White Paper

# Converged Packet Microwave for Simplified Network Evolution

DragonWave

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# TABLE OF CONTENTS

# Converged Packet Microwave for Simplified Network Evolution

Nine years ago, IP traffic overtook circuit-switched voice traffic on wired networks. Recently, the same milestone took place within the wireless domain; in early 2010, data traffic accounted for slightly more than 50% of all traffic carried over mobile networks. While this event was certainly not unexpected, it did arrive several years sooner than many had expected. This was due in large part to the unmitigated success of the iPhone, which opened the door to a new breed of mobile device and spurred a rapid transformation in the profile of a typical mobile user.

*As mobile data traffic growth continues unabated for the foreseeable future, voice traffic will soon account for only a minute slice of the mobile traffic pie, or in this case, stacked bar chart.*

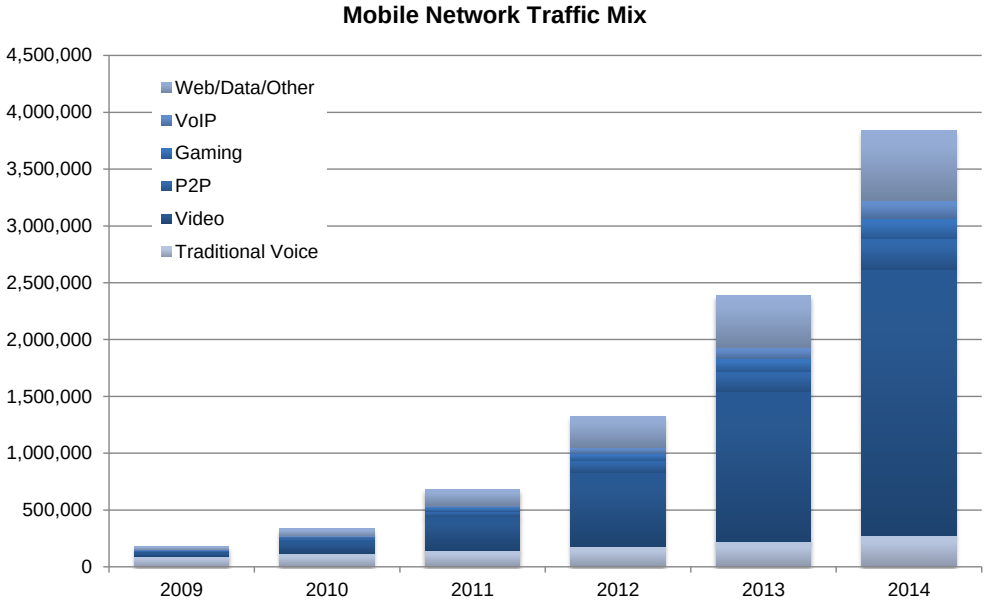


**Figure 1 illustrates the rapid growth of data traffic – driven in large part by a surge in video traffic over mobile networks. Video traffic is growing at an annual rate of 130%, representing 66% of the mobile traffic mix by 2014.[1]**

The unprecedented growth (show in Figure 1) translates to good and bad news for mobile operators. On one hand, demand for their mobile services has never been greater, on the other hand, existing mobile networks are being driven well beyond their intended capacity. In addition to this, the revenue curve for mobile services is unfortunately no match for the exponential growth in data – meaning that cost per bit must drop dramatically if future mobile services are to be profitable.

*Network Convergence describes the transition from voice and data networks into single unified packet-based network*

Moving to next generation mobile access networks is an important step in achieving this goal, but operators are then faced with the question of how best to backhaul TDM traffic on the existing network, as they evolve to packet-based 3G and 4G networks – all while simplifying their operations and reducing their total cost of ownership.

This paper reviews alternative backhaul strategies for mixed TDM and packet-

*architecture.*

based traffic and highlights the operational, economic and performance benefits of a converged packet microwave backhaul network.

## CHOOSING THE RIGHT MICROWAVE BACKHAUL SOLUTION FOR TODAY AND TOMORROW

To ensure a smooth transition to packet-based mobile networks, it is essential that operators select a backhaul solution that will meet near-term requirements without compromising the future performance of their network.

