![Advantech Wireless logo]

A-SAT™
Adaptive Satellite Access Technology

John Landovskis
Director VSAT Products
Advantech Wireless

Advantech Wireless

Main driver to lower OPEX

> Efficient use of satellite resources

Critical for efficiency

> A satellite access technique well matched to the network traffic and applications

Increasing demand for improved satellite efficiency

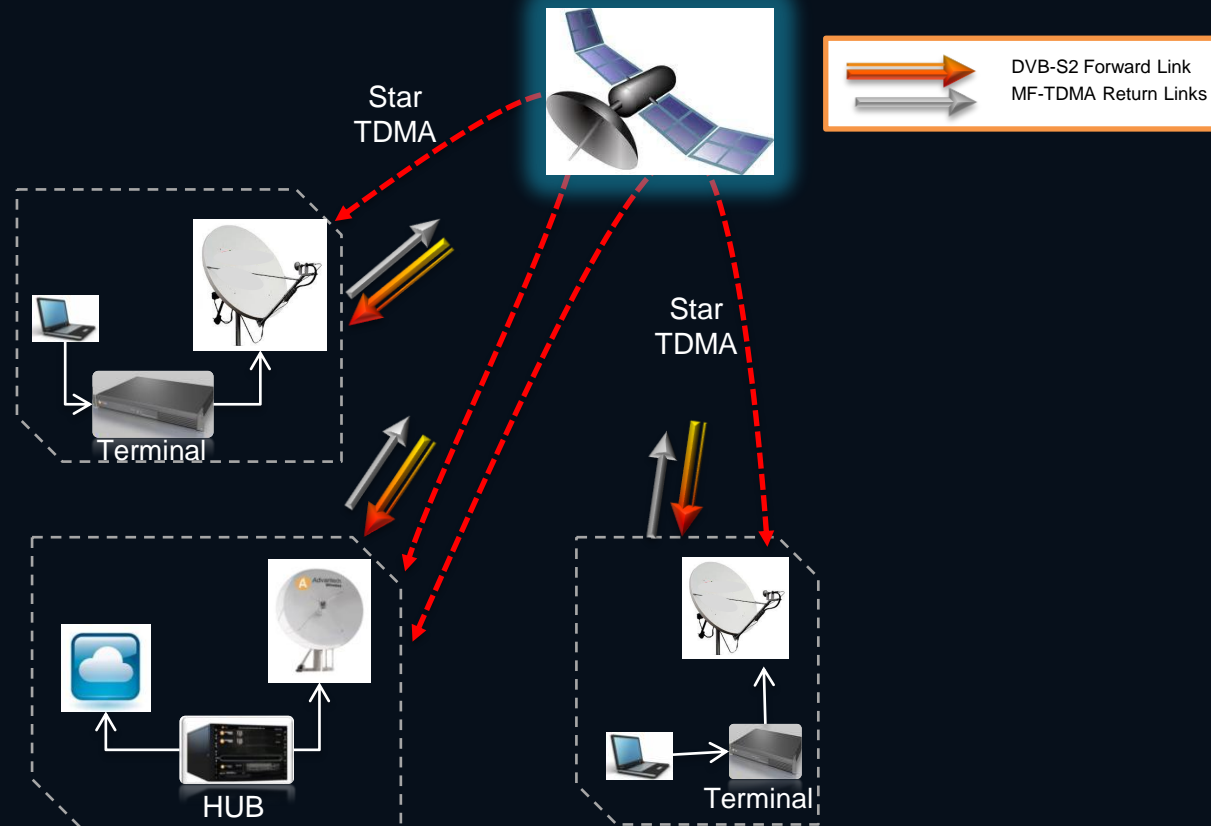> Scarcity of bandwidth in certain markets

How can this be achieved ?

Review of
Satellite Network Access Technologies

Advantech Wireless

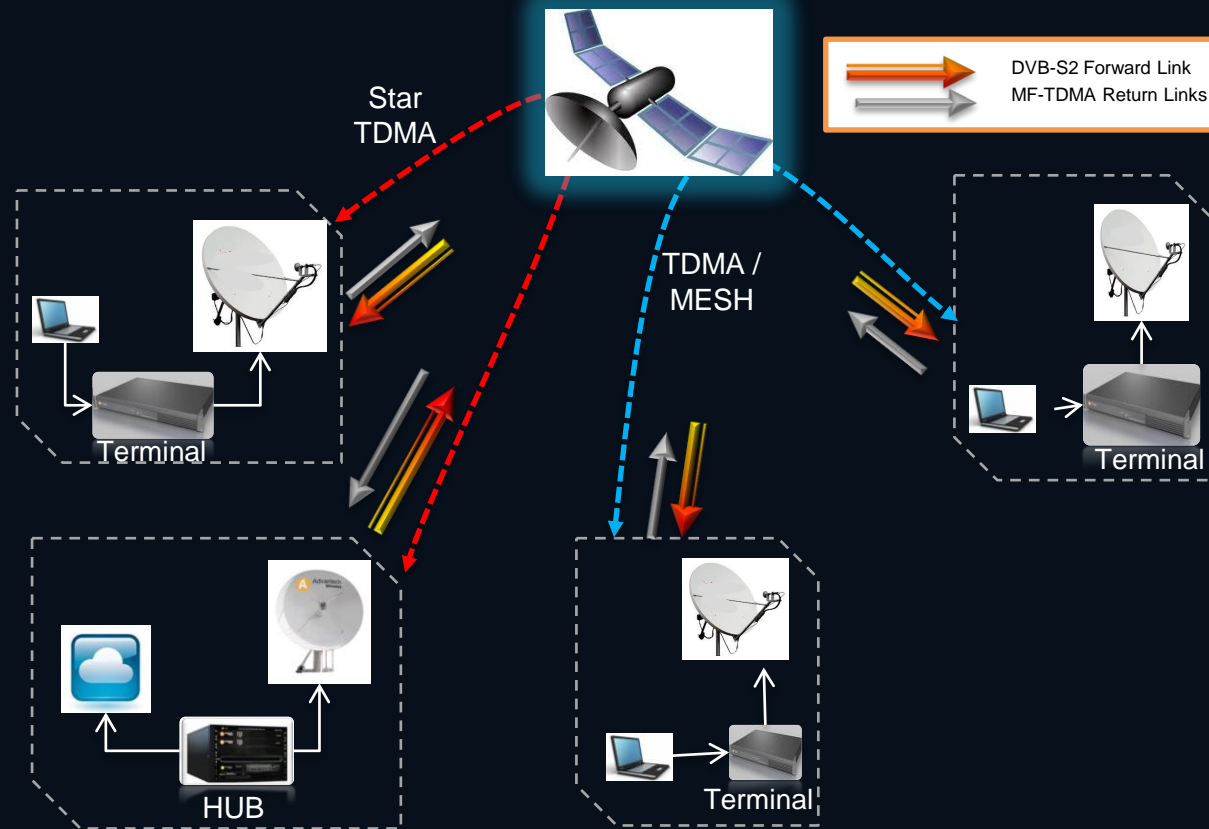DVB-RCS hub station for RCS signaling, synchronization and MF-TDMA access

