



Advancing a Connected World

**Cellular Backhaul Solution**

May 2011

# General cellular market information

## Key drivers for cellular operators

- **Extending coverage footprint profitably**
  - Offer low-cost; profitable solution for rural users
  - Offer value to metro subs traveling into remote areas
  - Drive maximum efficiency from new infrastructure
- **Expanding into capacity constrained regions**
  - Bandwidth sharing and bandwidth efficiency important
- **Winning and preserving customer loyalty**
  - Be the first-to-market to gain life-long customers
- **Leveraging greater revenue opportunities**
  - Offer additional services like data, fixed voice, WiFi or WiMAX to increase Average Revenue Per User (ARPU)
- **Meeting regulatory requirements**
  - Need to cover remote and sparsely populated areas as a prerequisite for additional licenses in the cities



# General cellular market information

## Cellular backhaul market facts

*Over 2.2 billion people live in areas that have no cellular coverage*

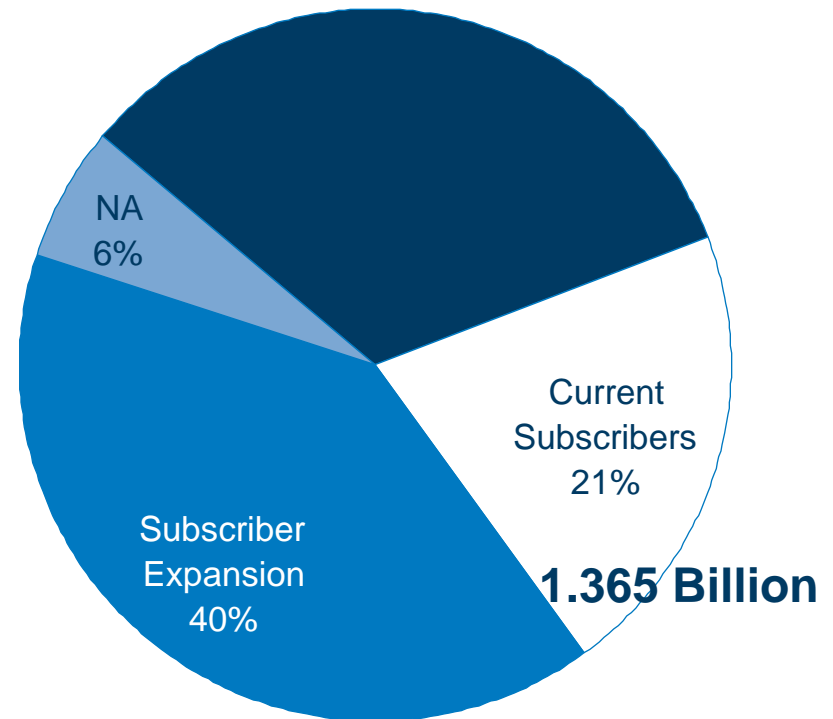
- **Demand for service is high in most of these areas**
- **Significant market growth opportunity**