*The backhaul network must be viewed as a strategic long-term asset.*

In addition to supporting this evolution, the backhaul network should be viewed as a strategic asset which has a critical role in unlocking advanced applications and services while providing operators with several important competitive advantages including:

- Rapid time to market with new services
- Flexible on-demand scalability to eliminate stranded capital and deliver a future-proof network
- Advanced Quality of Service (QoS) support
- Low latency
- Carrier-grade availability
- Simple operation and self-healing architecture
- Lowest total cost of ownership

While there is a wide range in the features and performance of different microwave solutions, when it comes to microwave backhaul for network evolution—where TDM and packet-based traffic must be managed—the primary types of microwave systems are: PDH/SDH/SONET, Hybrid, and Converged Packet.

### PDH/SDH/SONET Microwave Backhaul

By far the most common type of backhaul in place today, PDH/SDH/SONET microwave systems are optimized for what has historically been the dominant traffic type – TDM voice. While their initial price points may appear attractive, the poor performance when handling packet-based traffic, which will soon account for over 80% of mobile traffic, makes them only a short-term solution. In addition, the lack of scalability and efficiency means that they actually have a significantly higher cost per bit than next generation microwave systems.

*PDH/SDH/SONET microwave backhaul systems were designed for a much different traffic mix and do not meet the performance or scalability requirements of advanced 3G and 4G networks.*

Specific drawbacks include protocol conversion delay, high latency (greater than 1 millisecond), and lack of bandwidth granularity and scalability – a 155 Mbps system cannot operate at any other rate. In addition, PDH/SDH/SONET systems are not able to take advantage of statistical multiplexing or advanced signal processing techniques. There is also significant overhead associated with mapping packets to T1/E1s. As a consequence, overall spectral efficiency may be up to 10-times lower than a packet based system.

In general, operators may seek to extend their existing PDH/SDH/SONET backhaul networks in the short term but this is not considered a realistic long term solution.

## HYBRID MICROWAVE BACKHAUL

Hybrid microwave systems offer the benefit of carrying TDM and Ethernet in their native forms. This allows service providers to continue to support existing TDM traffic while simultaneously expanding their capacity for data traffic.

*Hybrid microwave backhaul solutions support TDM and Ethernet natively but increase complexity and cost at every point in the network.*

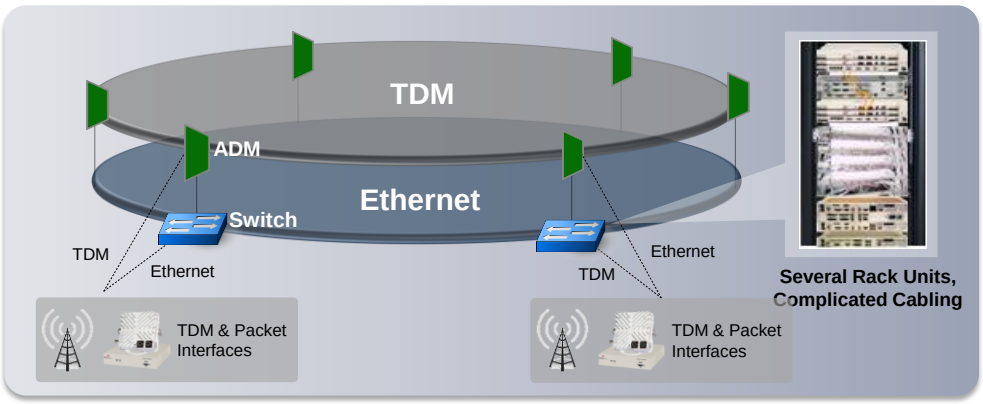


**Figure 2: A Hybrid microwave architecture with parallel TDM and Ethernet networks.**

The downside to supporting TDM and packet natively is the need to deploy, operate and maintain two parallel networks. As illustrated in Figure 2 above, this involves having both Ethernet and TDM infrastructure, including TDM switching equipment throughout the network. Beyond the complex intra-office cabling and congested racks, this approach also requires separate management and provisioning platforms, which introduces significant operational and management complexity and cost.

As TDM becomes a significantly smaller piece of the mobile traffic pie, operators with hybrid solutions will eventually look to simplify their operations in order to achieve a fully-optimized flat-IP network. In short, many hybrid solutions risk being a barrier to most operators' ultimate end-goal.

