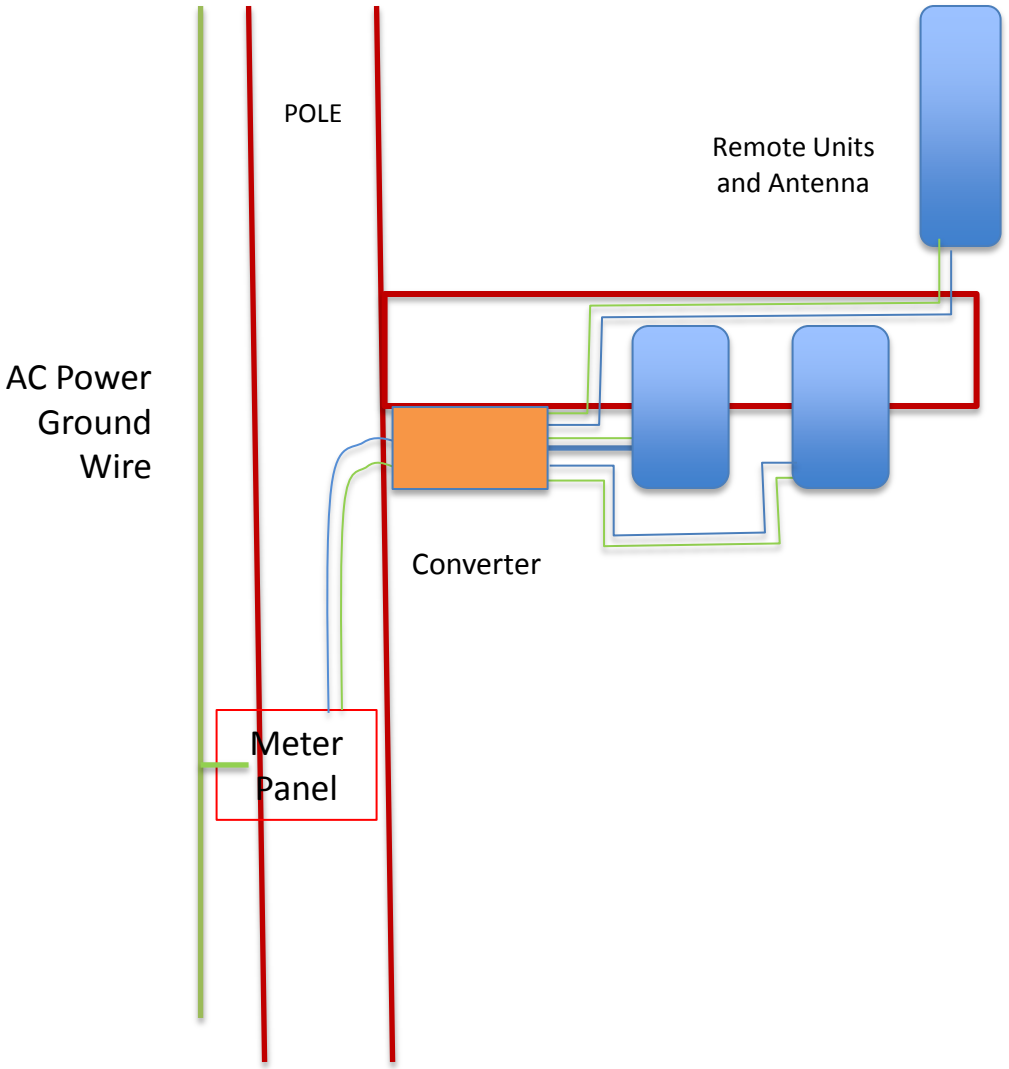
eg. Small Cells, FTTN, OSP Equipment

METHOD 3

Minimalist

Only Grounded Via Power Supply Cables

Or less still via Ground wire in POE



CASE STUDY 1: POLE MOUNTED

TELMEX MEXICO

- **Background:**
- **End User: TELMEX (Main telephone company in Mexico)**
- **Description of the Project:**

- Project 1 : Telmex needed to install Fiber equipment named TBA´s (Wide Band Terminals) mounted in poles and also the Distribution Boxes.

- Project 2 : Ground Security Camera's installed around Mexico City

TBA´S PROJECT – PURIST

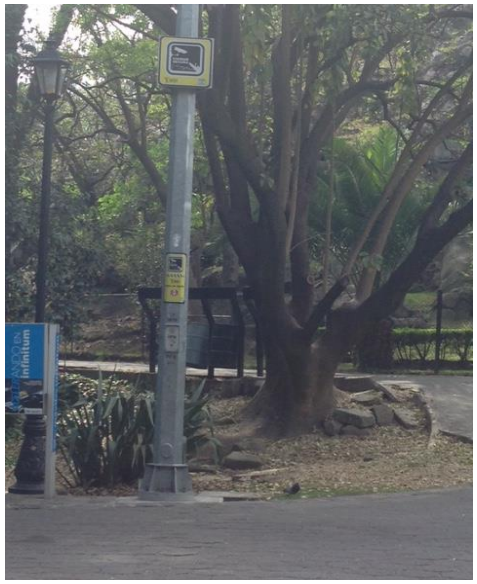
DISTRIBUTION BOX

TBA´S MOUNTED IN POLE

THE IDEA IS TO MAKE THE CADWELD PCC CONNECTION BETWEEN THE TWO GROUNDING CONDUCTORS OF THE TBA´S

TBA´S PROJECT

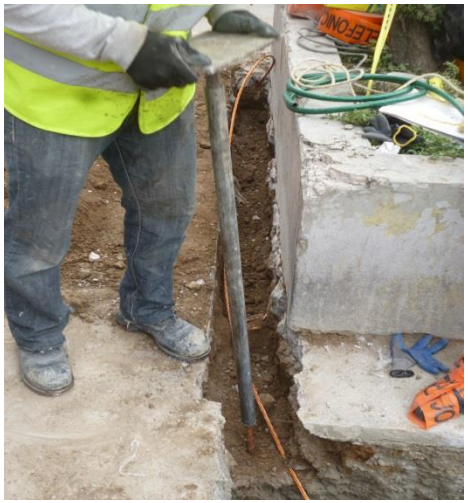
SECURE CITY PROJECT



THE OBJECTIVE IS THE GROUNDING SYSTEM OF THE SURVEILLANCE POLES SHOWN: CADWELD AND GROUND RODS. THE GROUNDING CONDUCTOR IS A COPPER CABLE.

