The Cost Of Reliability

HOW THE CHOICE OF ONE OF THE SMALLEST ELEMENTS IN RADIO ACCESS NETWORKS CAN HAVE A MASSIVE IMPACT ON OPERATION AND MAINTENANCE COSTS

Introduction

Wireless operators face mounting pressure to meet increasing performance requirements while minimizing overheads, putting high demands on the radio access network (RAN) to deliver improved coverage, capacity and end-user service in a way that enables a reduced cost per bit.

Maintenance costs are typically the largest fixed costs in any industry, and when equipment fails, the economic impact on a business can be enormous. This means that elements within a system must be designed to proper tolerances to ensure that RF performance requirements are consistently achieved.

The largest failure-cost categories affected by unreliability are maintenance labor, material, and capital. More specifically, the cost of lost time and effort, the cost of loss of coverage while the failed asset is unavailable to perform its intended function, and the cost of callout, failure analysis and replacement hardware. Within that, the cost of callout is often overlooked and for a RAN, the cost of a truck-roll and accessing the top of an antenna tower is significant.

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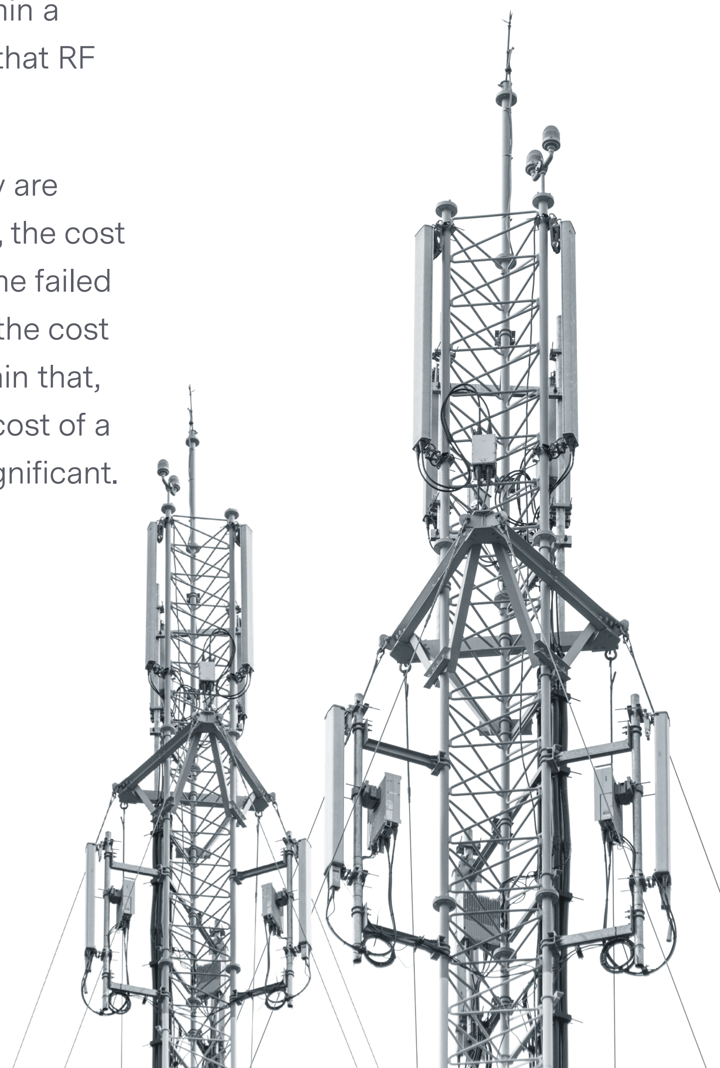

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Over the full life of the antenna, the purchase price is, in fact, a very small percentage of the total cost of ownership (TCO). However, attempting to identify and remedy poor performance in the network caused by parts not meeting performance can be extremely expensive. The costs associated in deploying field crews alone may be an order of magnitude larger than any initial component cost – even before the outlay in lost service is taken into consideration.

To put it into perspective, where a DC-DC convertor located at the top of a mast fails, the overall cost of repair can be up to 750 times the original cost of the DC-DC module.