*The market for hybrid microwave systems has entered decline in favor of packet-based microwave solutions.*

Despite the popularity of hybrid systems when TDM was still the predominant type of mobile network traffic, the debate surrounding the adoption of hybrid systems versus pure packet or converged packet microwave systems (which is examined next), is essentially over – the market for hybrid systems has been in decline since early 2010[2]. Consequently, the market for packet-based microwave systems has been accelerating[3].

*Converged packet backhaul networks offer improved operational simplicity and cost savings with a single flat-IP network and single management plane.*

## Converged Packet Microwave backhaul

Offering both TDM and Ethernet interfaces, converged packet microwave solutions are essentially another form of Hybrid microwave platform. The key difference when compared to conventional hybrid systems is that, rather than transporting parallel TDM and Ethernet networks, these products converge all data and voice traffic, creating a single flat-IP network.

*A reduction in network elements, including TDM switching and intra-office connections, results in lower network costs.*

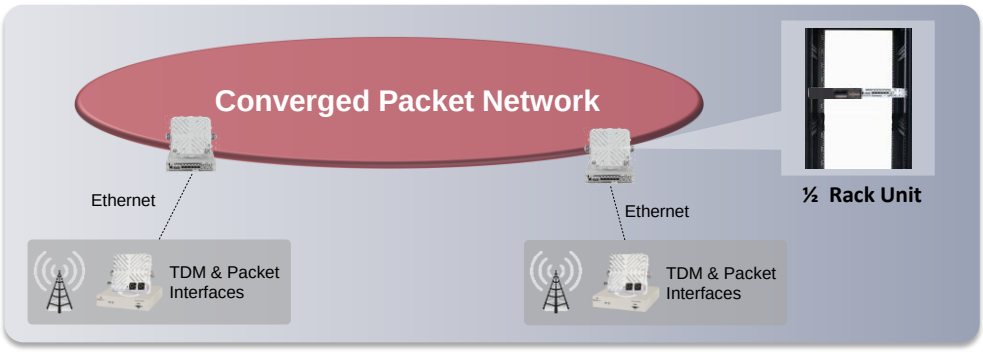


**Figure 3: A converged packet microwave architecture.**

Additionally, unlike conventional hybrid systems, which are built for legacy TDM traffic but have the capability to transport Ethernet, converged packet microwave system are engineered from the ground up for packet-networks, but fully support TDM traffic to enable a smooth transition to a flat-IP, uncompromised end state network.

One of the primary advantages of a converged backhaul network is the reduction of network elements as they do not require extensive intra-office connections or TDM switching throughout the network The economic benefit of a simplified converged packet microwave network is illustrated below.

*The simplified operations and infrastructure requirements of converged packet backhaul translates to significant TCO savings.*

