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
• Grounding of DAS Systems
• Grounding of Small Cells – Pole Mounted
• Case Study – Grounding of FTTN Cabinet NBN Australia
• Method of Cabinet Grounding – Telcordia and ITU
• Case Study – grounding of Pole Mounted FTTN and Surveillance equipment, Telmex Mexico
• RRH Grounding – Singtel (OPTUS) Australia
• Need for surge protection on Line Power Equipment +/-190V
• Traditional surge protection vs Filtering benefits in confined spaces
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

Inside Halo

Outside Ground Ring

MGB
Benefits of Halo – Parallel to Building Steel

- Halo Rings Create Faraday Cages
- Halos Block/Inhibit RF And Lightning Fields (Magnetic Fields)
- Halos Incorporate Isolated Grounding
- No Active Equipment Can Be Attached
- A Building Can Act As A Faraday Cage
- DAS May Not Need A Halo Ring
A Comparison Of Halo And COG
Similar to TIA 607

Relevant to Customer Premises Grounding

(As opposed to Carrier Network Grounding)
Small Roof Antennae on Building

5/8" DIA. X 3'-0" AIR TERMINAL PIPE MOUNTED MIN. 4'-0" ABOVE PCS EQUIPMENT

WAVEGUIDE HATCHPLATE

EXISTING BUILDING

DOWN LEADER

EXISTING GROUND SYSTEM

CPGFB (MAIN BUILDING GROUND BAR)
General Outside Antenna Grounding
Method of Grounding of Pole Mounted Electronic
eg. Small Cells, FTTN, OSP Equipment

**METHOD 1**

**Purist**

- Separate Telecom Ground
- AC Power Ground Wire
- Converter
- Remote Units and Antenna

**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

AC Power Ground Wire

POLE

Converter

Remote Units and Antenna

Meter Panel
Method of Grounding of Pole Mounted Small Cells
e.g. Small Cells, FTTN, OSP Equipment

METHOD 3

**Minimalist**

Only Grounded Via Power Supply Cables

Or less still via Ground wire in POE
• 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
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
### PLAN DE CONTROL SISTEMA DE TIERRA

#### ACTIVIDAD

<table>
<thead>
<tr>
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### UNIÓN DE DOS CABLES DE ACERO GALVANIZADO DE 4/0 EN DERIVACIÓN

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CASE STUDY 2 : NBN National Broadband Network - Australia

NBN Co is a wholly government owned company in 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

- 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)

Figure 11 - Spread the GEM mixture evenly

Figure 12 - Install the Earth Mesh
Telcordia “Generic Requirements for Network Elements Used in Wireless Networks GR3171 – CORE”
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 electrode or is itself constructed of concrete. In this case, the reinforcement or conductor may be used in place of the earthing ring of subclauses.
Need for SPD in Industry to Protect +/-190V Balanced Pairs to Equipment

PROTECTION OF LINE POWER SYSTEMS

DC-DC up converters elevate the voltage to ±190 Vdc for transmission across the OSP cable.

OSP cable contains both traditional -48Vdc and ±190 Vdc power.

Line powering uses the reliable DC source and battery plant available at the central location to supply power to the remote end.

DC-DC down converters change the elevated voltage back to -48Vdc or -12Vdc to power the load.

Courtesy of Alpha Technologies
• Conventional SPD Technology (AC Power)
  – Shunt Connected
  – Can be MOV or SAD
  – Space Constraint in Remote Box to Coordinate 2 tiers of Surge Protection

\[ \text{dv/dt unchanged from initial applied wave-shape} \]
Surge Reduction Filter Technology

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

\[ \text{dv/dt lowered from say 5000V/us to a few 100V/us} \]
PROTECTION OF REMOTE ELECTRONIC ENCLOSURES

Performance Variance Between Filters

<table>
<thead>
<tr>
<th>Mode</th>
<th>3 dB Frequency (Hz)</th>
<th>100 kHz Gain (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(L-N)</td>
<td>6500</td>
<td>-41.10</td>
</tr>
<tr>
<td>(L-PE)</td>
<td>20000</td>
<td>-15.09</td>
</tr>
<tr>
<td>(L-N)</td>
<td>3250</td>
<td>-48.83</td>
</tr>
<tr>
<td>(L-N(PE))</td>
<td>N/A</td>
<td>0.00</td>
</tr>
<tr>
<td>(L-N)</td>
<td>190000</td>
<td>-1.43</td>
</tr>
<tr>
<td>(L-N)</td>
<td>7000</td>
<td>-22.63</td>
</tr>
<tr>
<td>(L-N)</td>
<td>25500</td>
<td>-12.14</td>
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<tr>
<td>(L-L)</td>
<td>N/A</td>
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<tr>
<td>(L-PE)</td>
<td>7000</td>
<td>-25.68</td>
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<tr>
<td>(L-PE)</td>
<td>6500</td>
<td>-20.36</td>
</tr>
<tr>
<td>(L-N)</td>
<td>16250</td>
<td>-19.94</td>
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<tr>
<td>(L-N(PE))</td>
<td>N/A</td>
<td>0.00</td>
</tr>
<tr>
<td>(L-PE)</td>
<td>14000</td>
<td>-16.30</td>
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</table>
# Protection of Remote Electronic Enclosures

## Types of Filters

<table>
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<tr>
<th>Filter Type</th>
<th>Description</th>
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<tbody>
<tr>
<td>Parallel SPD</td>
<td>Primary protection</td>
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<tr>
<td>SPD + Parallel Filter</td>
<td>Primary protection, Noise filtering</td>
</tr>
<tr>
<td>SPD + Series Surge Filter</td>
<td>Input/Load, Surge filtering</td>
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## Typical Output

- **Parallel SPD**: Primary protection
- **SPD + Parallel Filter**: Primary protection, Noise filtering
- **SPD + Series Surge Filter**: Input/Load, Surge filtering
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