The cost of sending a skilled contractor crew or a truck-roll to a cell-site to undertake a high-risk (from health and safety perspective), high-cost task equates to around 10 times the cost of the equipment.

And the replacement system hardware costs alone exceed the value of the DC-DC converter many times over, running in to the thousands.

Total Cost of Ownership

TCO involves much more than the cost of the product itself. These elements of TCO are widely understood and included in financial models:

- The initial costs of site acquisition
- Tower or mast hardware requirements
- Electronic equipment such as radio, antennas and installation
- Ongoing operational cost of the network (energy consumption, anticipated maintenance)

However, there are additional factors that should be taken into account when looking at the risk of component failure and the associated costs, including:

- Failure Analysis
- Disengaged Workforce
- Operator Confidence

Failure Analysis

The time (and logistics) required to return failed units for failure analysis (FA) not only has financial implications, but it also draws customer engineers into FA activities rather than generating new products. Financial models often assume that FA activities will be carried out exclusively by suppliers with no impact on the in-house engineering team, but there is both commercial and motivational cost involved.

A typical FA cycle is around two to three months, or in some cases four to six, depending on whether the failure mode is reproducible and repeatable. This can represent between one and four engineers for that period of time, to follow the FA and the implementation and test of the corrective action. Effectively, this means using up significant amounts of staff time which will have a considerable effect on engineering efficiencies.

Disengaged Workforce

Then there's the hidden cost of unhappy engineers, having to interrupt their project schedules and personal lives to deal with the inevitable daily escalation calls. Employee engagement is now widely accepted as a key driver of motivation, commitment and productivity in the workplace, and the link between a motivated and committed workforce and business success is recognized across industries.

A disengaged workforce not only affects the quality and quantity of work output, unsatisfied employees are eager to look for other opportunities, manifesting in high staff turn-over, raising recruitment and training costs and demanding managerial and HR time.

Operator Confidence

Additionally, we need to consider the cost in lost customer satisfaction and trust. Network operator confidence in your hardware is a valuable commodity and losing it can mean losing the opportunity for future incremental revenue. While the cost of lost coverage is difficult to quantify in terms of both customer satisfaction in the network and the network operators' trust in the reliability of the equipment, losing credibility is priceless and takes much less time and far fewer experiences than building it.

Many OEMs and network integrators have encountered occasions where network operators start to lose confidence when hardware failures occur in the field. This usually brings about pressures from the customer to remove certain types of equipment from their network due to compromised performance and coverage, resulting in immediate escalation. This can ultimately lead to huge amounts of money in terms of people's time, whether that be in the retrieval and replacement of the equipment from the field, or, more poignantly, regular escalation calls until the problem is resolved.

Consequently, a failed $35 DC-DC module at 10 ppm (parts per million) failure rate can end up costing up to $20,000 per system for maintenance labor, materials, and equipment replacement costs. At a failure rate of 250 ppm, 25 system fails would equal $500,000 and a failure rate of 500 ppm for 50 system fails would total a staggering $1.25 million.

Furthermore, we need to consider instances where downtime or outages from failed equipment directly impacts network users. In today's ultra-connected world, coverage quality is essential and any interruptions could form the basis for customers leaving a network. Meaning a downed node could quite literally result in business losses running into the millions, and this loss of revenue could lead operators to switch providers altogether, resulting in damaging financial implications.

While at first glance these figures may appear unreasonable, the reality is that the costs associated with unreliable equipment outlined above are very real.

Bridging the Gap

Market leaders have asked the questions: what if you could minimize the actual total cost of ownership and what would it take to do that?

The answer? A change in the philosophy of TCO.

Total cost of ownership is no longer thought of as just the piece-price and operational expense related to the conversion efficiency. Even though they are extremely important factors, there are sometimes even conflicting KPIs in business for both CAPEX and OPEX. Market innovators are now widening the definition of TCO to include the very real and considerable costs associated with any potential field failures or compromised network performance.

This thinking has resulted in the emphasis being on reliability of product beyond just using the usual calculated mean time between failures figure as a benchmark data point between supplier solutions.