**Hybrid vs. Converged Packet 10-Year Total Cost of Ownership**

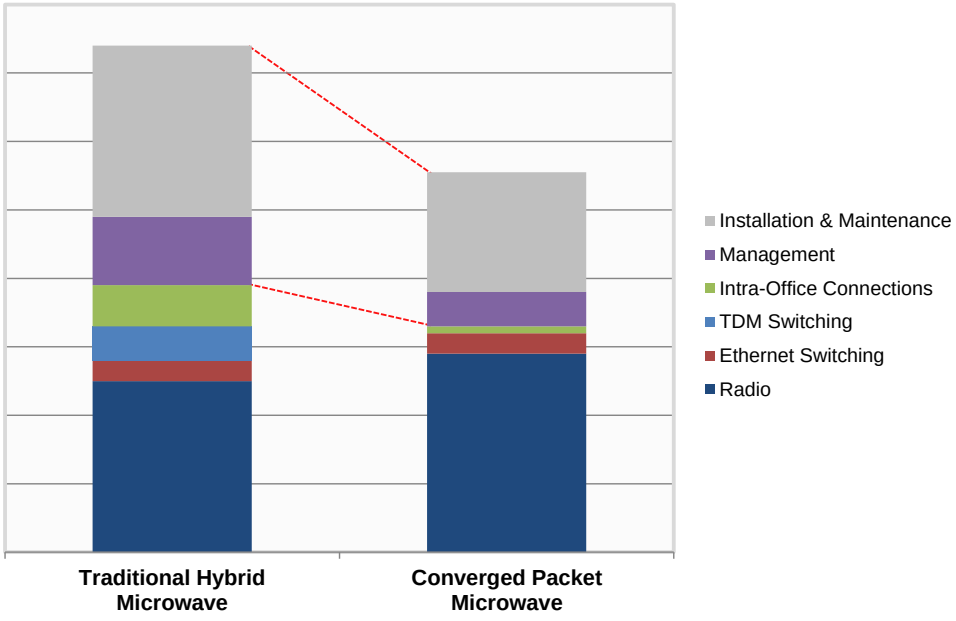


**Figure 4: Comparing the 10-yr TCO of hybrid and converged packet microwave deployments.**
**This comparison assumes a cost premium for converged packet microwave systems, but this is more than offset by the additional expense for intra-office connections and TDM switching in the hybrid scenario. Additionally, the CAPEX premium for converged packet systems is rapidly eroding as volume economics come to bear.**

When the cost comparison is expanded to encompass installation, maintenance and management expenses, the 10-year Total Cost of Ownership (TCO) savings for converged packet microwave is greater than 30%. Considering that network maintenance and operations represents 13% of OPEX[4] for the entire mobile network, it becomes clear that converged backhaul can have a significant positive impact on a service provider's bottom line.

*Backhaul convergence can also take place at the base station cell site router.*

In many instances the mobile network operator will use cell site routers or multiservice packet nodes to aggregate traffic at a multi base station site and provide a common service provisioning platform. In addition, many base stations are upgraded to support packet interfaces in order to eliminate the up to 30% overhead of mapping data traffic into TDM interfaces. In these instances, packet convergence is not required within the microwave platform and all-IP packet microwave systems are the ideal fit as they provide the lowest cost solution.

*The benefits of packet gateways are equally applicable to fiber-based networks.*

It should also be noted that while microwave will continue to be used for the majority of backhaul connections on a global basis, fiber-rich service providers can achieve equivalent improvements in efficiency and operational simplicity by deploying packet convergence gateways in their fiber backhaul networks.

## Synchronization in Converged Networks

Because synchronization is a building block of traditional networks, 4G-optimized backhaul solutions must also support advanced network synchronization including Synchronous Ethernet (SynchE), which locks the timing of the Ethernet physical layer, and 1588v2 which is used to carry synchronization data.

*Network synchronization and robust clock recovery are essential elements in carrier-grade converged packet networks*

These synchronization standards are of key importance to converged mobile networks, yet they do not define the clock recovery mechanisms – an essential element in converged networks. It is therefore essential that, in addition to supporting these standards, converged packet microwave solutions must also provide a highly robust clock recovery algorithm in order to filter out packet delay variation (PDV), network impairment and other scenarios, including:

- Packet loss and re-ordering
- Jitter/wander
- Heavy load, load step changes, load slow changes and bursts
- Latency changes and re-routing
- Network condition changes
- Temperature changes

Timing performance should be tested according to ITU-T G.8261 and G.823/G.824 masks.

## CONCLUSION

Any backhaul solution being deployed today must deliver the capacity, scalability and performance for advanced applications well into the future. Looking at the rapidly evolving traffic mix on mobile networks, as well as the shift to 3G and 4G networks, it is clear that the ultimate goal for service providers is to have a single, reliable, and unified packet-based network that will support both legacy and emerging services.

Today's converged packet microwave solutions offer operators the simplest and most cost effective approach to achieving this goal. Positioned for the future, these systems deliver a packet-based architecture that still provides complete support for TDM circuits, while providing the following key benefits:

- Lower capital expenditures, maintenance, and management costs
- Simple migration to the next-generation network without compromising legacy traffic
- Higher network utilization, lowering costs of transmission
- Implementation of strategic investments in IP/MPLS and Ethernet infrastructures – freeing resources that are currently invested in maintaining legacy infrastructure
- Advanced synchronization support and clock recovery mechanisms
- A flexible future-proof architecture

This approach enables operators to evolve their network gradually over time as their traffic and service mix changes, arriving at an uncompromised end-state network that is optimized for next-generation applications and services.

For information on DragonWave's converged packet microwave solutions, please visit www.dragonwaveinc.com.

1 Source: Cisco Systems, 2010 and DragonWave Inc.

2 Wireless Backhaul from an All-IP Perspective, MMaravedis Research, September, 2010

3 Wireless Backhaul from an All-IP Perspective, MMaravedis Research, September, 2010

4 Mobile Backhaul Evolution, YYankee Group Research, 2010