Star TDMA

Star TDMA

DVB-S2 Forward Link
MF-TDMA Return Links

Terminal

HUB

Terminal

RCS Star Architecture

Advantech Wireless

DVB-S2 Forward Link
MF-TDMA Return Links

Star TDMA

TDMA / MESH

DVB-RCS Star Network with SCPC point-to-point (PTP) overlay

Terminal

Terminal

HUB

Terminal

RCS with Star / Mesh

Advantech Wireless

DVB-S2 Forward Link
MF-TDMA Return Links

SCPC PTMP
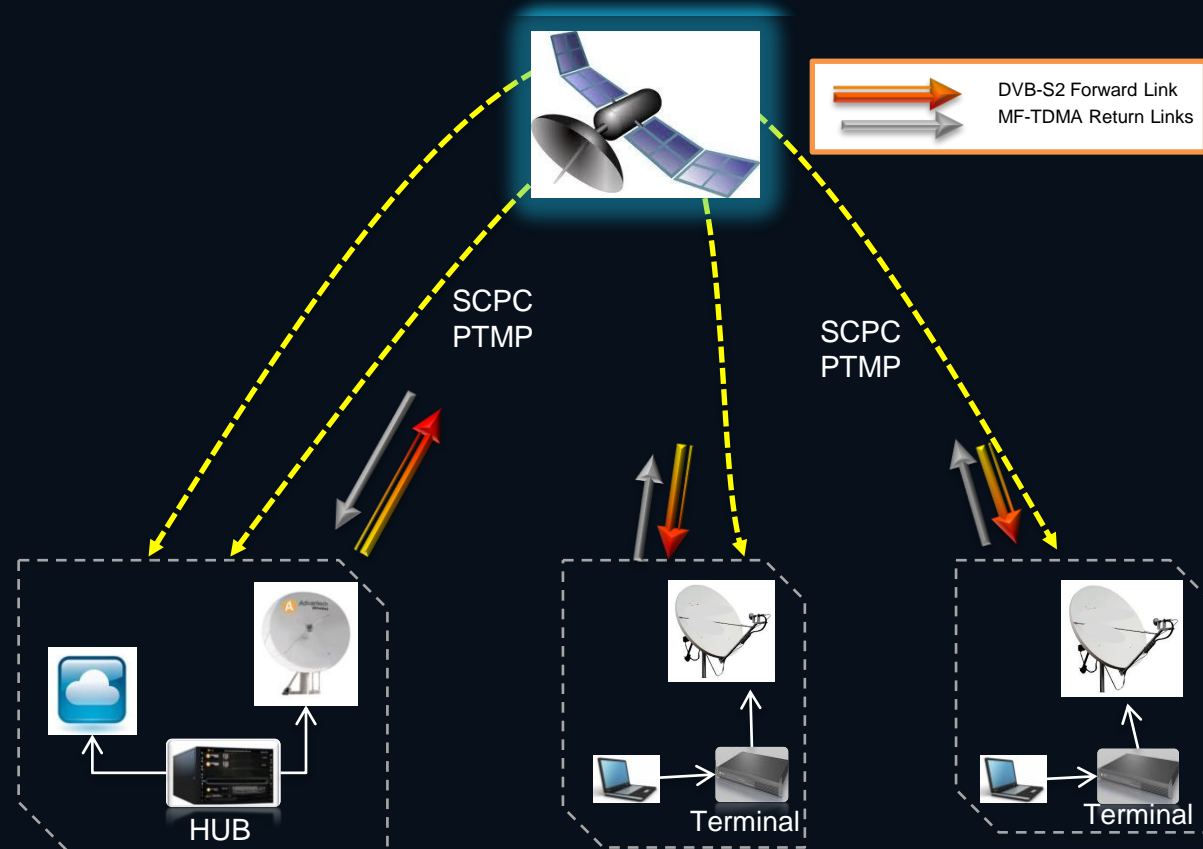
SCPC PTMP

SCPC PTPMP (Star connections to Hub) overlay uses DVB-S2 coding and modulation

HUB

Terminal

Terminal

RCS Controlled SCPC PTMP Architecture

DVB-S2 Forward Link
MF-TDMA Return Links

SCPC PTP

HUB

Terminal

Terminal
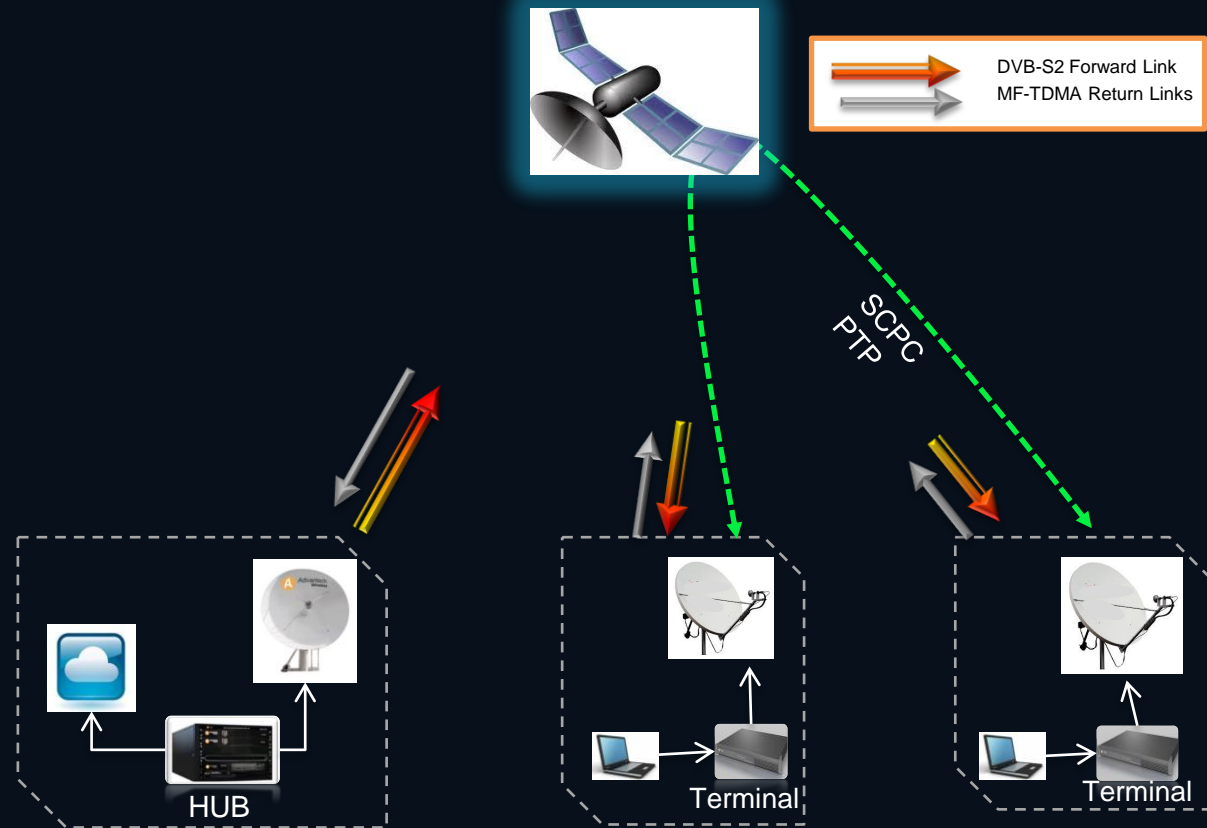
DVB-RCS hub control for direct SCPC PTP connection

RCS Controlled SCPC PTP Architecture

Advantech Wireless

SCPC

TDMA

Physical layer – SCPC is better than TDMA (bits/Hz)

> Bits/Hz→ Bits of traffic information per Hz of satellite bandwidth
> The higher the bits/Hz the more efficient the access scheme
> Less satellite resources required to carry the traffic: **less OPEX**