SECURE CITY PROJECT (INST. PROCESS)

POLE BASEMENT



GROUND ROD DRIVING

TRENCH TO FEED POWER

GT CADWELD CONNECTION

INSTALLATION INSTRUCTIONS

CASE STUDY 2 : NBN National Broadband Network - Australia

NBN Co is a wholly government owned company is Australia, which was set up to provide high speed fiber access to each household and business in the country

The Initial model that the NBN was using was FTTH or FTTB

However after a change in government the company was tasked to evaluate and implement FTTN model

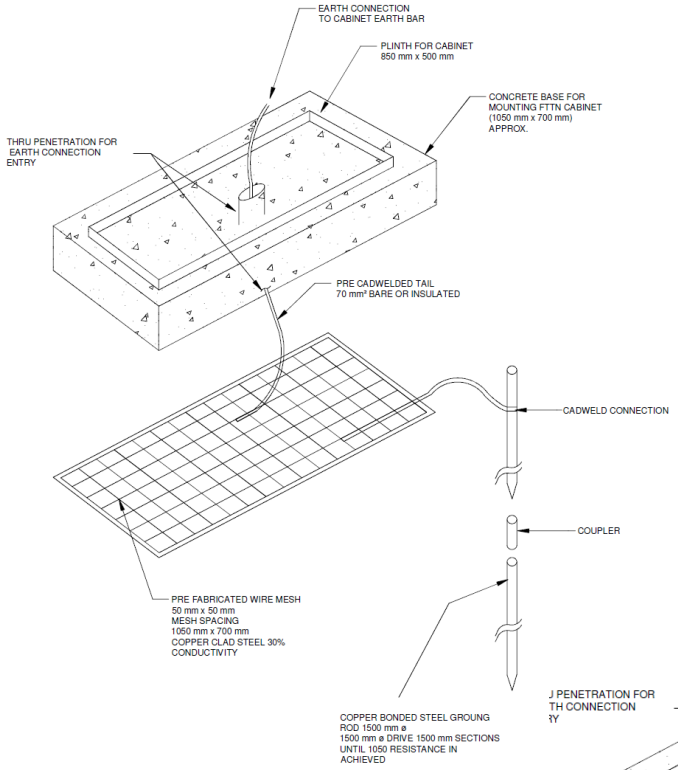
This removed the challenge of managing and grounding various power supplies in households and building powering Optical Termination Equipment

But this added the challenge of providing DC power plant at Fiber Nodes in Street Cabinets and the associated grounding

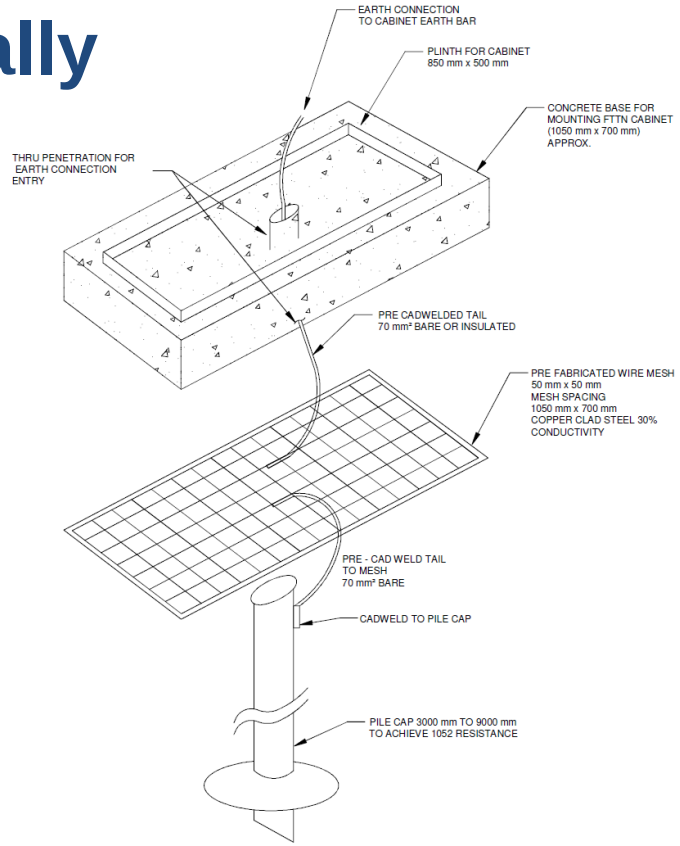
The criteria for the grounding solution

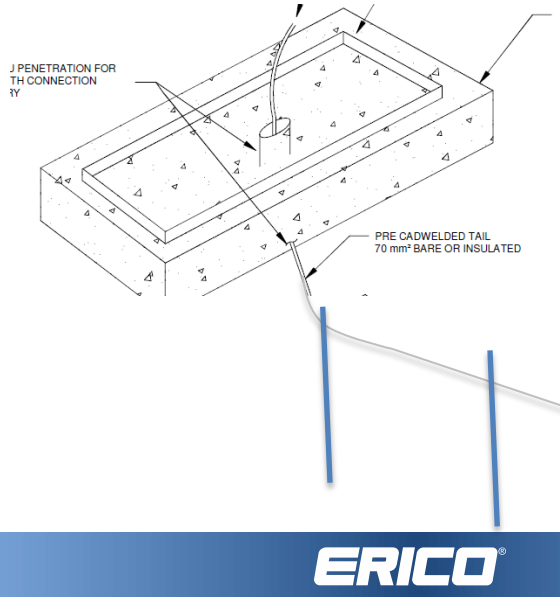
- something that met standards
- safe
- provided transient & noise control
- corrosion resistant
- theft resistant
- would not required special machinery
- the same solution at each node (Cookie Cutter)

