ASAT II™

WaveSwitch™

Futureproof Return Link Technology

In order to maintain a real multi-service operation nowadays, an efficient bandwidth on demand orchestrator is not enough, it is also required to assign the correct waveform in the right time according to the different application and the varying requirements.

Unlike other VSAT multi-service systems that partition the bandwidth pool into fixed areas, SpaceBridge's second generation WaveSwitch™ technology enables real-time, on-the-fly waveform orchestration as it is maximizing the bandwidth efficiency and providing the best user experience. Unlike other solutions in the market, SpaceBridge WaveSwitch™ switching mechanism operates automatically and according to smart configurable triggers to allocate each terminal transmission to the relevant waveformon-the-fly.

Different Waveforms

The current access technologies encompassing encapsulation/modulation/coding, collectively also known as waveforms, that used by the majority of VSAT market are based on SCPC/FDMA, SCPC DAMA, CDMA, TDMA, and MF-TDMA. Each access technology affects the application's performance, overheads, spectral efficiency oversubscription capabilities, and the total satellite bandwidth utilization that eventually influence the user experience and consequently affect the operator revenues and churn rate.

SCPC

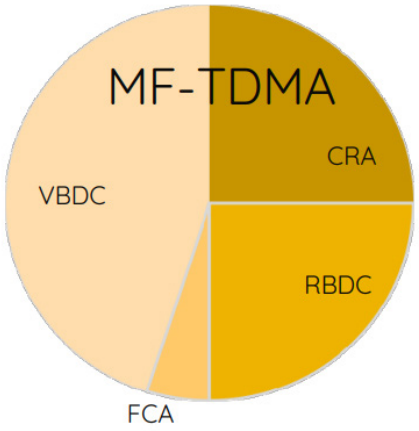
Single Channel per Carrier, SCPC continuous carrier systems are mostly known for strong physical performance, a.k.a power/bandwidth efficiency. This physical performance empowers system designers with the ability to select between reduced operational costs (through increased bandwidth efficiency) and increased robustness of the communications link. SCPC is very efficient, if the carrier is fully utilized, whereas MF-TDMA is more efficient when the individual carrier utilization is 30% or less.

SCPC Best Channel Efficiency for the fixed rate "always on" transmission:

- Clear Channel as true Single Channel per Carrier (unlike semi-SCPC solutions).
- Best-suited for High Density real-time streaming applications
- Best physical performance for continuous transmission
- Best Power-bandwidth efficiency
- Video, high throughput data i.e. UAV, radars and video contribution, Voice Trunking and Fiber backup
- Jitter/Latency sensitive applications like Oracle DB, various ERP's, frameless encryption, etc.

MF-TDMA

Short burst MF-TDMA systems are optimized for flexibility and responsiveness to changing traffic demands amongst its users. As an example, such systems excel at addressing scenarios where the user rapidly switches from web browsing (infrequent, small transmissions of data) to sourcing streaming video (near- constant, high rate transmission).



SpaceBridge MF-TDMA implementation includes DVBRCS extensions and enhancements such as 8PSK and 16APSK modulation schemes, improved efficient encapsulation and acceleration methods such as MPEG over MF-TDMA , 1/2ATM and more.

ASCPC™

SpaceBridge present Adaptive SCPC- ASCPC™, an access method hat guarantees capacity using adaptive SCPC- like channels while enabling intelligent CIR oversubscription.

SpaceBridge ASCPC™ offers the Best Effective Channel Efficiency in the “middle-ground” by combining the best properties from SCPC and MFTDMA. ASCPC™ is best suited for demanding interactive applications like VoIP, offering the same jitter and latency as SCPC, at the same time achieving significant level of Statistical Multiplexing Gain and is therefore permitting traffic oversubscription. ASCPC™ has the best performance for VoIP services, Remote Desktop, Corporate Connectivity, Video Streaming/ videoconferencing, cellular Backhaul and more demanding applications.

Access Technology / Waveform	Key Strength	Sample Applications Supported
MF-TDMA	Best Bandwidth assignment efficiency for low to medium data rates supporting high traffic fluctuation and medium to high oversubscription.	USO / ICT Internet Service, Transactional data, SCADA, Lottery, Automated teller machines (ATM), corporate connectivity, remote offices.
ASCPC	Best effective channel efficiency for demanding SLA, Jitter and latency (delay) requirements and low to medium oversubscription	VoIP services, cellular backhauling, citrix, / remote desktop, corporate connectivity, video streaming / video conferencing, corporate connectivity, remote offices
SCPC	Best continuous or low fluctuation bandwidth assignment efficiency for dedicated high data rates. No oversubscription - dedicated service with fixed carriers.	Fixed bandwidth trunking, symmetrical high data rate links, video channel contribution / distribution.