*GSM Standard accounts for 90% of Mobile Networks today*

*Base Station (BTS) Prices Continue to Fall*

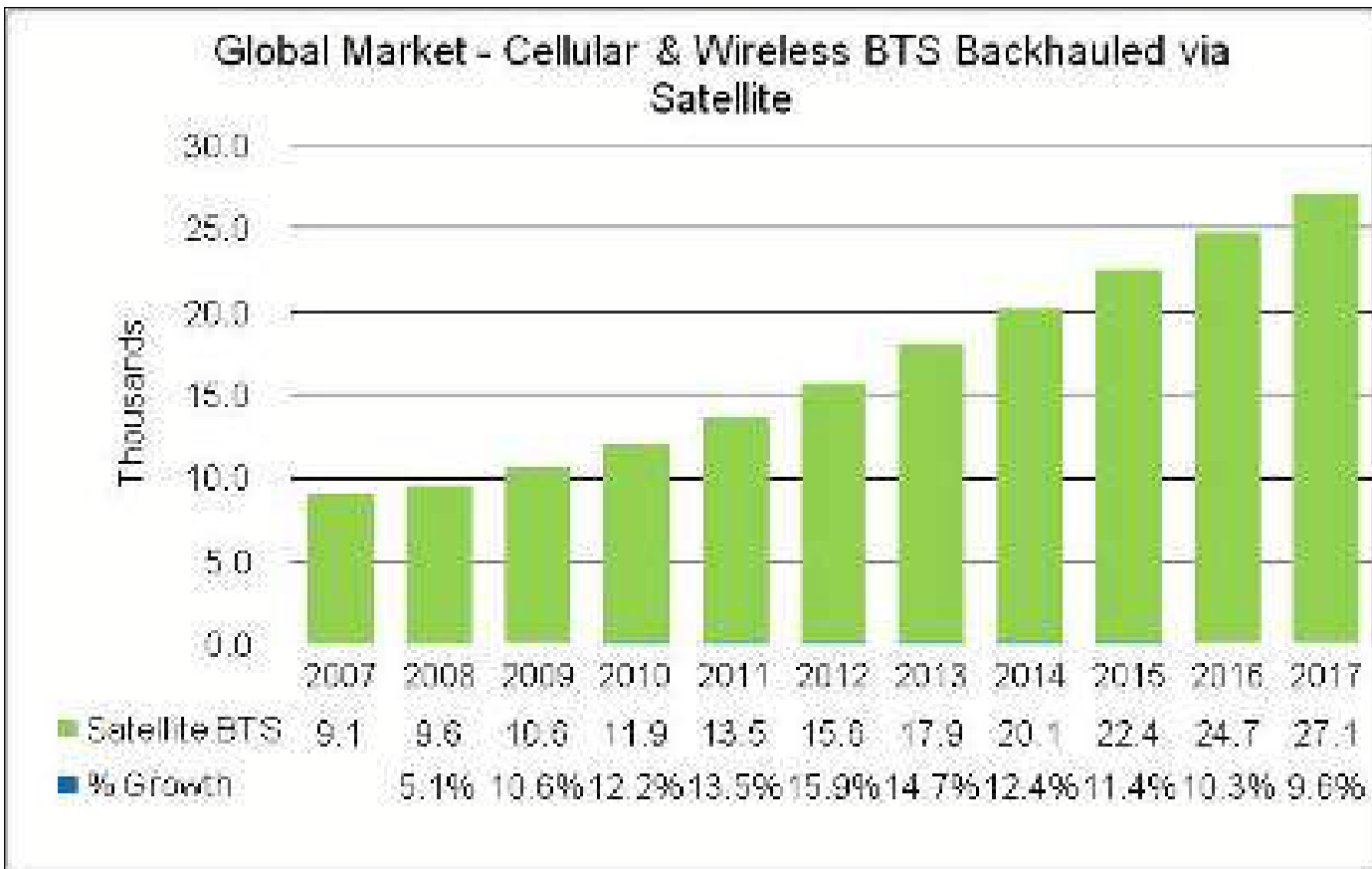
- **Drives deployment in sparsely-populated regions**