Bandwidth utilization – MF-TDMA is better than SCPC or SCPC DAMA

> Allows sharing (statistical multiplexing) of a carrier by different sources of traffic
> All satellite resources are used, nothing is wasted: **less OPEX**

Continuous streaming traffic (video, trunking data) → **SCPC**

Burst-like traffic (Internet browsing, SCADA, transactional, Banking Machines) → **TDMA**
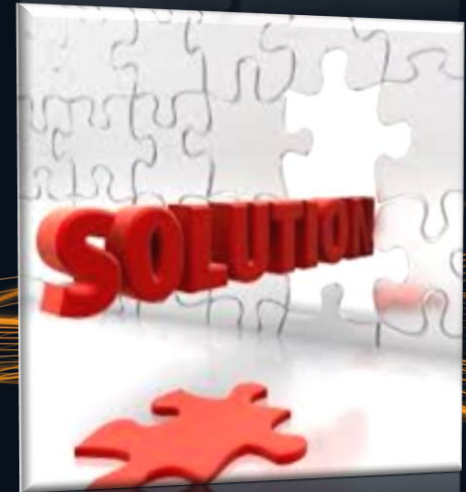
Issue

Define access scheme to be used for my satellite network at time of purchase

Question

Which access scheme do I use? TDMA or SCPC

Solution

An access scheme that adapts dynamically to the requirements of the data to be transmitted from remote terminals to hub station

Advantech Wireless

1 ASAT™ patent pending technology uses highly efficient (buts/Hz) DVB-S2 (SCPC) for fixed traffic loads
i.e. video streaming, content distribution, trunking data

2 ASAT™ technology uses flexible short burst DVB-RCS (MF-TDMA) for very dynamic traffic loads
i.e. internet traffic, SCADA, banking ATM machines, etc