SPACEBRIDGE
ALL THINGS CONNECTED

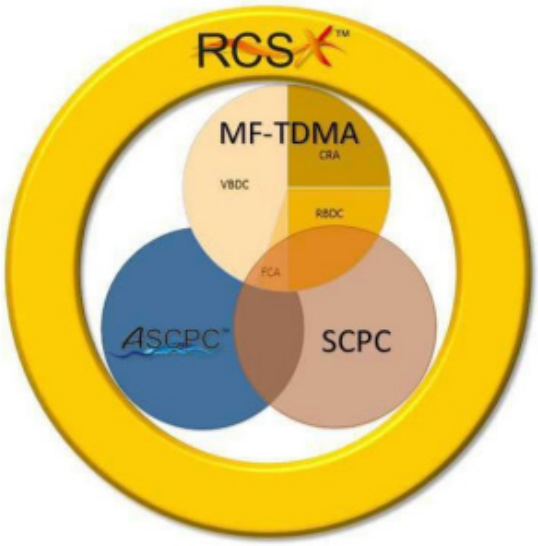
ALL THINGS CONNECTED

WHITEPAPER: WaveSwitch™

WaveSwitch™ on-the-fly waveform and access method switching technology

As traffic characteristics change rapidly there is a constant demand for bandwidth changes and new application requirements. Satellite service providers struggle to decide which platform is most suitable to satisfy the varying needs of their customer applications, while optimizing bandwidth utilization.

To address the high complexity of new generation satellite services without degrading service quality, SpaceBridge introduced WaveSwitch™. This novel service modeling architecture dynamically optimizes waveform assignment to achieve the highest application performance, with minimum satellite bandwidth resources.



Current platforms offering multiple waveforms require the operator to choose which waveform is optimal for a remote site. Manual intervention is normally required and the type of modem purchased for each site must be consistent with the planned operational mode. Due to readily changing customer requirements, the operators find it harder to predict the proper access technology to use.

With WaveSwitch™, no manual intervention is required. The system will dynamically assign from SpaceBridge' industry leading RCSX™ selection of waveforms - ASCPC™, MF-TDMA, and SCPC DVBS2 and DVB-S2X access technologies.

WaveSwitch™ will seamlessly optimize the access technology to the varying customer application requirements in real time.

WaveSwitch™ allows the operator to choose which waveforms the system would transition between for individual terminals. In cases were high bandwidth isn't even an option for example, but still involves demanding interactive applications, an operator would configure the system to transition the involved terminals between ASCPC™ and MF-TDMA only.

Although WaveSwitch™ is extremely robust, configurable,and allows a set of triggers, it also offers intelligent automatic switching by recognizing the relevant applications and switching the waveform according to their requirements based on intelligent triggers.

In parallel, WaveSwitch™ technology enables onthe- fly re-configuration of the system frequency plan, so that bandwidth can be allocated in real time between the three waveforms based on system wide bandwidth allocation policy.

Triggers

WaveSwitch™ technology offers a high level of flexibility for configuring the triggers that will cause switching between different waveforms. The following switching triggers are available:

Manual switching: It could be used for troubleshooting, test, or when it is known the applications that a specific remote site is using. Manual switching between MF-TDMA, ASCPC™ and SCPC at any time via the NMS is available.

Scheduled Events: It is configured by setting the waveform switching in a specific moment and time or for regularly scheduled events. It is mostly used when the transmissions of specific traffic are planned.

Traffic volume: WaveSwitch™ can be configured to automatically change waveforms upon a certain threshold of traffic. e.g., if a remote site is passing high volume of traffic which might be more suitable for the SCPC waveform, the system will switch it.

Traffic Variability: A remote site can switch between the three waveforms RCSX™ Offers (SCPC, ASCPC™ and MF-TDMA) if it detects different traffic variability.

Pre-configured session: Waveforms can also be switched according to a pre-configured session which is based on a specific rules and classifications like multicast sessions based on destination IP Address, Video streaming, specified with Type Of Service, among others.

Link Quality: The system verifies the link quality for each of the remotes and determines if any of them is experiencing difficulties with a certain waveform and the modcod used. Based on this information and analysis it automatically switches that specific remote to the waveform (including ULPC and ACM) that best suits the condition of the transmission.