**World Population: 6.5 Billion**



# General cellular market information

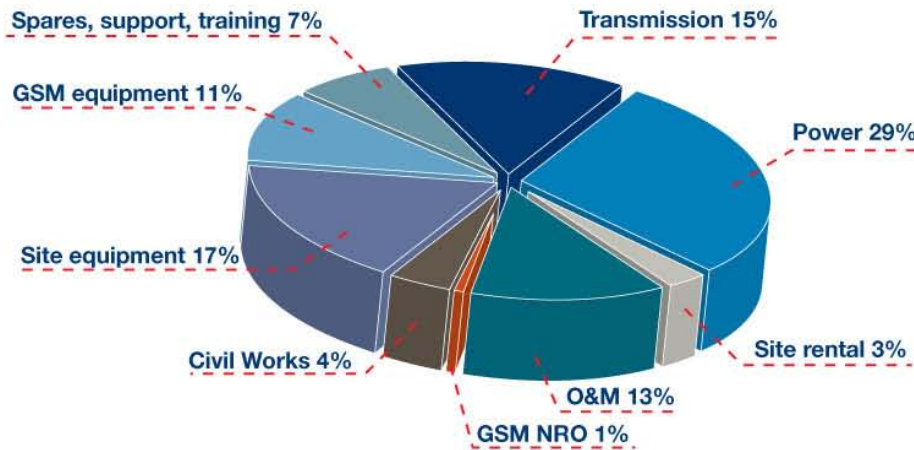
## Rural growth



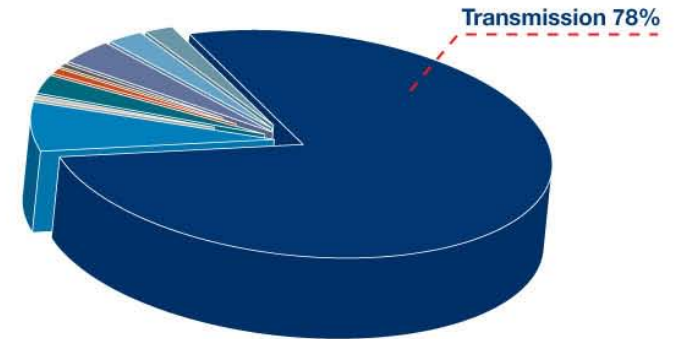
Source: NSR'08

# General cellular market information

## Backhaul cost challenge



Based on leased line transmission at a rate of USD500 per E1 per month



What if the most cost-efficient available alternative costs USD10,000 per E1 per month?

Source: Ericsson

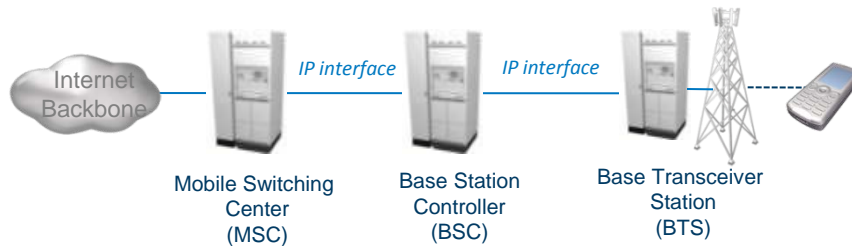
# General cellular market information

## Evolving network architecture

Legacy: All-TDM network



Future: All-IP network



Vendors offering IP based cellular network equipment:

- Ericsson
- Huawei
- ZTE
- Nokia / Siemens
- IP Access
- Zyntex
- Alcatel/Lucent

### Key Findings:

- Majority of cellular vendors are already offering IP based equipment
- New network deployments based on all-IP equipment
- Trend indicates widespread deployment of IP technology displacing TDM based networks
- Rural BTS' traffic is lower in volume and more peaky ideally suited for bandwidth sharing