3 Dynamic switching between access modes based on traffic conditions, or other defined criteria (time of day, rain fades, etc)

A-SAT™ Features
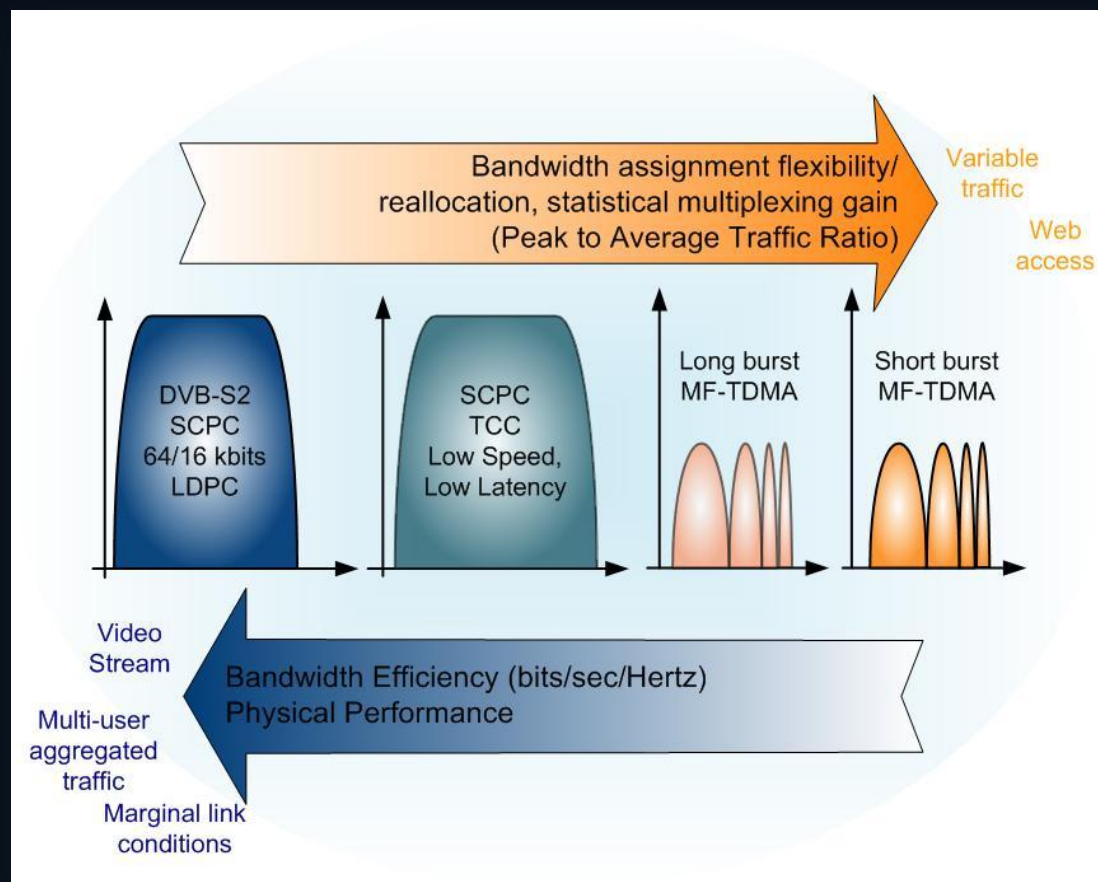
Advantech Wireless

TDMA

- Best bandwidth assignment efficiency
- Flexibility for variable traffic
- Voice, VoIP
- Web access, etc.
- GSM Abis, A-Ter
- 3G/4G Backhaul

SCPC

- Best physical performance
- Power-bandwidth efficiency
- For difficult and high capacity links
- Clear channel E1

ENCAPSULATION SCHEME

MPE/MPEG TS; ATM-1, ATM-2; FR/HDLC; GSE

Bandwidth assignment flexibility/ reallocation, statistical multiplexing gain (Peak to Average Traffic Ratio)

Variable traffic

Web access

DVB-S2 SCPC 64/16 kbits LDPC

SCPC TCC Low Speed, Low Latency

Long burst MF-TDMA

Short burst MF-TDMA

Video Stream

Multi-user aggregated traffic

Marginal link conditions

Bandwidth Efficiency (bits/sec/Hertz) Physical Performance

Forward Outbound from Gateway: up to 155 Mbps — **Forward Link**

Return Inbound MF-TDMA from terminal: up to 8 Mbps — **MF-TDMA Return link**

Return Inbound SCPC From Terminal: up to 155 Mbps — **SCPC Return Link**

Forward Link

MF-TDMA Return link

SCPC Return Link

MF-TDMA Return link

SCPC Return Link

Forward Link

Gateway

Network Management System

PC

LAN

Router

MF-TDMA / SCPC Terminal S6520

MF-TDMA / SCPC High Speed Terminal S6720

A-SAT™ Network Block Diagram

Advantech Wireless

IP Traffic

IP Subsystem IPS 100 Router /Ethernet Switches, etc

Forward Link Subsystem FLS 100 (IP encapsulator, DVB-S2 Modulator)

Hub Antenna & RF

DVB-S2 TDM Outbound Link

Forward Link Signaling

IP

Return Link Subsystem RLS 100 (MF-TDMA demods, Scheduler, IP Reassembly etc)