Trigger Examples

PRIORITIES

- Especially important for military customers
- General or command center will always get bandwidth

SCHEDULED TRIGGERS

- Time of day
  - Example - video conference on Friday from 2-3pm
- Repeating on a regular basis;
  - Example - General Manager's staff meeting every Momday morning
- Ensures availability of bandwidth

VOLUME TRIGGERS

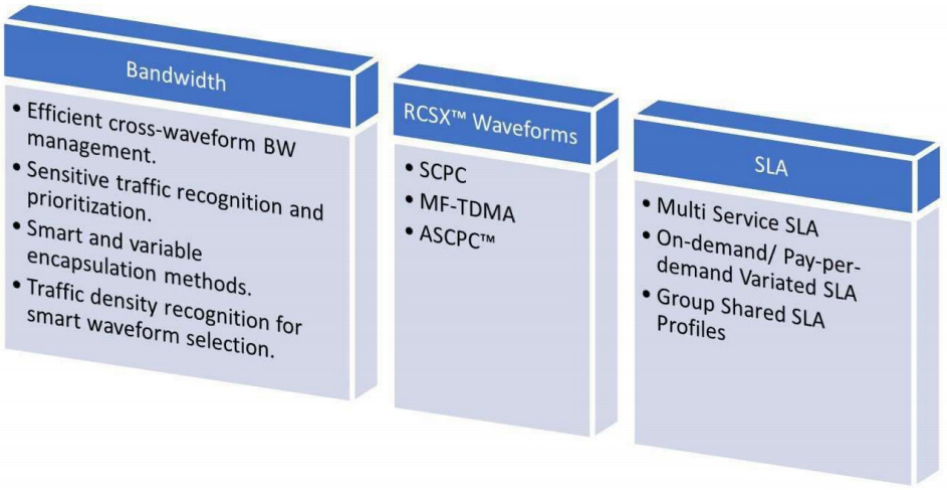
- Exceeds a certain level
- Averaged over 1 sec to 10 minutes
  - Example - MF-TDMA for data rates less than 128kbps
    ASCPC for data rates between 128kbps and 1Mbps
    SCPC for data rates greater than 1Mbps

3D-BOD™

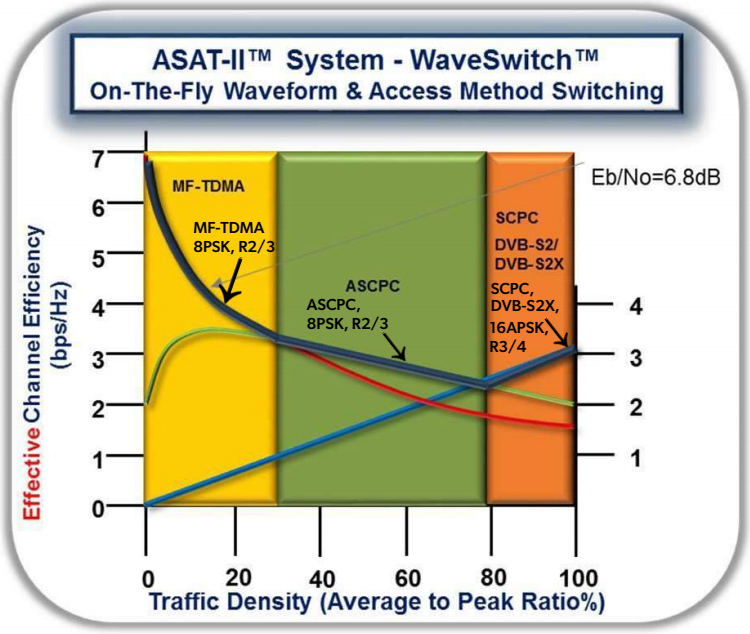
ASAT II™ WaveSwitch™ is based on 3-dimentional BOD (Bandwidth on Demand) model, while factoring Bandwidth, Waveforms, and SLA. 3D BOD delivers the customers with the best possible service, in the highest quality and with most efficient bandwidth utilization.

SpaceBridge practices optimal bandwidth management techniques in order to opti-mize Bandwidth management availability to support multi service and variated SLA delivery.

With multi service traffic flows, variety of applications, different traffic density rates, and varying band- width peaks, WaveSwitch™ achieves the best service quality and user experience to customers in the most bandwidth efficient means by combining the power of all 3 waveforms dynamically in real time manner.



