Efficiency – The Midas Touch

David Burr, Vice President, Business Development, Comtech EF Data

Over time all markets commoditize, and satellite communications is no exception. New competitors enter the market, new ideas are copied, customers play suppliers off each other and margins get squeezed. Nowhere is this more obvious than for satellite operators in today's market who find themselves at a crossroads.

On the one hand, you could choose to ride prices to the bottom. After all, people do buy commodities, often in high volume. The company with the lowest cost wins the largest market share, even if the margins are low. The problem is that few satellite operators think of themselves as cheap, so for most this is not a very attractive choice.

Many operators choose to differentiate themselves by adding value beyond basic MHz by bundling the raw capacity with equipment and offering some form of managed service. The choice of VSAT platform and how the service is constructed provides enough room for operators to differentiate and deliver a more attractive proposition to its customers. But what if they get it wrong and lose money, perhaps more than if they had stayed with just selling MHz? This is what makes many satellite operators hesitate from going down the road to managed services.

There are choices to be made and choosing wisely can make it much easier, which is especially important when you are just getting started with managed services. The key thing to start with is an efficient platform. Since satellite operators are in the core business of selling capacity, one would think that this would be the obvious starting point. However, it is surprising how many operators ignore this point when choosing their VSAT platform. It never pays to be wasteful with one's core product, so having an efficient platform and understanding how to leverage it is key to successfully deploy managed services.

Start with Efficiency in Mind

At Comtech EF Data, efficiency is at the core of everything that we do. The vast majority of VSAT platforms today use a technology called Time Division Multiple Access (TDMA) on the return link. In fact, so many VSAT platforms use TDMA that many people may not even be aware that alternatives exist. Comtech EF Data's Heights Dynamic Network Access (H-DNA) is such an alternative technology and has the important benefit of

being significantly more efficient than TDMA systems. H-DNA combines the efficiency of SCPC (Single Channel Per Carrier) – such as the use of high-performance coding with very low overhead – with the ability to respond to bandwidth changes on a sub-second basis. As shown in Figure 1, TDMA shares a carrier between sites by slicing it in time, SCPC assigns a separate continuous carrier to each site.
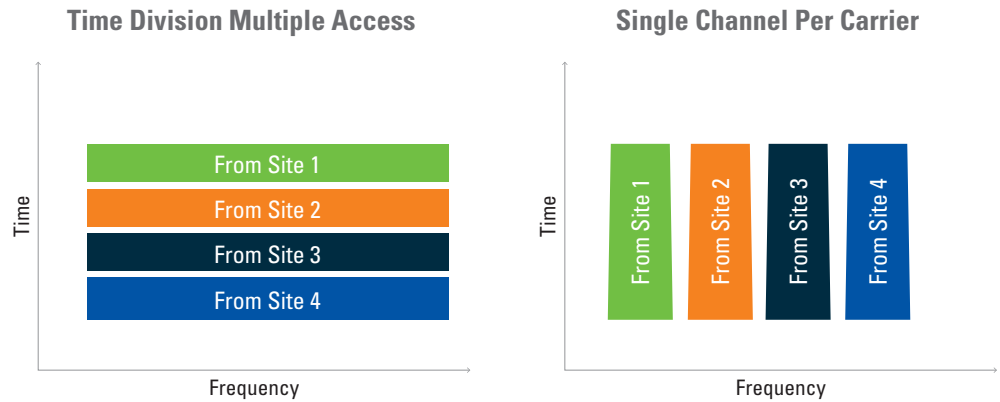
Time Division Multiple Access