DVB-RCS Inbound Link

Network Management System IMS 100

Divider

DVB-S2 Demodulator(s) S6040

DVB-S2 Demodulator(s) SBD75e

ASI Interface
Video Content

DVB-S2 SCPC Inbound Links

VSAT Antenna BUC & LNB

Remote Terminal

DVB-S2

Advantech S6520 A-SAT Indoor Unit

IP Traffic

DVB-S2 TCC Or RCS

VSAT Antenna BUC & LNB

Remote Terminal

DVB-S2

Advantech S6720 A-SAT Indoor Unit

ASI Video

DVB-S2 TCC Or RCS

IP Traffic

2013 Advantech

S6720 High Speed A-SAT™ Terminal

IP Ethernet

ASI Interface

Switch

DVB-RCS MF-TDMA Modem

L-Band Combiner / Divider

IP Encapsulator

High Speed DVB-S2 Modulator

RF Transceiver

L-Band

L-Band

S6720 High Speed A-SAT IDU
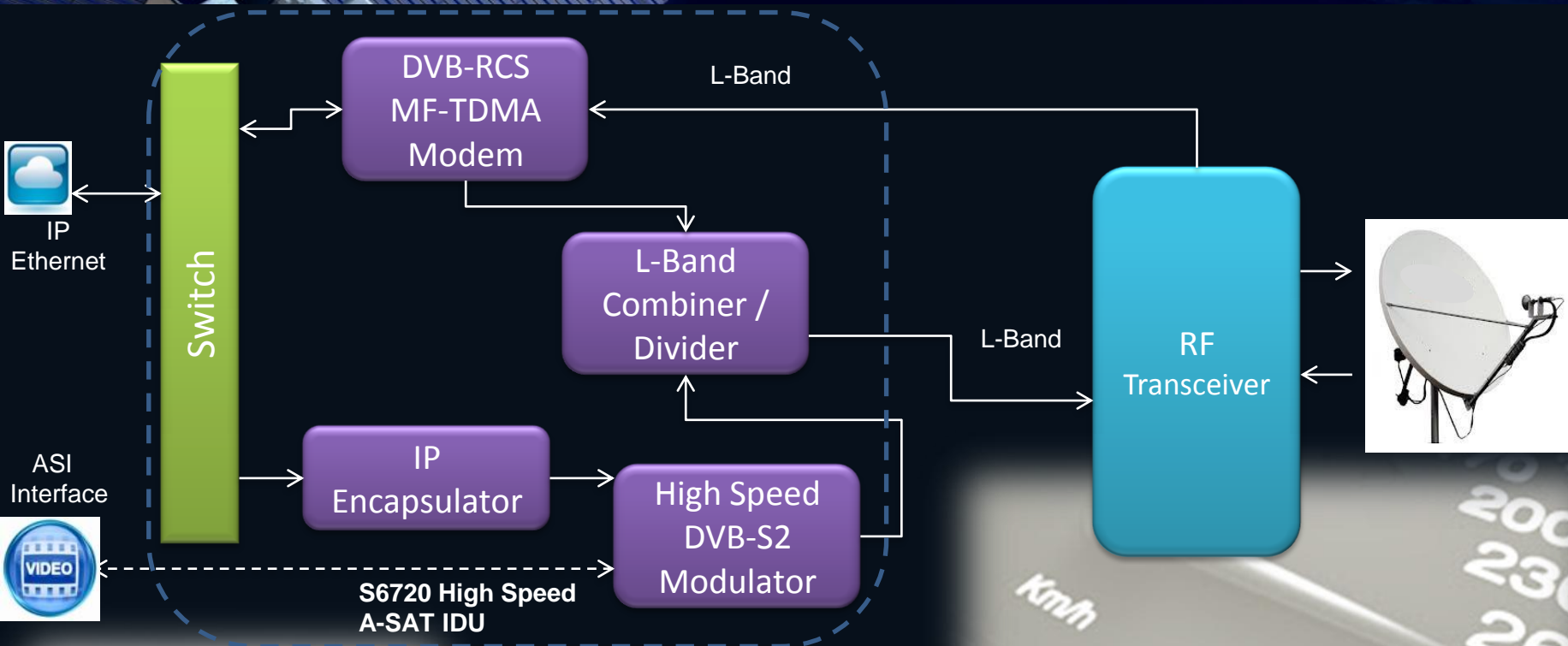
155 Mbps DVB-S2 Inbounds (FL)

