Considerations for Remediating an Overstressed Mount

With the evolution and advancement of wireless cellular technology, carriers are deploying more equipment on cell sites than ever before. These increased equipment loads require additional structural capacity from both the towers themselves and the mounts affixed to them. To keep pace with these changes, structural design standards now contain enhanced focus on the capacity of appurtenance mounting systems. Subsequently, this has led to a better understanding of the importance of structural evaluations of mounting systems and other appurtenances.

> Due to the manner in which mounts/appurtenances are being loaded, existing mounts may not have sufficient structural capacity to handle the additional equipment that today's networks demand.

Evaluation of proposed loading changes can show the mount to be non-compliant with the requirements of ANSI/TIA-222. Those mounts found to have insufficient capacity will need to be modified or replaced in order to comply with these requirements. There are many factors to consider when deciding which solution to pursue (modification or replacement) and this PAN will provide insight on some crucial considerations that should help in making an informed decision. The implications of both mount remediation solutions (reinforcement and replacement) will be discussed with respect to project costs, network interruption, construction considerations, site acquisition efforts, site design

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and other business needs.

Determining Mount Modification or Replacement

When deciding whether a mount system should be replaced or modified, safety and code compliance are paramount in addition to speed-to-market and costs considerations. The following are some key factors to consider:

Construction Considerations

- Equipment Reinstallation: Removing and re-installing existing equipment represents a significant portion of overall costs for both modification and replacement options. Even if exact bids are procured, these quotes are unlikely to include the cascading effects of the chosen solution on the larger project. In addition to the labor expense of such re-installations, outage time, carrier outage approval processes and the customer impact must be considered. If equipment must be taken off-air for a substantial period of time in order to install a new mount system, the carrier may require a temporary site to be erected during construction to maintain coverage which could in turn incur extra delays and costs. Another consideration to be assessed is the cost associated with system performance issues- in many cases, existing operating A&L (antenna and line) systems must be temporarily disconnected in order to replace the mount. When the system is restored, system performance issues often suddenly appear on what had previously been a properly-functioning system.
- Adjacent Equipment: Depending on what members were found to be deficient in the analysis and the extent of the overstress, mount modifications may need to be installed immediately above or below the mount location. If other equipment is installed in close vertical proximity to the mount, the modification design must adjust accordingly and costs could be significantly impacted.
- Previous Modifications/Inspections: If a mount has been previously upgraded, these modifications should weigh into the decision of the mount remediation path. Post-modification inspections (PMI's) and any other available mount information should be provided to the Engineer of Record (EOR) to be evaluated. If the effectiveness of legacy installations is found to be deficient with the additional loads, then potential removal or replacement of such mod-

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PLATFORM REINFORCEMENT
Support rail addition - before.

PLATFORM REINFORCEMENT
Support rail addition - after.

PLATFORM REPLACEMENT
Before.

PLATFORM REPLACEMENT
After.

ifications must be considered when compiling mount modification cost estimates. Moreover, it is recommended that post-modification inspections (PMI's) be implemented to ensure new installations are compliant with the design requirements. This recommendation applies to both new mount installations (to confirm conformance to manufacturer design) as well as reinforcement kit installations on existing mounts (to check compliance to EOR specified design).

Site Acquisition Impacts

- Leased Area: In cases where network providers lease space from tower companies, the leased areas are often allocated in terms of vertical linear space and/or equipment and mount characteristics. If the overall footprint of the mounts expands and/or if additional vertical lease space is required in order to accommodate mount modifications or an entire new mount assembly, care should be taken to consider the potential effects on the lease agreement, if any.
- Site Aesthetics: Local municipal or landlord-specific requirements may exist for the overall aesthetic appearance of the site, of which the visual profile of the mount plays a part. If aesthetic components are present, they may need to be re-installed after replacing or modifying the mount. The costs and time involved in this undertaking may be significant. In short, any applicable jurisdictional or landlord requirements should be considered during the mount evaluation process.
- Structural Capacity of the Associated Tower Structure: Modifications made to mount systems will add weight and wind loading to the supporting structure. If the tower is approaching its maximum structural capacity, adding mount modifications could increase the loading enough to trigger the need for a modification on the tower as well, which introduces more time and expense to the project. Mounts currently in production are typically designed to be lighter and lower profile than in the past, so replacing the entire mount assembly may actually have less of an impact on the tower structural capacity than would modifying the existing mount. However, capacities of new replacement mounts still vary widely across mount types and manufacturers, so care must be taken to compare the capacities between existing modified mounts and potential replacement mounts. Depending on the type of supporting structure, the type of mount system present, the location

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PLATFORM REPLACEMENT
3 sided platform replaced with 4 sided platform - before.

PLATFORM REPLACEMENT
3 sided platform replaced with 4 sided platform - after.

T-ARM REINFORCEMENT
Before.

T-ARM REINFORCEMENT
After.

at which the mount is affixed to the structure, and the type of connection attaching the mount to the structure, any mount remediation may also introduce or alter local stresses on the structure.