Single Channel Per Carrier

Figure 1 – Illustration of TDMA and SCPC

There are two fundamental resources in satellite networks – bandwidth and power – and efficiency improves the use of both. Spectral Efficiency, measured in bits per Hz, is a measure of how efficiently bandwidth is used. It is easy to understand the value of efficiency in lowering the cost of services. Satellite bandwidth is still the largest expense for most services and using less of it significantly reduces overall costs. Improving spectral efficiency is most valuable for high bandwidth applications such as 4G mobile backhaul and providing Internet to cruise ships.
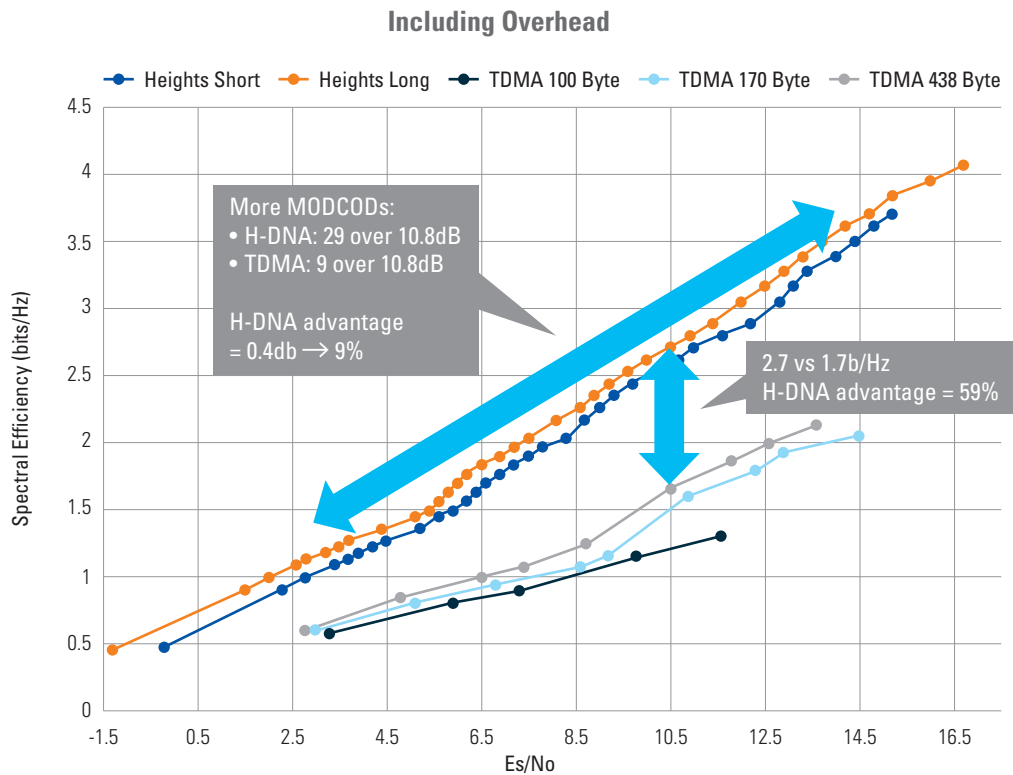
Including Overhead

Figure 2 – Heights vs. TDMA Spectral Efficiency

Comtech EF Data's proprietary H-DNA access method provides best in class performance by combining the efficiency of SCPC with the dynamic nature of TDMA. The key advantages are better Spectral Efficiency and better Terminal Efficiency.

Spectral Efficiency is a measure of the amount of data that can be transmitted in a given bandwidth and is measured in bits per Hz. Higher Spectral Efficiency minimizes the amount of satellite capacity that is required to support the required link data rate. TDMA divides the traffic into small bursts of traffic to be sent over the air. The small burst size limits the coding block size which reduces the effectiveness of error correction codes since more powerful error correction codes require larger blocks of data, larger than can fit into the small TDMA bursts. H-DNA is not constrained by such limited block sizes, so it can use longer more efficient coding. In addition, H-DNA supports many more different code rates that allow it to more precisely choose the optimum coding which reduces wasted power. As shown in Figure 2, these and other factors contribute to H-DNA providing higher spectral efficiency with 59% more bits per Hz than TDMA.