128 Kbps to 8 Mbps TDMA (RL)
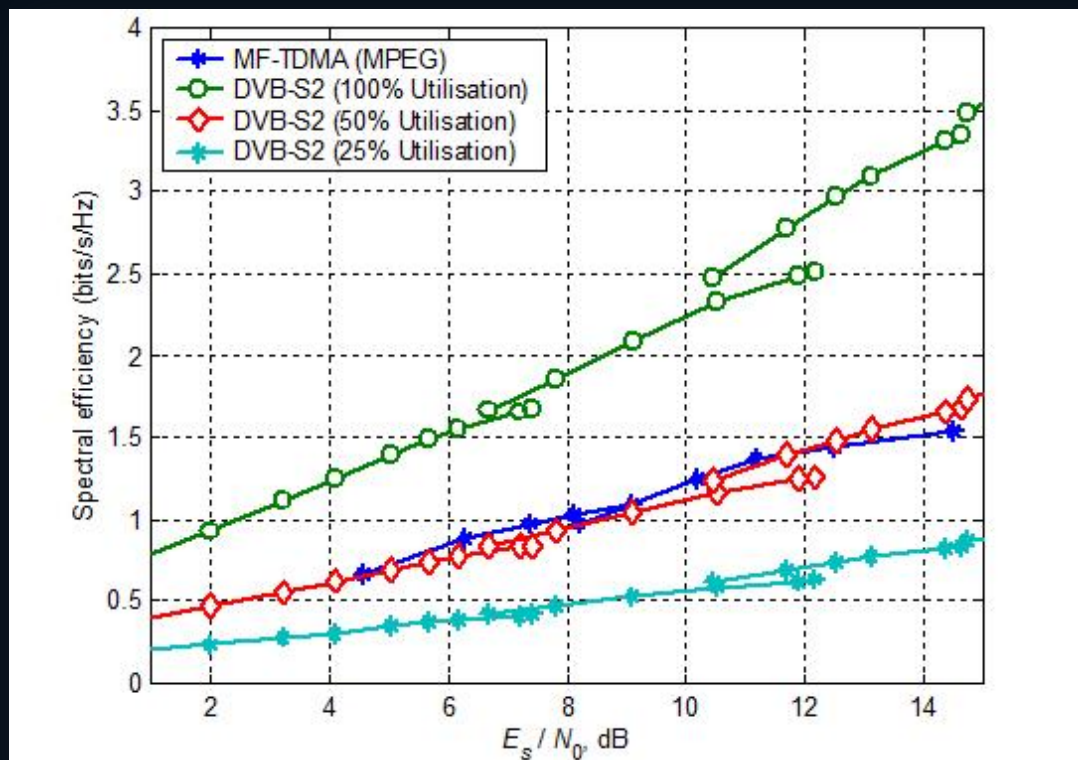
128 Kbps to 155 Mbps SCPC (RL)

A-SAT™ Performance

Expressed as bits/Hz, i.e., throughput achieved in available bandwidth

SCPC is very efficient if carrier is fully utilized. See figure

MF-TDMA is more efficient than SCPC at 50% utilization or less
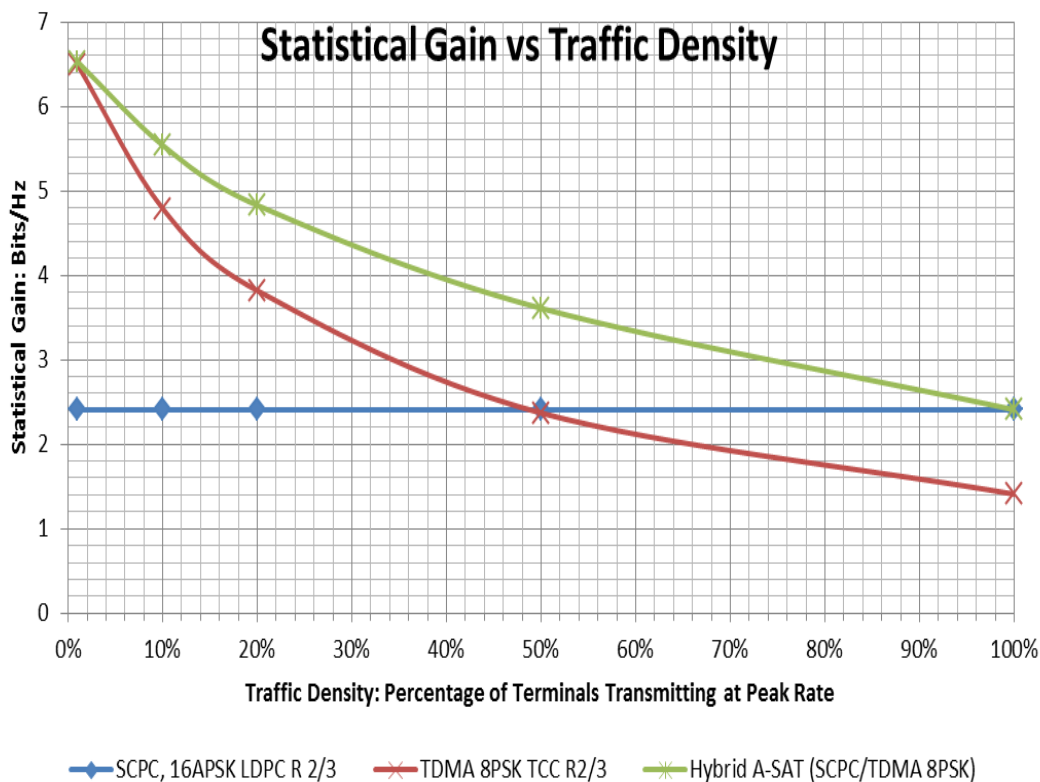
Statistical Gain

Ratio of inbound network throughput to the occupied bandwidth at various traffic densities.

Traffic Density

Percentage of terminal population operating at peak data rate. Remainder of terminals operating at average data rate.

Average Data Rate

Data rate assumed per terminal averaged over extended time. Here, average data rate is assumed to be 20% of peak data rate.

Statistical Gain vs Traffic Density

Y-axis: Statistical Gain: Bits/Hz
X-axis: Traffic Density: Percentage of Terminals Transmitting at Peak Rate

Legend:
- SCPC, 16APSK LDPC R 2/3
- TDMA 8PSK TCC R2/3
- Hybrid A-SAT (SCPC/TDMA 8PSK)

Conclusions drawn from chart

Traditional SCPC Bits/Hz Calculation

Assumes 100% traffic Density

Does not account for typical Traffic Densities less than 100%

In varying traffic profiles equally important is the statistical multiplexing gain

Considers traffic profile and ability to achieve statistical multiplexing gain of different waveform/access modes