# General cellular market information

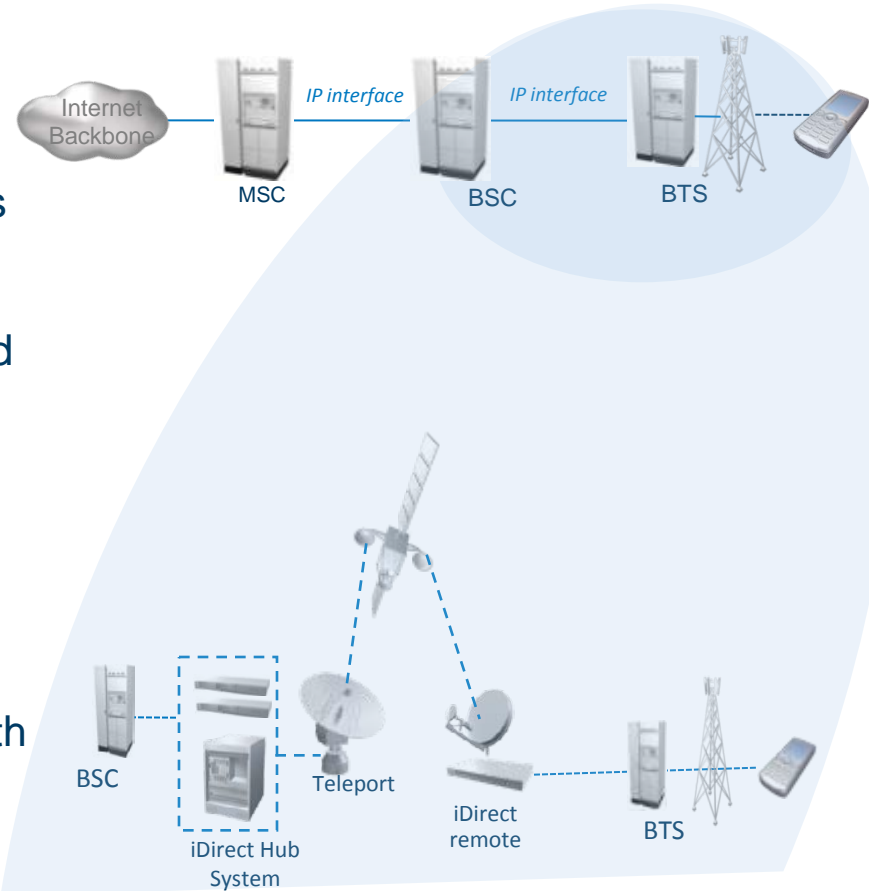
## Mobile cellular

### Characteristics of BSC/BTS traffic

- Large number of BTSs typically connected to one BSC
- BTS dispersed over large territories
- Microwave or terrestrial infrastructure is cost-prohibitive when covering long distances to reach BTS in rural areas
- Rural BTS' traffic is lower in volume and more peaky

### Ideal connectivity for satellite

- Long distance between BTS and BSC best served via satellite backhauling
- BTS traffic is ideally suited for bandwidth sharing

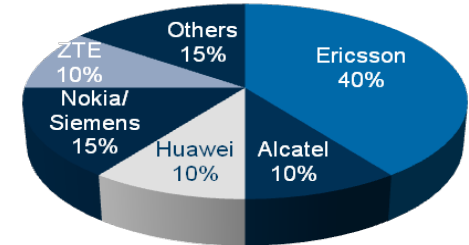


# General cellular market information

## Equipment Vendor Landscape

- iDirect remains vendor agnostic providing freedom of choice to mobile operators
- We continuously test new equipment
- Ericsson / iDirect Partnership
  - Recent announcement Ericsson MiniSite
  - Integrated Ericsson Pico GSM BTS and iDirect D-TDMA satellite remote in a single, weatherproof enclosure

Vendor Market Share



Vendor	Offers IP enabled equipment	Operational iDirect networks
Ericsson	Yes	Yes
Huawei	Yes	Yes
ZTE	Yes	Yes
Nokia / Siemens	Yes	Yes
Alcatel / Lucent	Planned 2009	Yes
Others •IP Access •Zyntex	Yes	Yes



# General cellular market information

## Satellite opportunity

Satellite is ideally suited for cellular operators to:

- Profitably expand into under-served regions where there is no terrestrial build-out
- Be first-to-market to gain customer's commitment
- Rapidly adjust to changing traffic and subscriber growth
- Leverage greater revenue opportunities and increase customer stickiness by easily adding new services
- Provide rapid means to meet regulatory requirements of universal access

# General cellular market information

## Customer needs

- Bandwidth efficiencies to enable higher profitability
- High reliability and terrestrial grade link quality
- Ease of Network Management to enable SPs to do rapid configuration changes without site visits
- Scalability and flexibility for network expansions and technology upgrades
- Equipment agnostic to ensure interoperability with all systems and maximum flexibility



# General cellular market information

## Improving cellular backhaul ROI

- ROI analysis is made generally over 18 months duration
  - To increase service providers interest in very remote areas, states would use a USO fund to subsidize the cost of communications for these locations
- World cellular market expansion is now achieved through lower PPP (Purchasing Power Parity) countries and locations
  - ARPU in these regions is expected to be lower than \$8.00
  - Satellite bandwidth, being one of the main component in the cost per subscriber for any site, has to be optimized