NBN Solutions Considered Initially



- Achieve 12.5ohms
- Needed Deep driven electrodes



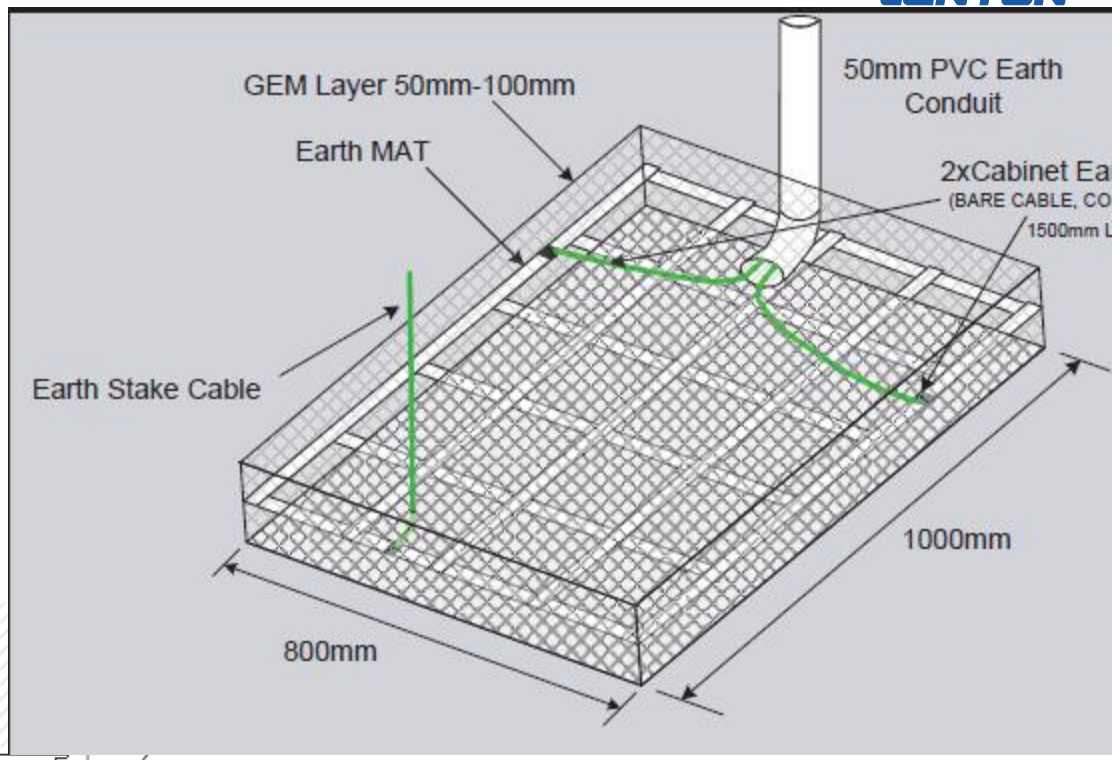


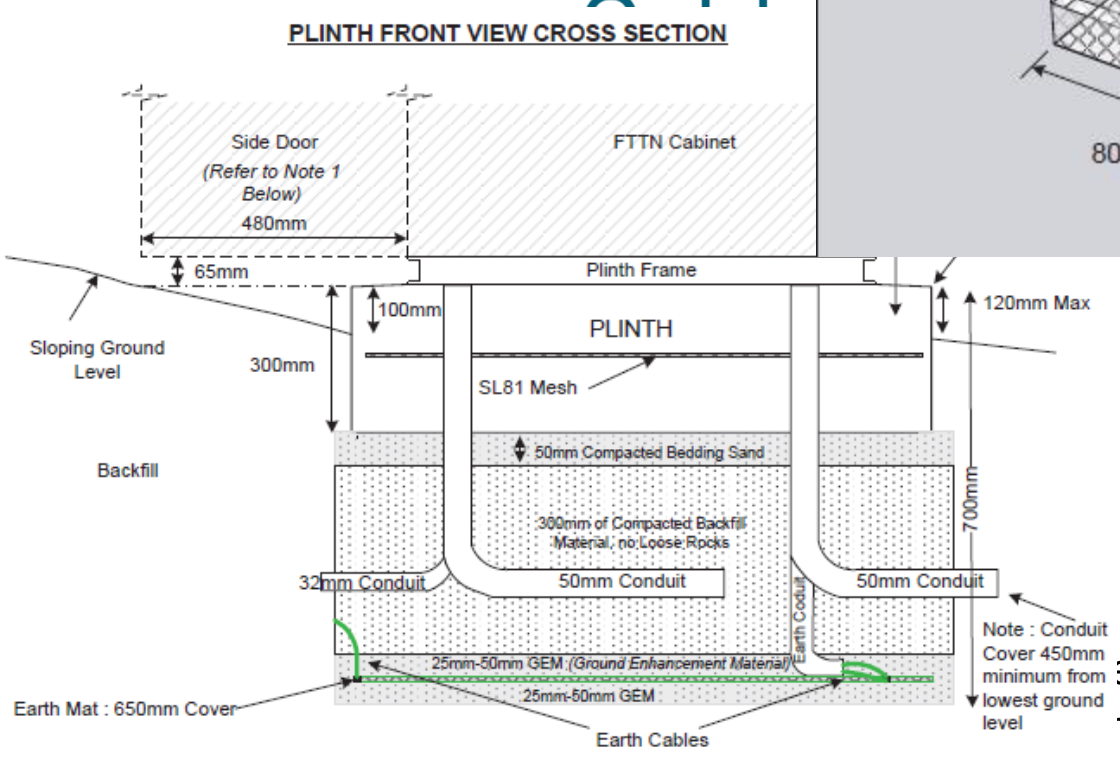
Not scalable
Difficulty in deciding no and length pf rods as sites differ
About damaging other Services