Achieves superior performance for both SCPC or TDMA

Traffic Density profile is continually changing due to

Applications

Time of the day

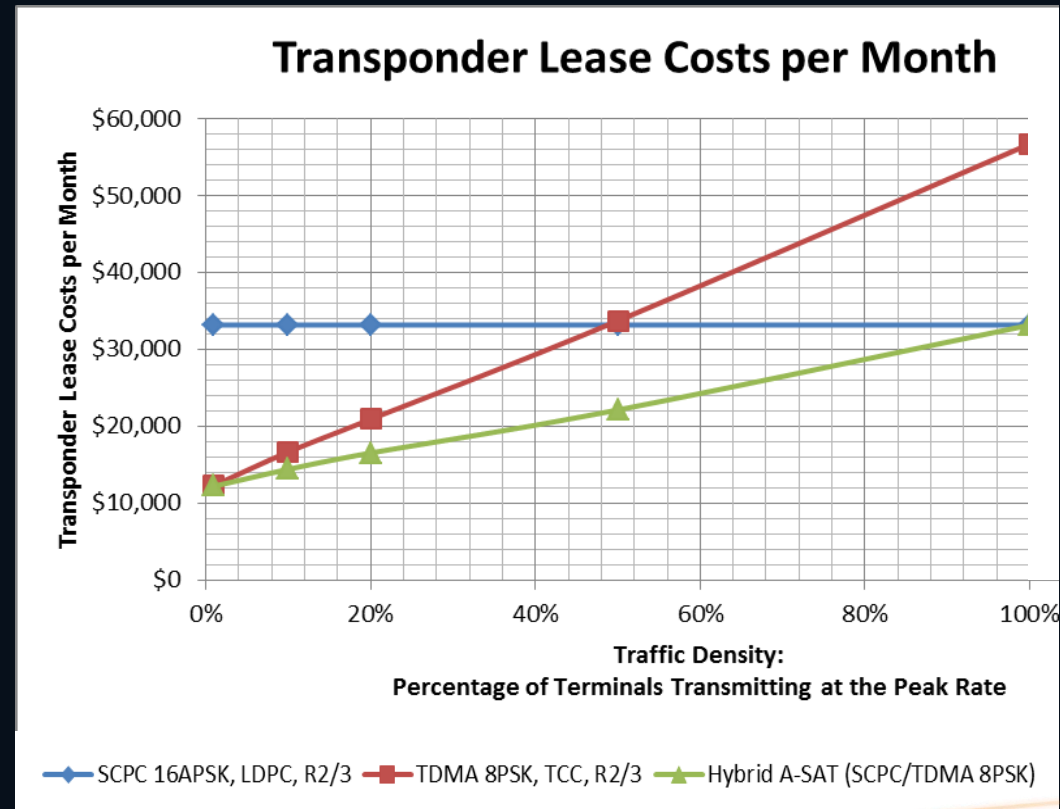Geographical spread

Packet sizes: data or VoIP (Encapsulation)

Advantech Wireless

Transponder Lease Costs

Assume 20Mbps (8.3MHz) per month for SCPC as baseline

Assumes $4,000 per MHz per month

A-SAT always most cost effective in space segment lease.

Transponder Lease Costs per Month

Chart: Transponder Lease Costs per Month vs. Traffic Density: Percentage of Terminals Transmitting at the Peak Rate

Legend:
- SCPC 16APSK, LDPC, R2/3
- TDMA 8PSK, TCC, R2/3
- Hybrid A-SAT (SCPC/TDMA 8PSK)

Annual savings could exceed $250K

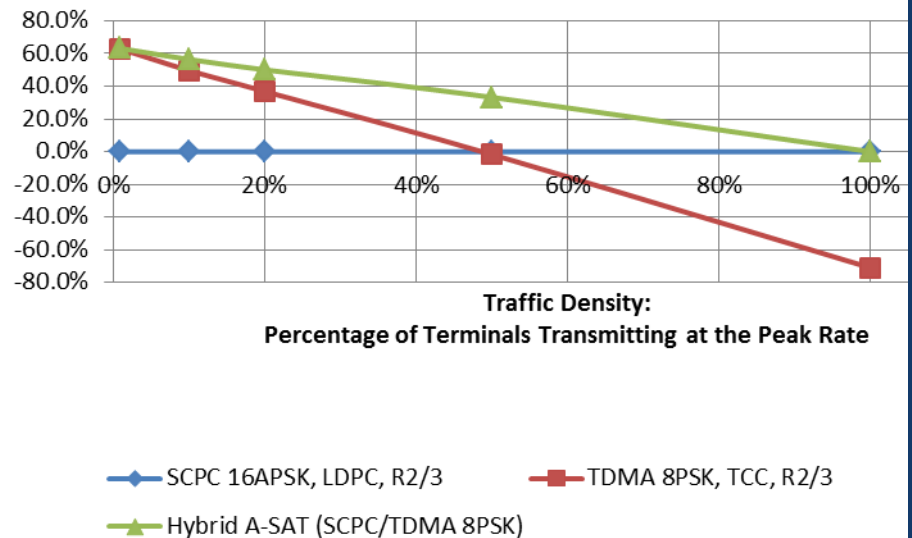**Percentage Improvement over SCPC-Only Solution**

TDMA-only solution not as effective when traffic density exceeds 50%

A-SAT™ solution always better than or equal to SCPC-only solution

Percentage Improvemement Compared to SCPC

Traffic Density: Percentage of Terminals Transmitting at the Peak Rate

- SCPC 16APSK, LDPC, R2/3
- TDMA 8PSK, TCC, R2/3
- Hybrid A-SAT (SCPC/TDMA 8PSK)

Advantech Wireless

Manual switching

Manual switching of SCPC/MF-TDMA at any time via the NMS .