# General cellular market information

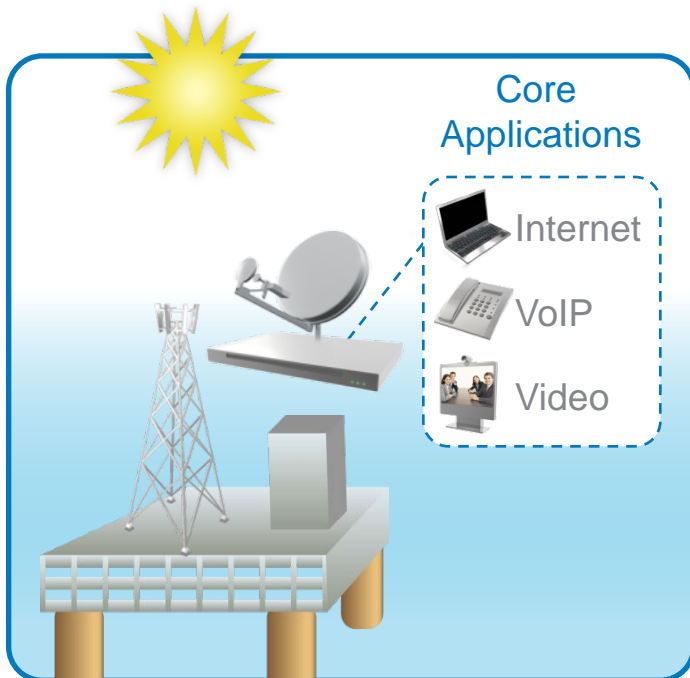
## Improving cellular backhaul ROI (Cont'd)

- Several possible ways to improve ROI on lower ARPU locations
  - Government subsidies and regional licensing approach
  - Lower Opex: Backhaul optimized solutions
  - Lower Capex: Newer technologies and products
  - Providing other services through the same sites : WiFi, or any other wireless Internet Access service

**iDirect has a suitable solution that meets the last three ROI improvement paths: Lower Opex, Lower Capex, Multi-service support**

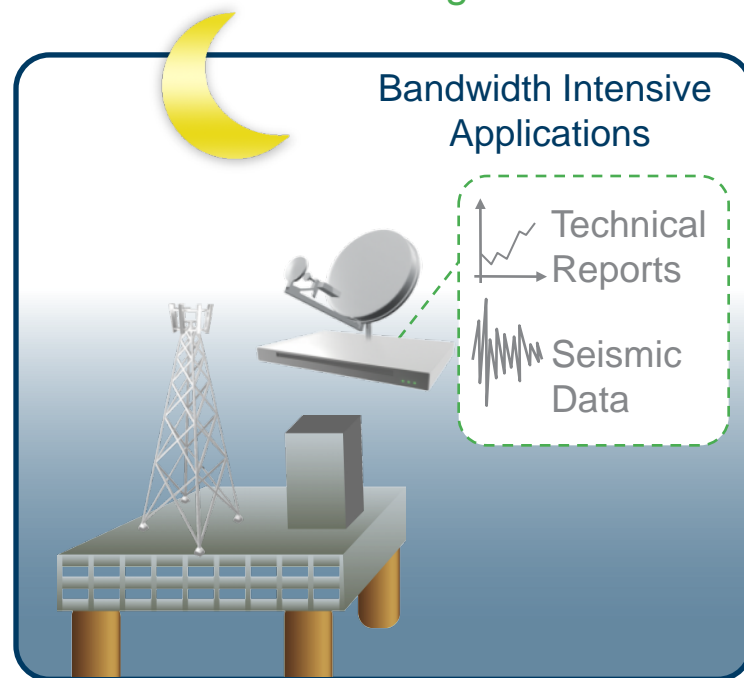
# D-TDMA & SCPC Return on the same Intelligent Platform

## TDMA Mode



Default TDMA mode efficiently transmits variable data, voice and video-conferencing traffic

## SCPC Switching Mode



At any time, the router can temporarily switch to SCPC mode to efficiently send large data files that require higher, constant bandwidth.