Final Solution

MESH Buried in Ground Enhancement Material Below Cabinet

Focus on Low Impedance design not absolute Resistance value

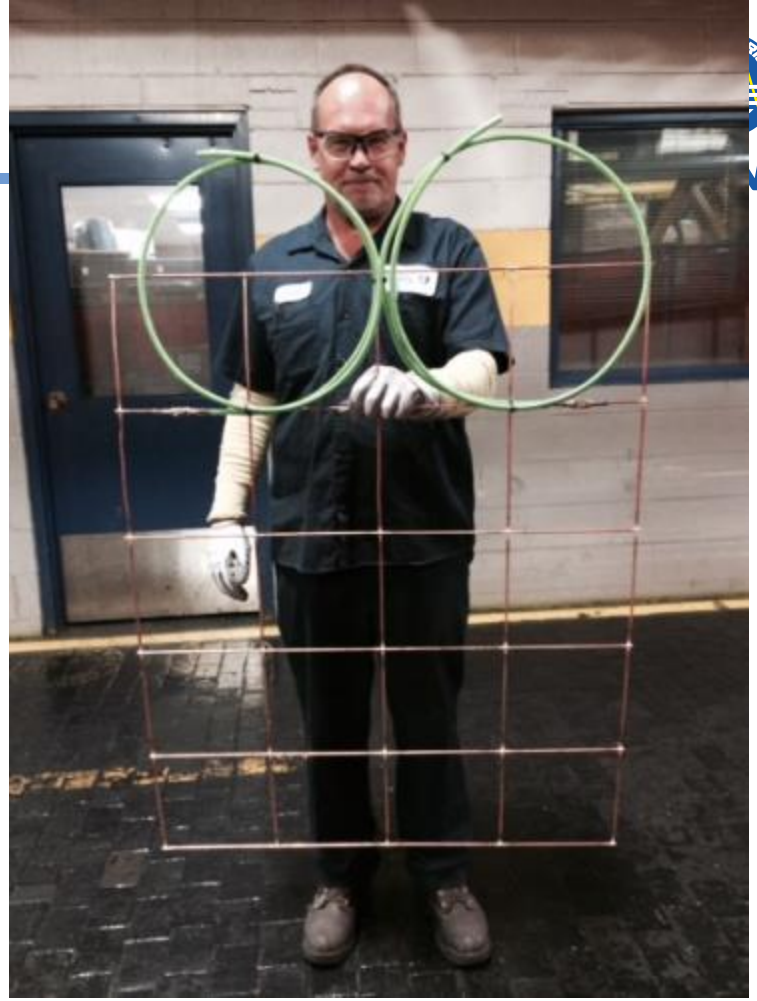




Final Solution

Figure 12 - Install the Earth Mesh

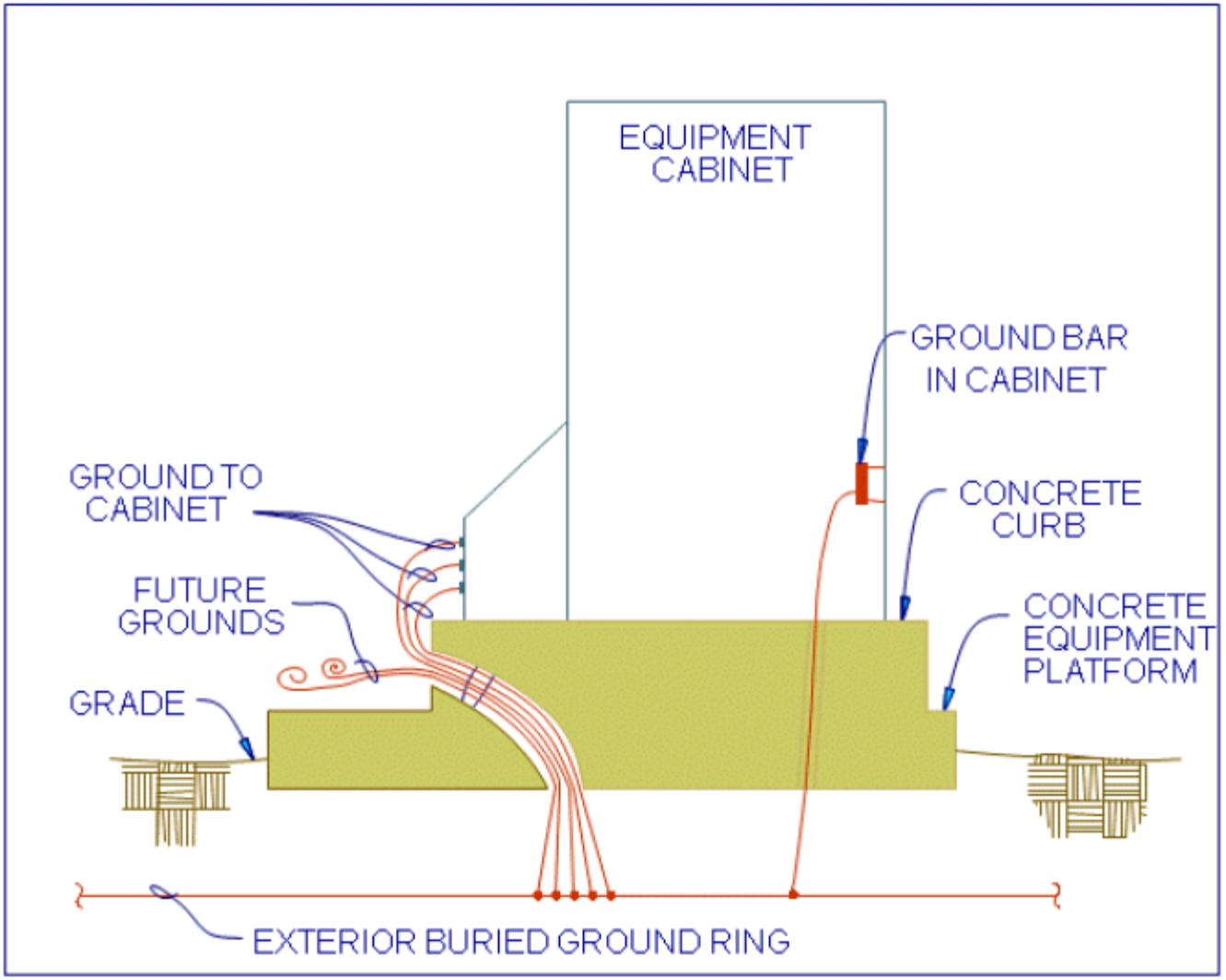
Figure 11 - Spread the GEM mixture evenly



- something that met standards
- safe
- provided transient & noise control (low impedance
- corrosion resistant (copper coated steel)
- theft resistant (Non copper, below plinth)
- would not required special machinery
- the same solution at each node (Cookie Cutter)

EXTERIOR CABINET - Telcordia GR3171

Figure 10-2 Typical Exterior Cabinet Grounding Detail



Telcordia "Generic Requirements for Network Elements Used in Wireless Networks GR3171 – CORE"

ITU K35 BONDING CONFIGURATION & EARTHING FOR REMOTE ELECTRONIC ENCLOSURES

4.2 Earthing ring for EEC

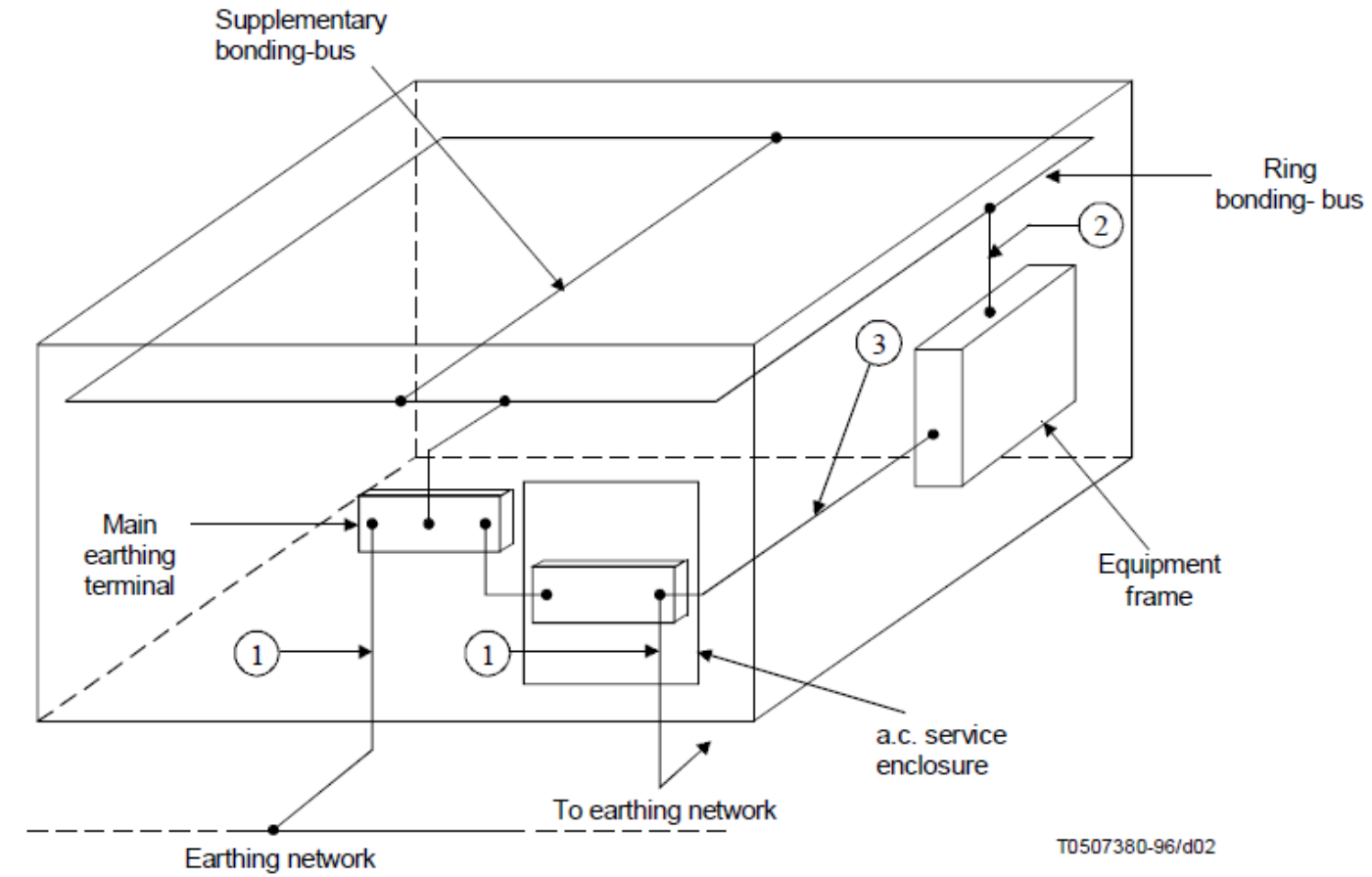
- The earthing network provides some voltage equalization in the earth near an EEC. The EEC should be provided with a buried exterior earthing ring that satisfies at least the following conditions:
  - the ring should be uninsulated, buried at a depth of 0.3 - 0.5 m;
  - the ring should encircle the foundation pad of the EEC or be located below the perimeter of the pad;
  - one uninsulated earthing conductor should connect the ring to the Main Earthing Terminal