Traffic volume

- MF-TDMA to SCPC when the traffic volume on the RL exceeds (from RCS to SCPC) a certain bit rate threshold for a minimum period of time
- SCPC to MF-TDMA when the traffic volume on the RL is below (from SCPC to RCS) a certain bit rate threshold for a minimum .

Pre-configured session

- Switch request from MF-TDMA to SCPC when it detects the beginning of a pre-configured session (with IP filter). Example:
    a. Start of a Multicast session (use IP destination address),
    b. Start of a large file transfer (use IP destination address)
    c. Start of a video or other application requiring minimal jitter (with specific ToS).

Link Quality

- Switching based on the link quality. As an example, if the link is below a certain threshold not handled by RCS, a switch to a more robust SCPC link.

Scheduled Event

- NMS initiated waveform change based on a schedule (time of day application). Ex. Pre-scheduled interactive video conference at high rate

Traffic Variability

- Modem waveform switch request from MF-TDMA to SCPC (or vice versa) when it detects a change from High variability to low variability. For high variability, MF-TDMA is better. For low variability, SCPC is better.

A-SAT™ Summary

Technology dynamically adapts the satellite physical link to maximize efficiency based on application and traffic flow

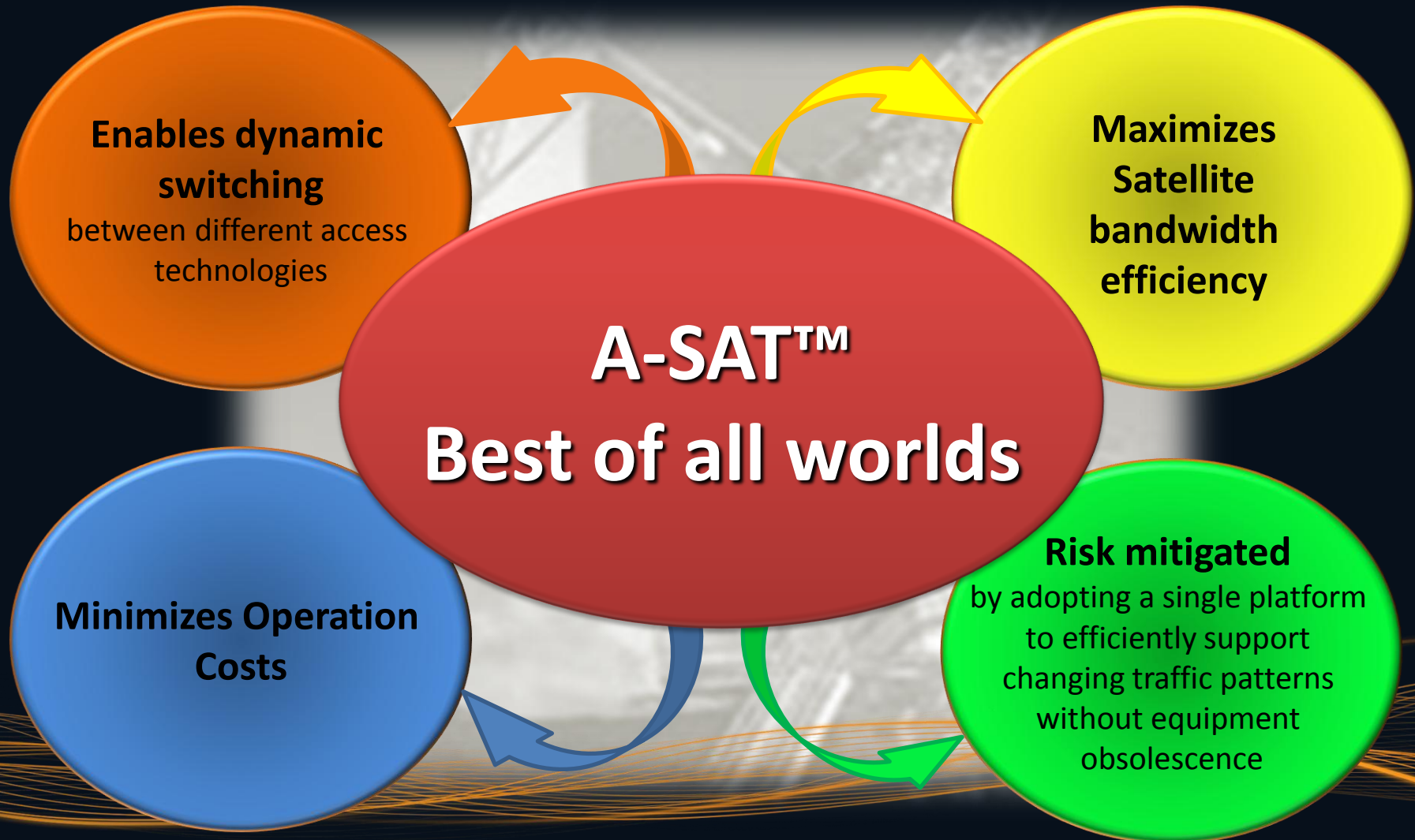**Burst-like traffic flow** → **TDMA transmission**

Statistical multiplexing provides huge gains by sharing bandwidth among many users

Constant traffic flow → **SCPC transmission**

Satellite efficiency is optimized using continuous carrier transmission (SCPC) waveforms, such as DVB-S2 or TCC for low speed, low latency

Advantech Wireless

Enables dynamic switching between different access technologies

Maximizes Satellite bandwidth efficiency

A-SAT™
Best of all worlds

Minimizes Operation Costs

Risk mitigated by adopting a single platform to efficiently support changing traffic patterns without equipment obsolescence

Thank you!

For more information please visit:

www.advantechwireless.com