Wireless access system designers are now focusing their efforts on designing systems in a way that significantly reduces the number of unscheduled maintenance incidents and consequences caused by product failure events in the field to reduce the overall cost of ownership.

Those architects have expanded the definition of TCO to include many other aspects that are fundamentally linked to achieving benefits in those areas based on the evaluation, testing and ultimately the proven reliability of the products they use, including:

- Improved end-customer (network operator) relationships
- Reduced OPEX costs of field-replacement of hardware
- The effect of the efficiency of power conversion on energy consumption
- Improving (reducing) the CAPEX related to spares and repairs inventory
- Focus engineers on developing new designs instead of troubleshooting issues related to poor network performance, leading to:
    - Engineering schedules being maintained with better team efficiency
    - Happier engineers that are not constantly diverted into failure analysis tasks will reduced turn-over

And while decreasing the number of deployed field crews is quickly becoming the defacto standard – saving both network providers and their organizations hundreds of thousands of dollars per year – one must consider the increase in wireless communication nodes required for 5G mesh-network builds.

The growing demand for 5G has resulted in many more systems in the field. And although many 5G sites may generally be easier to access, and therefore maintain, the cost assumptions associated with the rollout of full 5G sites is still unknown. But we shouldn't assume they will inevitably be lower. Some of the infrastructure will continue using towers and masts, therefore we must recognize that future networks will bring different costs but not presume it will be cheaper.

Any unforeseen costs, however, can be avoided by selecting units with:

- An IPC9592B[1] based test program, but extended in certain areas to increase the reliability of a product in this application
- A design approach that has reliability as a core value
- Consideration given to component stress (thermal and electrical)
- Construction of high quality and traceability

[1] The IPC9592 standardizes and identifies the requirements for power conversion devices for the computer and telecommunications industries, setting out a set of consistent specifications and methods to assure suitability, quality, safety, and reliability for the electronic industry.

Choosing the Right Equipment

Advanced Energy offers one of the broadest portfolios of this class of focused product solutions in the market, with reliability designed in as a core philosophy driven by our engagement and long history with tier one telecom OEMs. With a proven field-return failure rate of less than 15 ppm for our AVE450B series over the last six years, Advanced Energy can offer consistent reliability attained by our optimized qualification process.

Our growing range of isolated DC-DC converters are specially designed to produce the regulated low noise DC supply for RF power amplifiers in wireless base stations and similar telecommunications applications.

Specifically, our ADH700 series provides an ultra-efficient, high power telecom solution. The convertor has an input range of 36 VDC to 75 VDC and is designed primarily for use with standard 48 V telecommunications equipment supplies. Rated at 700 watts, the converter can operate over an ambient temperature range of -40 to 85˚C, continuing to deliver full power up to a baseplate temperature of 100˚C.

Based on a high power density design that incorporates an aluminum thermal baseplate and is optimized for either conduction or forced air cooling, ADH700 series converters have an installed height of just 0.5 inch (12.7 mm), making them ideal for systems with demanding inter-board spacing requirements.

The selection of a power conversion module for wireless telecom networks can have financial cost implications of failure estimated up to 1,000 times the cost of the original converter, therefore proven field reliability must be a consideration. Furthermore, recognizing the impact within a TCO model of the 'intangible' costs outlined above, such as the cost of failure analysis, a disengaged workforce and loss of operator confidence, underlines the true cost of reliability.

To learn more about Advanced Energy's Artesyn DC-DC modules for telecom applications, visit our website.

ABOUT ADVANCED ENERGY

Advanced Energy (AE) has devoted more than three decades to perfecting power for its global customers. AE designs and manufactures highly engineered, precision power conversion, measurement and control solutions for mission-critical applications and processes.

AE's power solutions enable customer innovation in complex semiconductor and industrial thin film plasma manufacturing processes, demanding high and low voltage applications, and temperature-critical thermal processes.

With deep applications know-how and responsive service and support across the globe, AE builds collaborative partnerships to meet rapid technological developments, propel growth for its customers and power the future of technology.

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