NOTE – National safety rules may require additional rod electrodes and/or additional connections to the a.c. power service entrance.

4.3 Concrete-encased earth electrode

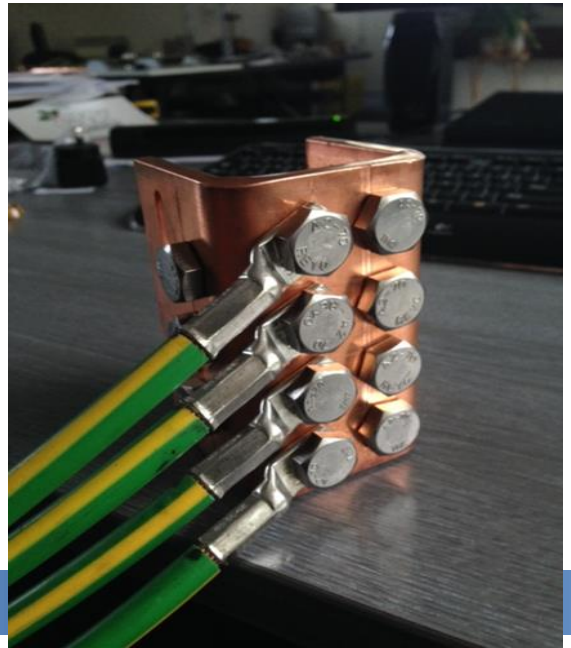
- An EEE often rests on a foundation earth electrodeor is itself constructed of concrete. In this case, the reinforcement or conductor may be used in place of the earthing ring of subclauses