Let's examine how this advantage in spectral efficiency impacts the service profitability on an example service. Consider the case of a 4G mobile backhaul network with 30 sites requiring a CIR of 8 Mbps forward and 2 Mbps return. Table 3 below lists the relevant parameters of Modulation and Coding (MODCOD), overhead and Rain Fade Efficiency which is the advantage that true Adaptive Coding and Modulation (ACM) has over adaptive TDMA.

	TDMA Return Link	H-DNA Return Link
MODCOD	8PSK 2/3	16ARY 2/3
Overhead	20%	3%
Rain Fade Efficiency	92.50%	100%
Spectral Efficiency (bits/Hz)	1.5	2.6
Number of Sites	30	30
Site Data Rate (Mbps)	2	2
Total Data Rate (Mbps)	60	60
Required Bandwidth (MHz)	40	23.1
Sell price ($ / Mbps)	$500	$500
Capacity Yield ($ / MHz)	$750	$1,300

Table 3 – Return Link Capacity Yield Comparison

Both cases assume that the customer is paying $500/Mbps for the capacity portion of the service. When you sell at a given $/Mbps, a more efficient solution will yield a higher $/MHz and improve profitability. H-DNA enables a capacity yield of $1,300/MHz, 73% higher than the TDMA at $750/MHz. For many networks, this can mean the difference between making money and losing money.

The operator has a choice in how to leverage this advantage:

1. **Profitability** - It might simply take this as higher profitability, helping claw back what was lost due to price compression and make the core business healthier.
2. **Volume** - It might choose to pass some or all of this through to the customers in the form of lower prices in an effort to attract more customers and increase volume.
3. **Premium** - It could choose to invest in additional features or services that can command a premium price, attract more customers and increases stickiness.

All these options to differentiate start with an efficient platform. Efficiency gives the operator room to pursue its chosen path of differentiation and how to create value in the market.

Enabling Digital Transformation

The highest profitability can be found in the high bandwidth sites in high value verticals. The most promising category of customers that fit this situation are those companies and industries that are undergoing Digital Transformation programs. Many companies and industries have realized that by adopting the latest information technologies – such as automation, Big Data, IoT, artificial intelligence, real-time collaboration – they can dramatically improve the performance of their core business and how quickly they can service their customers. Digital transformation projects are sweeping through a wide range of industries including oil and gas, mining, transportation, banking, manufacturing and others.

As companies undergo digital transformation programs, their bandwidth demand jumps dramatically. In addition, this additional bandwidth is used by programs that are delivering value directly to the core business, making them less sensitive to the cost of the capacity. Being able to respond quickly with upgrades to these customers with less pressure on capacity pricing is the ideal case for a satellite operator.

In most cases, these companies have existing VSAT platforms which are running out of steam and not able to keep up with the connectivity to feed their new business models. Efficiency can be the key to success here as well.