D-TDMA is ideal for rural expansion

SCPC Return is ideal to move the largest BTS from TDMA

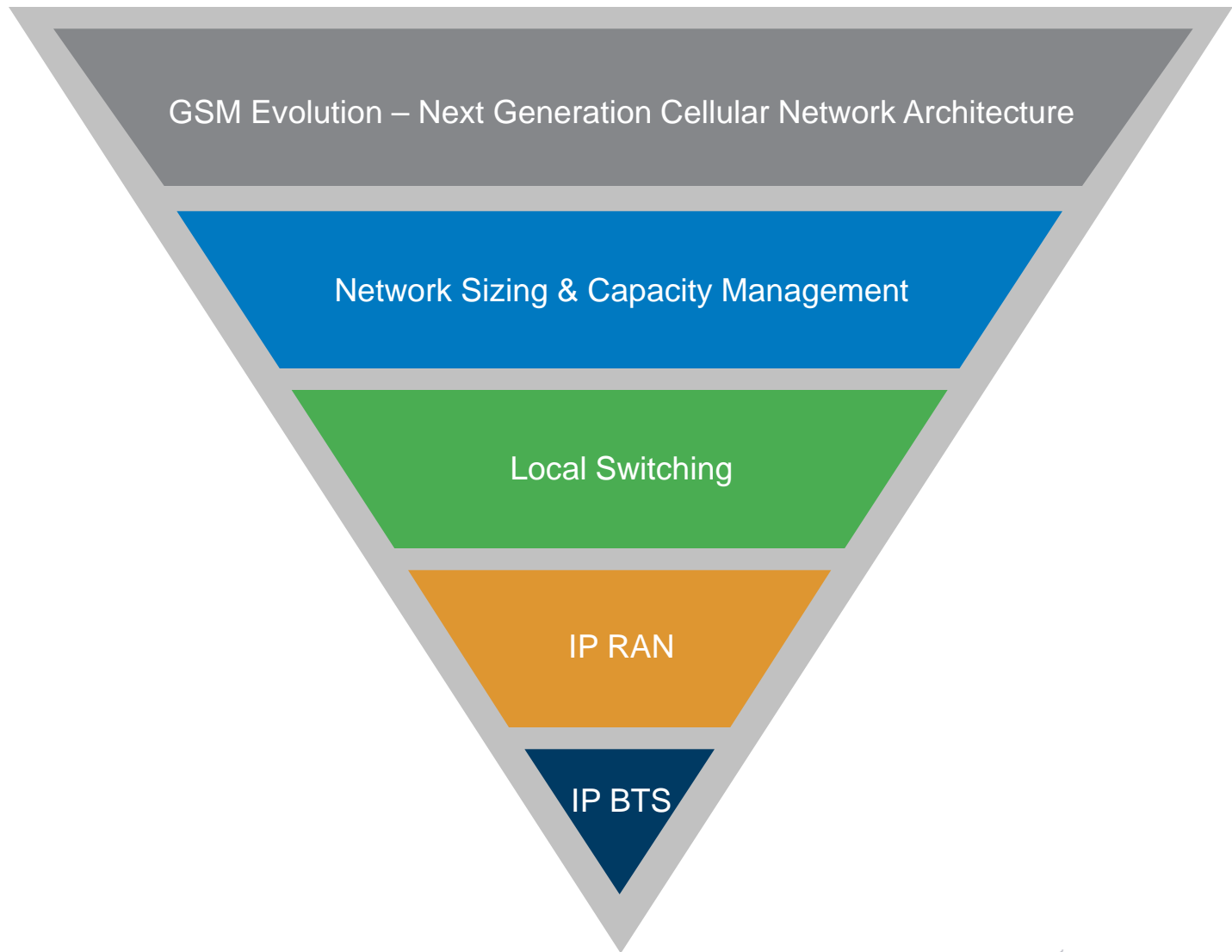
Where traffic per site is >30 Erlangs the overhead of D-TDMA can exceed the Erlang savings – in which case iSCPC may be more efficient