ITU K35 BONDING CONFIGURATION & EARTHING FOR REMOTE ELECTRONIC ENCLOSURES



① Earthing conductor
② Equipment bonding conductor
③ Protective conductor

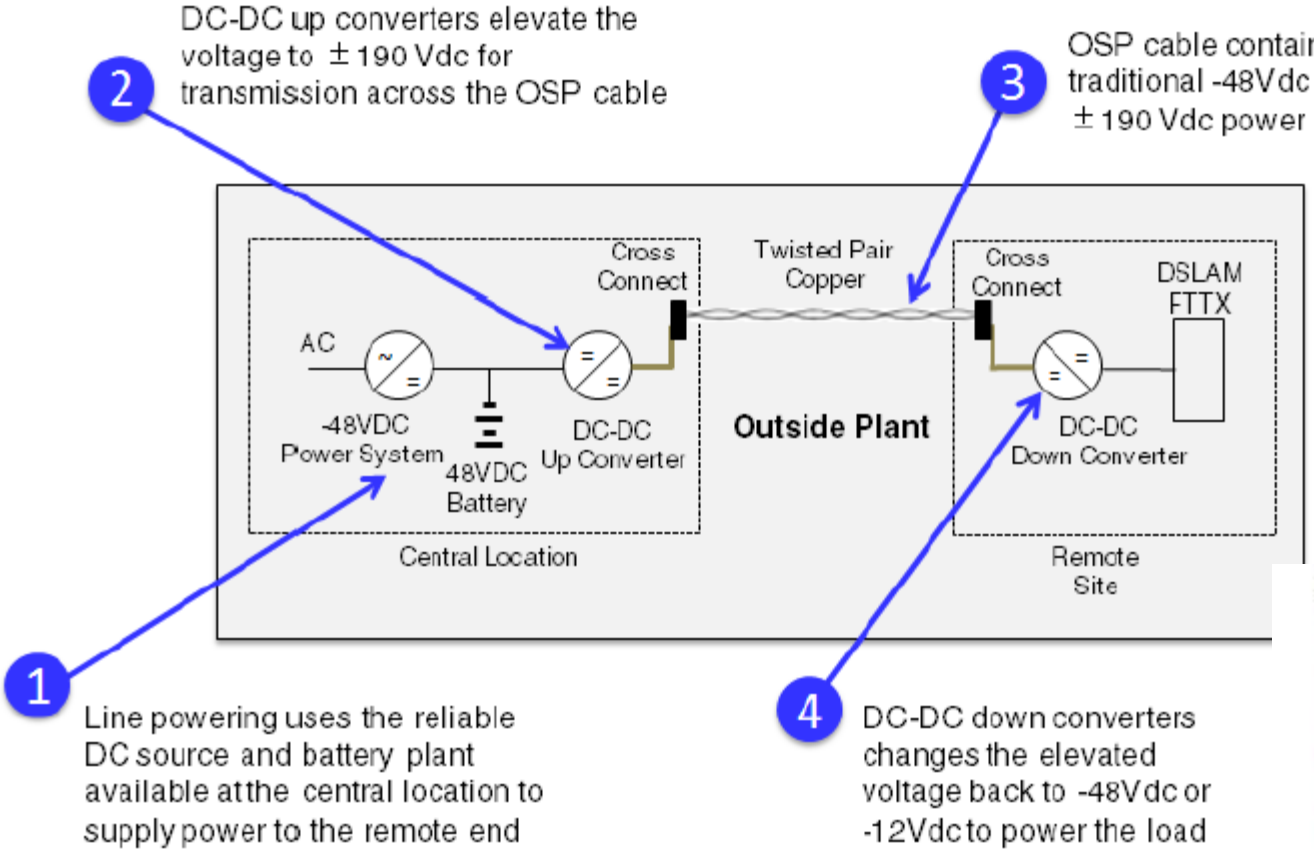
GROUNDING OF REMOTE RADIO HEADS



CASE STUDY 3

SINGTEL OPTUS

PROTECTION OF LINE POWER SYSTEMS

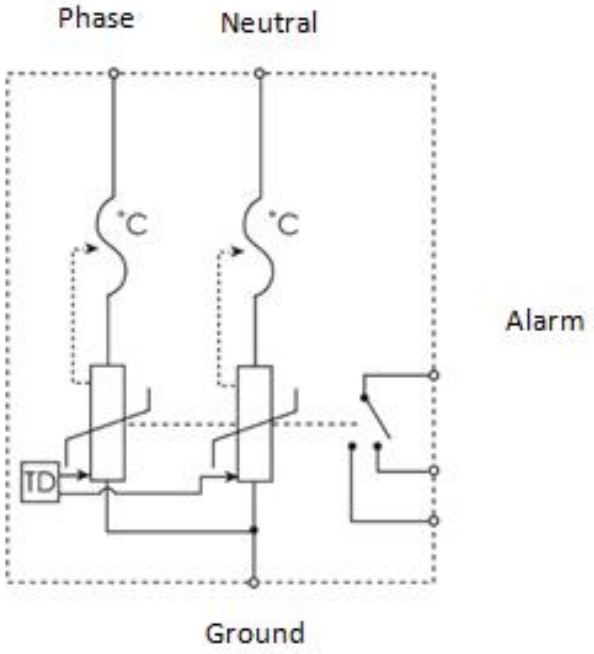


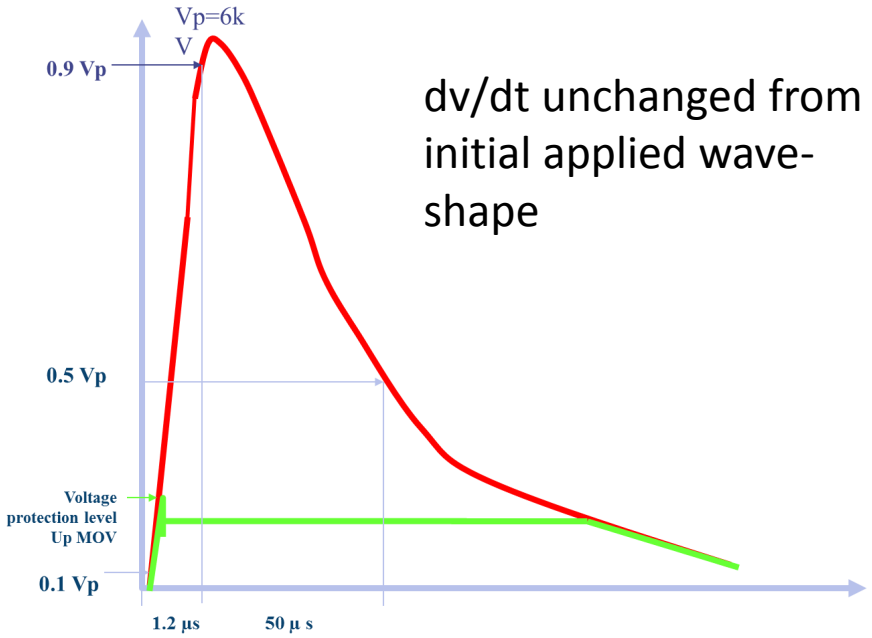
Courtesy of Alpha Technologies

Need for SPD in Industry to Protect +/- 190V Balanced Pairs to Equioment

PROTECTION OF REMOTE ELECTRONIC ENCLOSURES

- **Conventional SPD Technology (AC Power)**
  - **Shunt Connected**
  - **Can be MOV or SAD**
  - **Space Constraint in Remote Box to Coordinate 2 tiers of Surge Protection**



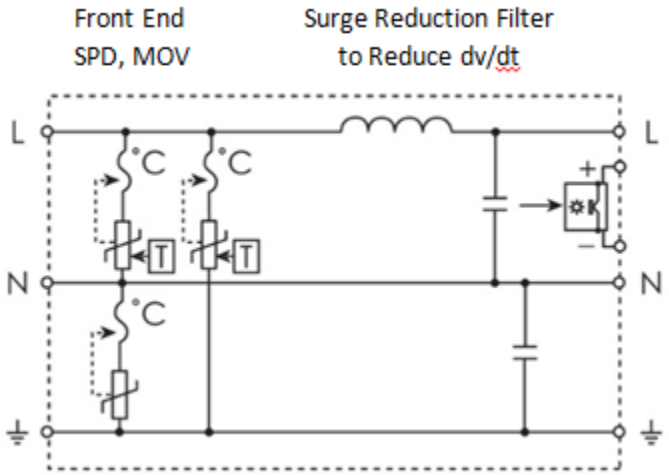


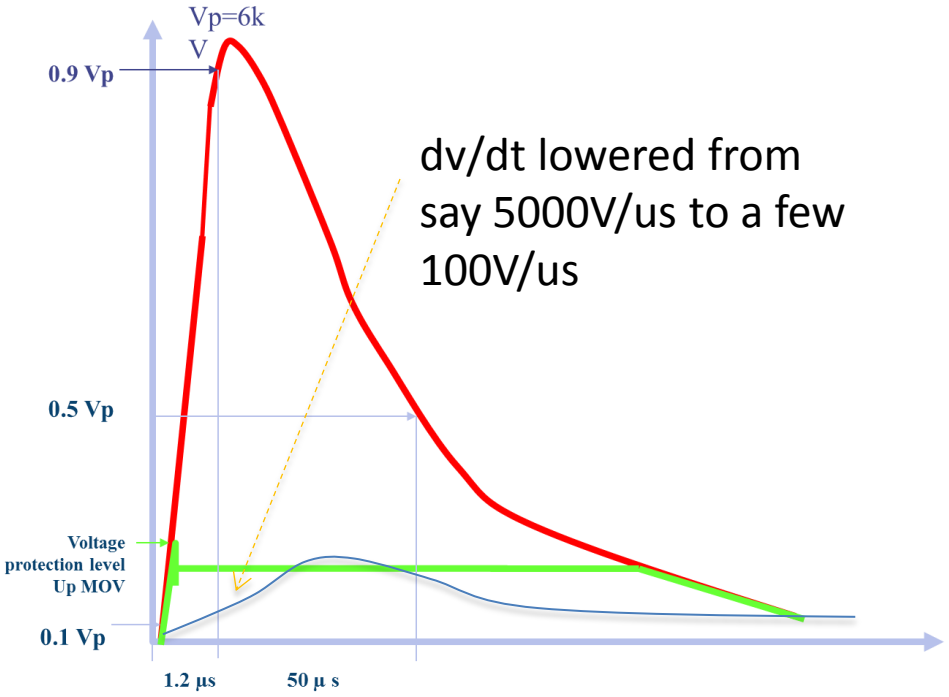
dv/dt unchanged from initial applied wave-shape