Uniquely performing WaveSwitch™ waveform selection on-the-fly according to dynamic real time user requirements and SLA policies, ensuring the all user bandwidth orchestrations and best user experience quality.



ASAT™ 2nd Generation WaveSwitch™ Business Cases

Frequent considerations

Detached from specific business case considerations, the items below normally play an important role and are significant factors in the Operator's decision making strategy for choosing the best system for his business case.

- Traffic requirements defined by customer
- Various applications required to be supported
- Satellite network hardware must support various applications (ATW)
- On the fly adapt to the rapidly changing capacity demands
- Utilize optimal efficiency for eachapplication
- Which Access Scheme to Use?
  - -SCPC
  - -MF-TDMA
  - -ASCPC™

Business Case Example: Network Definition

A network consists of 100 RemoteTerminals:

- 5% of the terminals have Internet and Cellular backhaul service
- 20% of the terminals have Internet and Trunking service
- 75% of the terminals have only Internet service

While Internet Browsing applications are known to be bursty, with relatively low throughput (comparing to the downlink), and fairly resilient for Jitter, it is perfect for oversubscribed networks.

Unlike Internet Browsing, Cellular Backhauling requires a very demanding SLA, with extreme sensitivity to Jitter and often demonstrate difficulties in high contention rates networks. However, may still demonstrate a certain variability in traffic consumption.

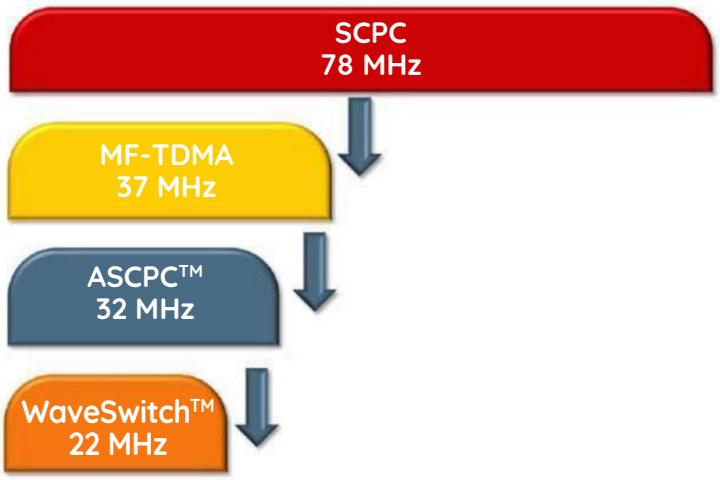
Trunking, a set of applications with extreme throughout requirements, which normally demonstrates steady traffic density with nonebursty traffic, requires to operate in congestion-free network environment.

As each of these applications demonstrate different traffic density rates, bursts, and other traffic behavior characteristics, the Operator still needs to choose which waveforms will be used, and in case of multiple waveforms, how to orchestrate them.

Alternatively, an operator can choose to stick with one of the available waveforms, however it will best serve only one of the applications mentioned above. For the rest of the application we will either see lesser spectral efficiency or lower network utilization.

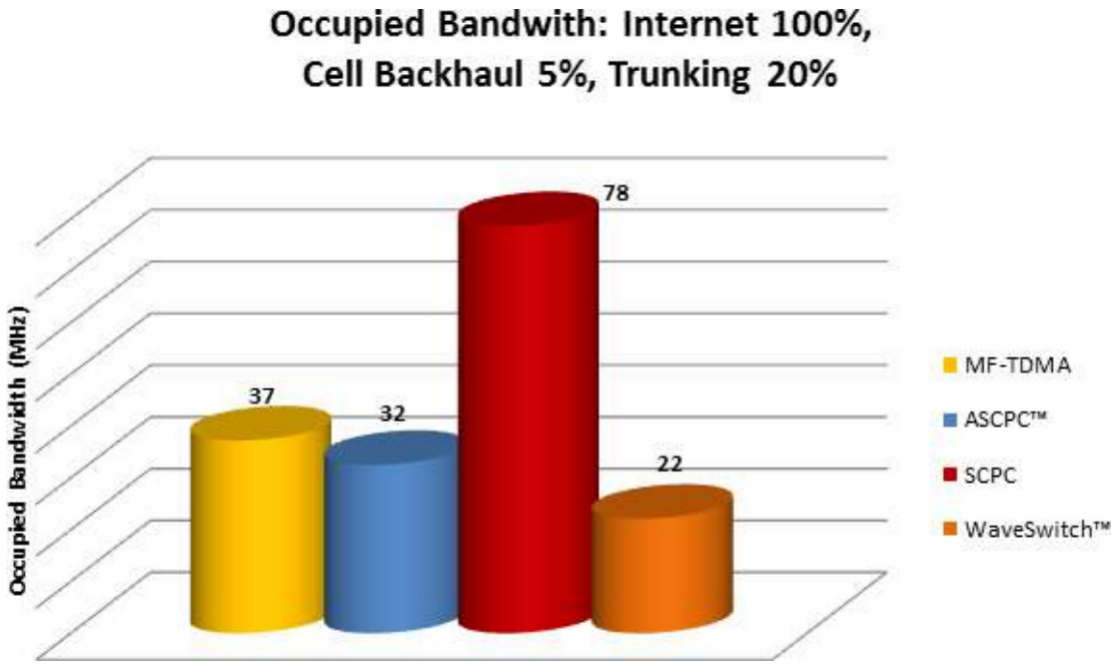
Applications	Peak Data Rate (kbps)	CIR (kbps)
Internet Browsing	250	50
Cellular backhaul	1500	1000
Trunking	2000	2000