# General cellular market information

## Main market players

- Cellular Operators
- Cellular platform vendors
- Mediation device vendors
- VSAT vendors
- VSAT operators
- Satellite operators

# The Cellular Backhaul Business Case



# The Cellular Backhaul Business Case

- The Broadband VSAT-based backhaul results in up to 80% OPEX savings

## ▼ IP BTS:

- Statistical multiplexing gains on IP interface
- TDMA allows for sizing on average demand and not SCPC peak demand

## ▼ IP RAN:

- Erlang gains (typical 30% to 40%)
- Busy hour decorrelation gains (typical 10% to 40%)

## ▼ BTS Local Switching

- Most calls are local and are not transported over satellite (typical gain: 40% to 80%)

## ▼ Network Sizing and Capacity Management

- Hub-based solution allows centralized management (bandwidth savings typical 20 to 80%)

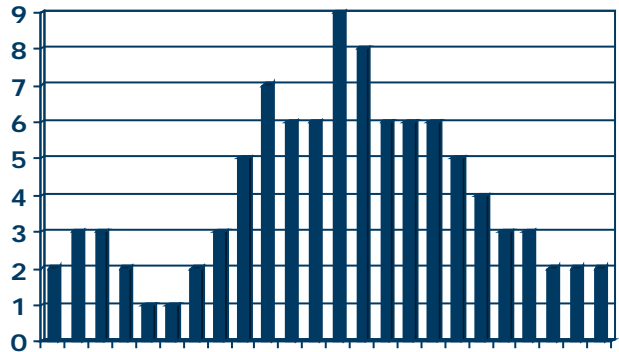
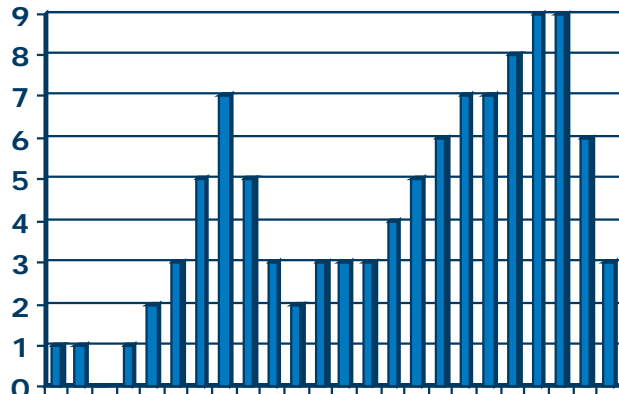
## ▼ GSM + UMTS integration

- Single platform for all cellular payloads

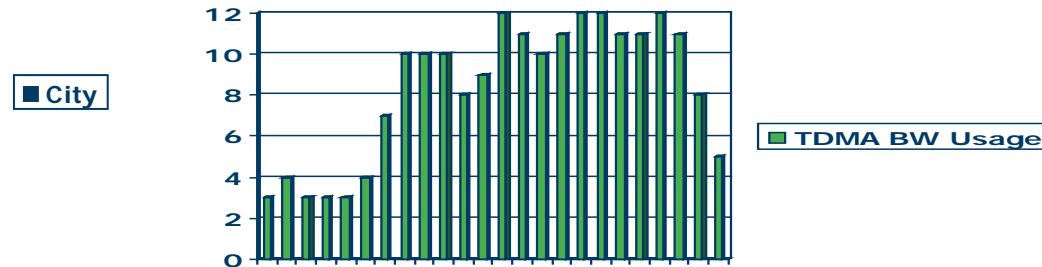
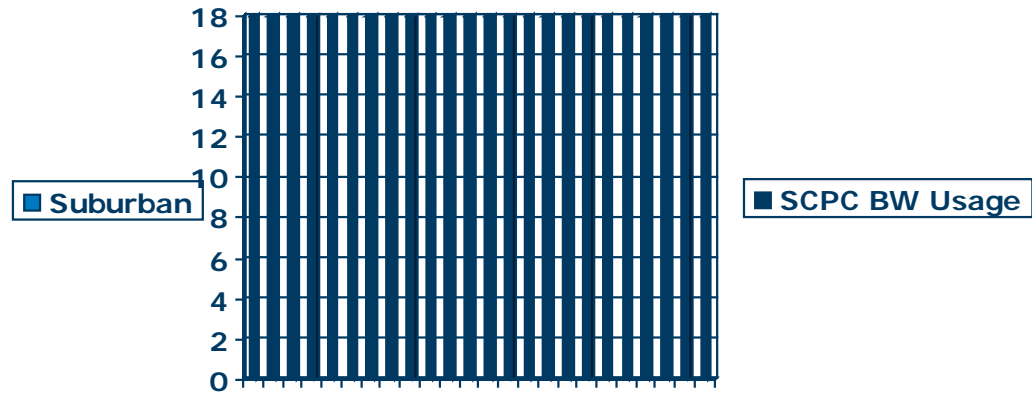