PROTECTION OF REMOTE ELECTRONIC ENCLOSURES

Surge Reduction Filter Technology

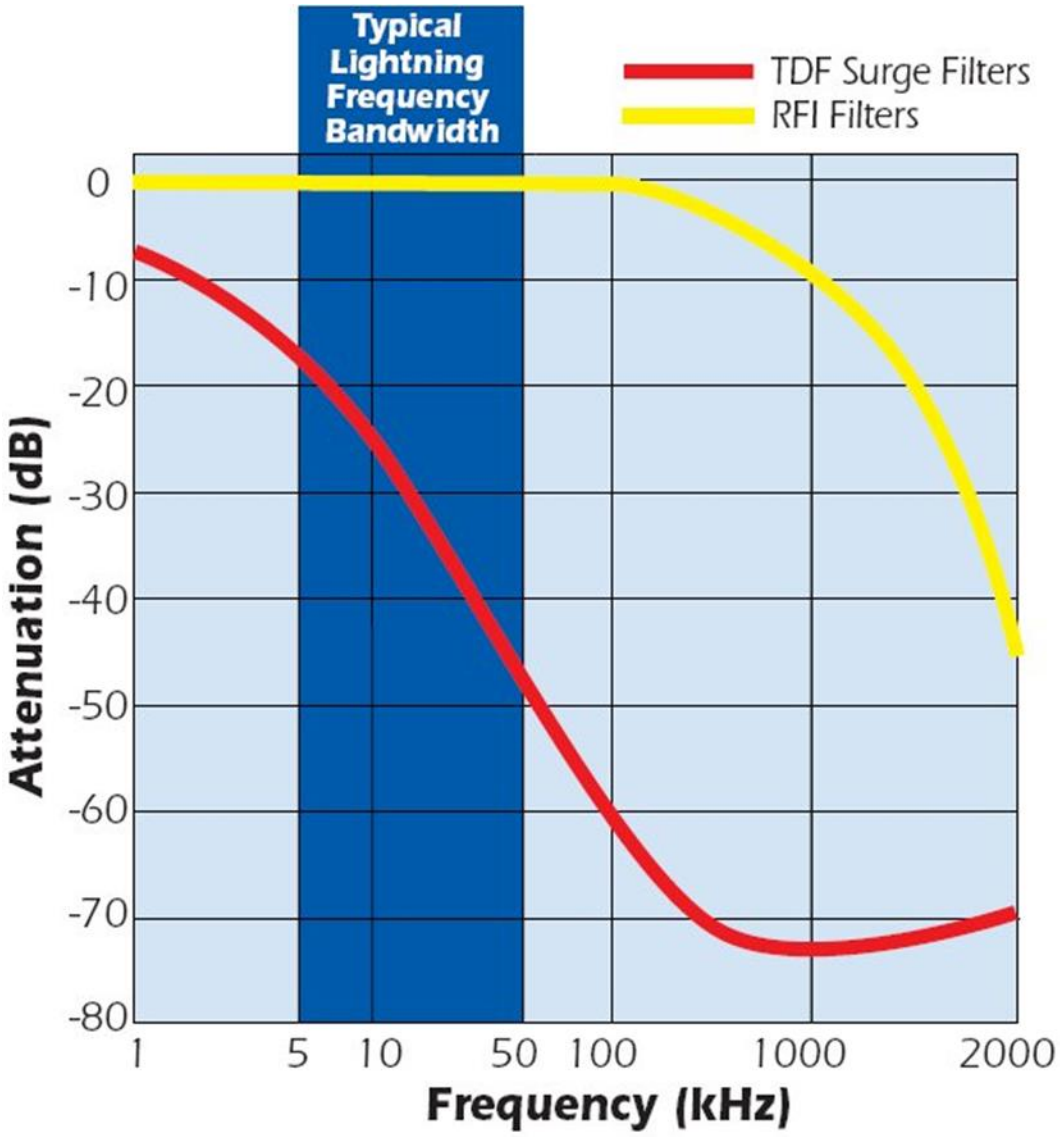
- Lower Vpr
- Lower di/dt
- Suited for small spaces where there is no opportunity to cascade 2 tiers of protection