- Site Geographic Location: Federal, state, or other jurisdictional requirements vary by location. Any applicable height restriction or other regulatory requirements must be considered in the modification or replacement decision process. A site's physical location characteristics can drastically affect mount capacities. The EOR evaluating existing or proposed mounts must account for all topographic effects, exposure, ice and wind load requirements. To ensure standardization, a mount system's capacity as stated by the manufacturer will assume a certain maximum height AGL, wind speed, and exposure category, but usually does not consider any topographic effects. A site will likely deviate from these manufacturer's assumptions in at least one way (i.e. site's location on a coastline classifies it as Exposure D, while manufacturer capacity rating was for Exposure C), so it is imperative to factor in those geographical considerations when comparing mount remediation options. In short, a manufacturer mount capacity letter should be used as a reference starting point, not blanket-applied to every site.

Site Design and Business Needs

- Mount Design Optimization and RF Design Compatibility: Based on the relative size and weight of the equipment as compared to the mount structure, mounts are inherently sensitive to loading changes. Even small adjustments to the proposed equipment (in any plane) can have a large impact on the mount's structural capacity. To maximize a mount's usage, it is important to optimize equipment placement both vertically and horizontally according to the mount's structural properties. However, maximizing the structural capacity of the mount must be balanced with the RF design for the site. Consideration of both structural load optimization and RF design requirements must occur in tandem.

- Future Site Growth: Keeping in mind future projects and site needs is important when considering modification and replacement options. Short-term cost savings must be weighed against long-term network needs.

- Speed to Market: Site-specific circumstances

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T-ARM REPLACEMENT
T-arm replaced with sector frames - before.

T-ARM REPLACEMENT
T-arm replaced with sector frames - after.

T-ARM REPLACEMENT
Before.

T-ARM REPLACEMENT
After.

will dictate whether a modification or replacement is the fastest solution to deploy. Properly managed, mount upgrades can be more efficient than mount replacements due to the coordination involved in a replacement- but this is not always the case and each circumstance should be individually evaluated. If the project for which the mount was analyzed has time constraints requiring accelerated builds, end users may be inclined to choose the higher-cost solution if that solution is sufficiently faster than the other available options. Safety should always be in the forefront in this decision as well.

- Maintenance Activity: The engineer evaluating the mounts should consider whether tower climber access will be impacted by potential mount modifications. If a tower climber's equipment access is impeded due to the addition of mount reinforcements, end users may need to resort to alternative access methods such as man-lifts or cranes. These alternate means typically require additional coordination and resources.

Stakeholder Involvement

The process by which mount remediations are selected will vary depending on an end user's organizational structure. The hierarchy and sequence of communication may fluctuate. But despite these variations, the below list of subject matter experts (SME's) and/or stakeholders should be consulted at some point during the mount evaluation process:

- Engineer of Record (EOR): The end user should engage qualified engineers that have experience in the analysis and assessment of mounts. Since the EOR is usually the project participant who identifies the need for remediation in the first place, the initial recommendations are usually made by the EOR according to the failure mode and extent.
- Site Acquisition: This stakeholder should assess risks associated with each identified potential solution based on their knowledge of the site-specific leasing, zoning and permitting constraints.
- Regulatory: Mount remediation activity should be noted in the project scope of work that is reviewed by regulatory stakeholder(s) to ensure that the effects of such activity conform to applicable regulatory requirements.
- Mount Manufacturer(s): End users and/or the EOR should confer with manufacturers of the mount systems or reinforcement solutions under consideration to determine what materials, parameters, restraints, goals and assumptions were used in their design process. This will enable the end user to evaluate mount products against their own organizational or network design standards, market preferences, and geographical conditions.
- Site Construction, Installation and Maintenance: After potential solutions have been identified, construction SME(s) should determine the approximate cost, duration and resources needed for the installation of each solution in accordance with applicable regulations and industry standards. Identified mount modification solutions should also be evaluated for potential interference with site maintenance activities.
- RF Design/Optimization: The network design engineers can provide insight on the likely future RF development of the site. Also, if the EOR has determined that a change to the RF configuration would positively impact the mount's capacity, the RF engineer should evaluate the proposed changes' impact to the network and determine whether those changes are acceptable.

Conclusion

End users will be empowered to make the best business decision for their sites requiring mount remediation by considering each factor discussed above. Since many of these considerations are multi-disciplinary in nature, it is recommended that end users engage multiple parties with expertise in the various aspects of the site deployment process. These SME's may reside within the end user's organization, or the end user may consult external vendors on these project aspects.

During this process, different groups within the same organization may prioritize factors differently based on group-specific business objectives. Therefore, interdisciplinary communication on this decision is imperative so that a cohesive solution can be reached. Such cross-functional coordination will ensure that all risks, costs, and benefits associated with each option are properly identified and prioritized. Since the focus and weight given to each factor will shift according to site-specific circumstances, each site's return on investment (ROI) calculation will be unique. By implementing the afore-mentioned factors into the decision process, end users can ensure the best mount remediation solution is consistently selected regardless of varying site conditions. ■