Below is an illustration of the different waveforms spectral population in MHz:

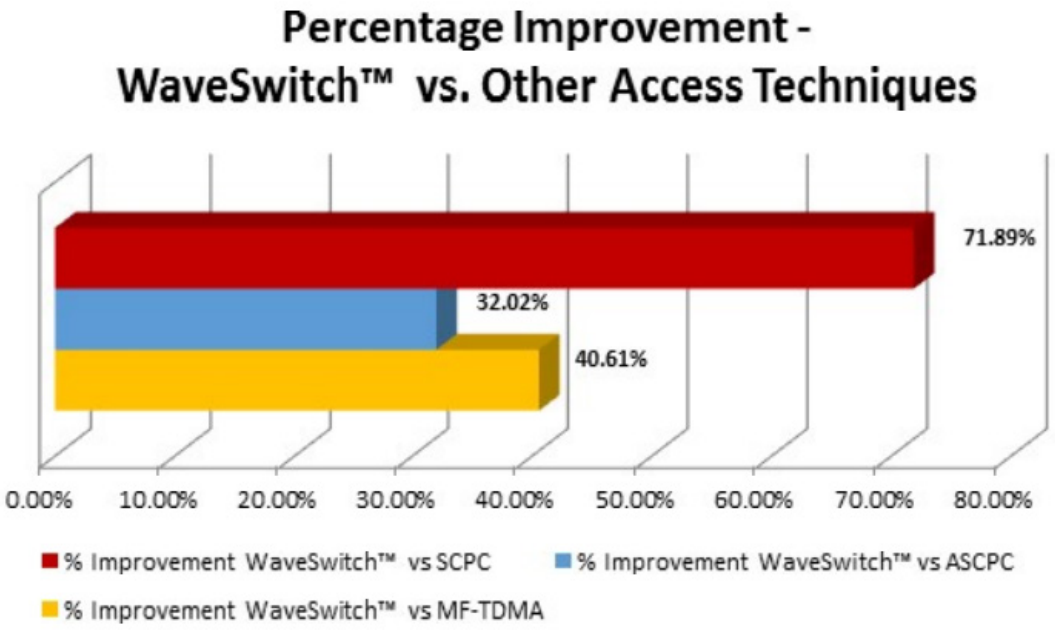


As we can clearly see below in the above and below diagrams, SCPC is the most inefficient waveform in terms of -statistical multiplexing factor and spectral resources expenditure while ASCPC™ demonstrates the best efficiency out of the three.

However, with WaveSwitch™ combining the three waveforms together and performing intelligent waveforms mitigation, at the right time with the relevant traffic density, WaveSwitch™ clearly present a much more efficient orchestration and provide the desired user experience while preserving satisfied customers and smooth operation.



Below is an illustration of WaveSwitch™ improvement percentage over the usage of the individual waveforms.



Benefits of WaveSwitch™

- Prioritization of terminals for bandwidth.
- Enables dynamic switching between different access techniques.
- Maximizes satellite bandwidth efficiency with potential OPEX savings over 50%.
- Enhanced user experience by matching the waveform to the applications being supported.
- Risk mitigation being assured all applications will be effectively supported by remote satellite terminals.
- Reduces operational expenses by reducing operator intervention and providing optimal utilization of satellite space segment.