dv/dt lowered from say 5000V/us to a few 100V/us

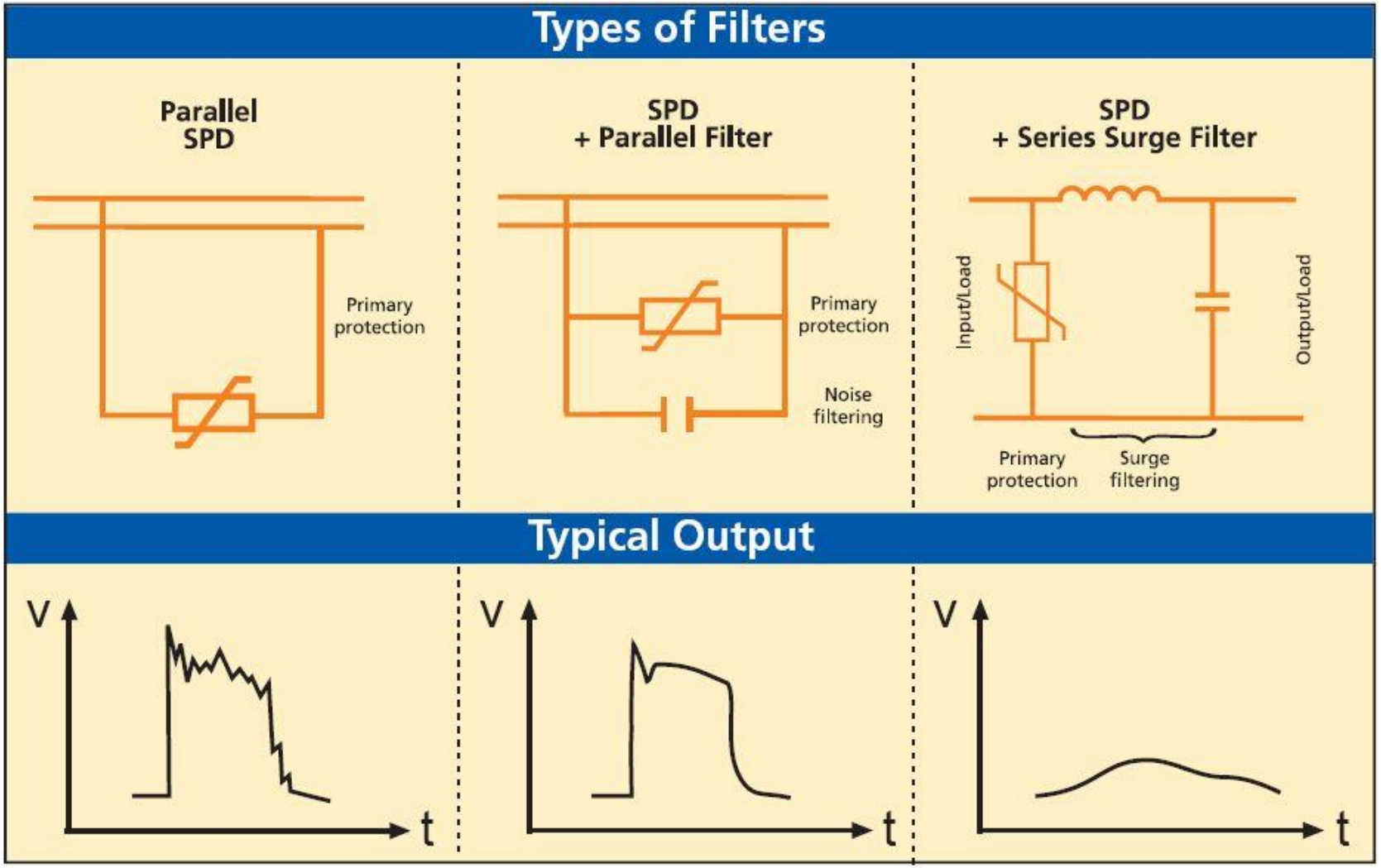
PROTECTION OF REMOTE ELECTRONIC ENCLOSURES



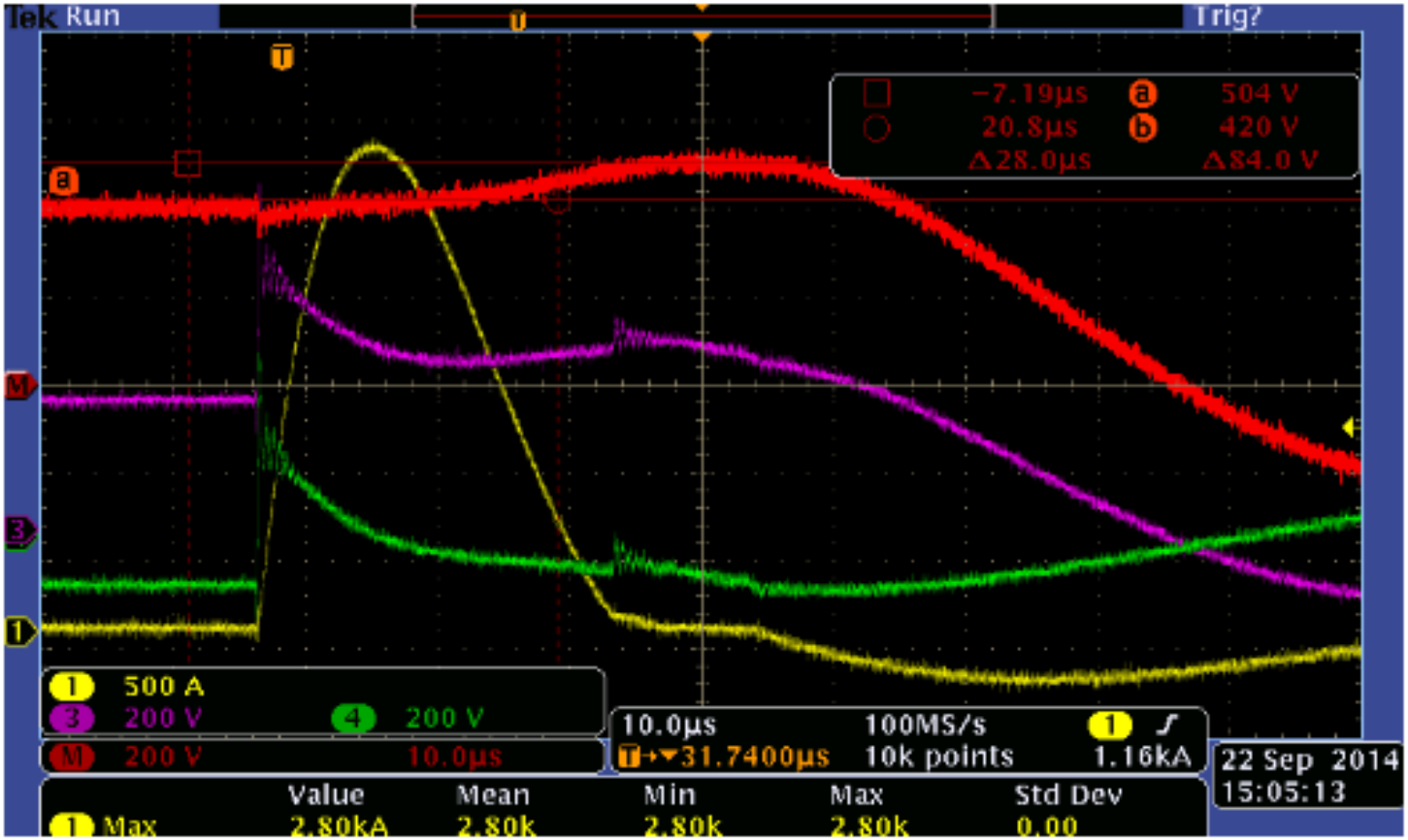
Performance Variance Between Filters

Mode	3 dB Frequency (Hz)	100 kHz Gain (dB)
(L-N)	6500	-41.10
(L-PE)	20000	-15.09
(L-N)	3250	-48.83
(L-N(PE))	N/A	0.00
(L-N)	190000	-1.43
(L-N)	7000	-22.63
(L-N)	25500	-12.14
(L-L)	N/A	1.00
(L-PE)	7000	-25.68
(L-PE)	6500	-20.36
(L-N)	16250	-19.94
(L-N(PE))	N/A	0.00
(L-PE)	14000	-16.30

PROTECTION OF REMOTE ELECTRONIC ENCLOSURES



PROTECTION OF REMOTE ELECTRONIC ENCLOSURES



Summary

- Large parts of telecommunication network now sit at customer premises on poles and roadside cabinets
- Grounding and protection practices for these elements vary.
- Looked at Grounding of :
  - DAS
  - Pole Mounted Electronics, Small Cells, FTTN – Case Study
- Cabinet Grounding - FTTN – MESH example
- RRH Grounding Case Study
- In future consider SPD for Line Power Equipment
- Surge reduction filter can be used to replace coordinated protection to get low Vpr and low dv/dt