A measure of the efficient use of VSAT terminal power, Terminal Efficiency, relates to the data rate that can be uplinked from a particular terminal in bits-per Watt of amplifier power. Improving the Terminal Efficiency increases the data rate that can be uplinked from a given antenna and amplifier combination. Businesses that are going through digital transformation are consuming more bandwidth, and applications such as IoT and real-time collaboration are particularly heavy users of return link capacity. What do you do when your increasing data consumption hits the limit of your terminal? The traditional approach would be to swap in a higher power amplifier. The modem is probably running out of horsepower as well, so this probably just became a terminal replacement. A more elegant solution would be to keep the exiting antenna and amplifier and increase the Terminal Efficiency by changing to a more efficient VSAT platform and avoiding touching the amplifier at all.
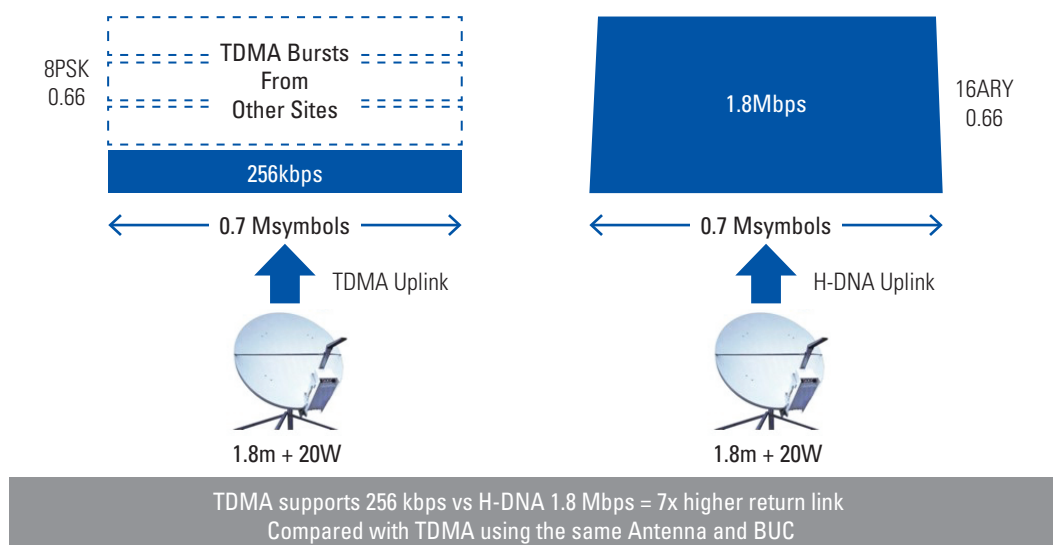

Figure 4 – Heights vs TDMA Terminal Efficiency

The good news is that today it is possible to dramatically improve Terminal Efficiency and increase the return data rate without touching the amplifier. Compared to TDMA, Comtech EF Data's H-DNA can increase the Terminal Efficiency by a factor of anywhere from 4x to 10x. Taking this approach not only saves the expense of replacing the amplifiers but makes for a quicker and simpler upgrade. This is tremendously valuable given the avalanche of increasing data going through so many industries driven by Digital Transformation.

Improving Spectral Efficiency also leads directly to improvements in Terminal Efficiency since each Hz needs to be transmitted by the terminal which requires power. Doubling the Spectral Efficiency in bits/Hz will also double the Terminal Efficiency in bits/Watt. Furthermore, TDMA divides the carrier into bursts which are shared across multiple sites. This necessitates a carrier size that must be large enough to support the traffic from all of the sites accessing that carrier. Figure 4 shows how these factors interact and shows an improvement of 7x by upgrading from TDMA to H-DNA.

There is a tremendous advantage with this approach to network upgrades:

- It reduces CapEx spend by reusing the existing RF
- It simplifies and accelerates the network upgrade by eliminating complexity
- It reduces the risk of damaging the outdoor equipment due to components breaking or stripping and eliminates the possibility of bad weather interfering with the install schedule
- It reduces the Total Cost of Ownership and improves the long-term profitability with higher spectral efficiently

The ability to dramatically improve the uplink ability of the terminal is a perfect solution for digital transformation projects which lead to a significant increase in data, especially data in the return direction from applications such as IoT and real time collaboration. Given the large number of industries going through this type of transformation, this approach is widely applicable.

Conclusion

With many satellite operators moving or contemplating the move to offering managed services, it is important to make efficiency an important part of the plan. Doing so:
- Provides dramatic improvements in the transponder yield which improves profitability
- Enables more price competitive services to reach larger numbers of customers
- Helps fund enhanced functionality providing the opportunity for further differentiation
- Enables Digital Transformation initiatives that are occurring in companies in a wide variety of industries

The best-in-class efficiency of Comtech EF Data's Heights platform makes it the ideal choice for satellite operators looking to navigate the path to managed services. Efficiency provides a "Midas Touch", improving everything that it touches. ⋀

David Burr *is Vice President, Business Development for Comtech EF Data. He develops strategies to address maritime and satellite operator markets and is passionate about efficiency for satellite communications. Burr previously held Product Management, Sales Engineering and Project Management roles at SES, O3b, New Skies, Polarsat, Comstream and GTE. He holds a degree in Electrical Engineering from Boston University.*