# Busy Hour Decorrelation (cont.)

Example calling patterns for 2 sites -

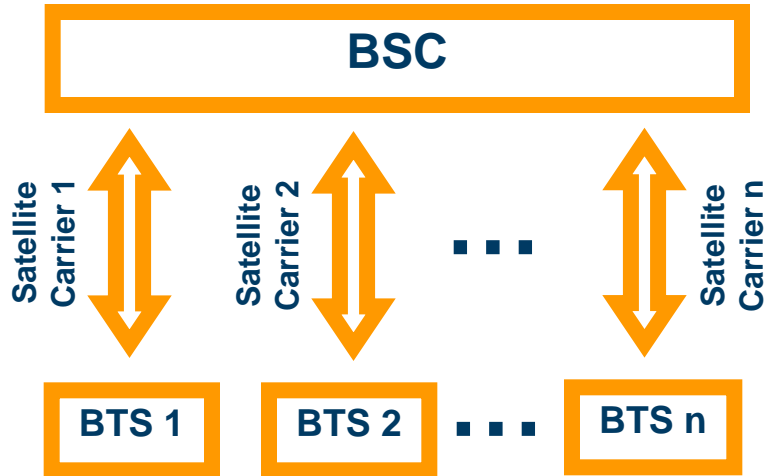


Resulting network BW utilization -



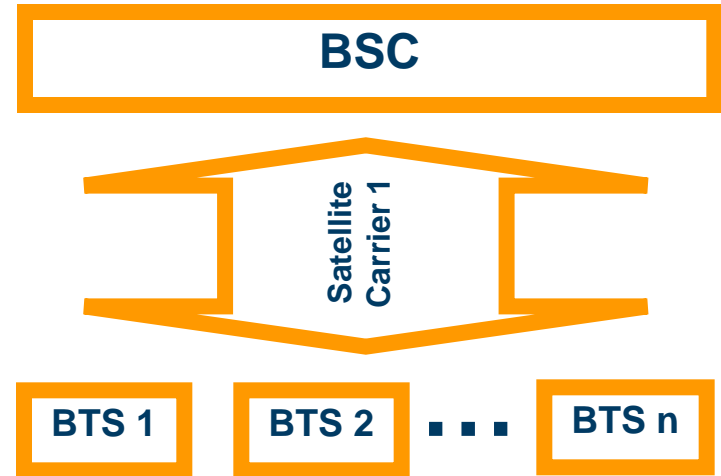
**Result – In this simple example, the TDMA solution only uses 66% of the BW that would be required by the SCPC solution.**

## SCPC Paradigm: "n" separate full duplex carriers



- **Given Assumptions Herein:**
  - 10 BTS
  - 10 Erlangs per BTS
  - 1% Grade of Service
  - 16 kbps full duplex per line
  - 1 bit/second/Hz for SCPC modem
- **Implications:**
  - 10 satellite carriers
  - 18 lines in each satellite carrier
  - 180 lines in the entire network
  - 2880 kbps downstream in network
  - 2880 kbps upstream in network

## iDirect D-TDMA Paradigm: 1 shared full duplex carrier

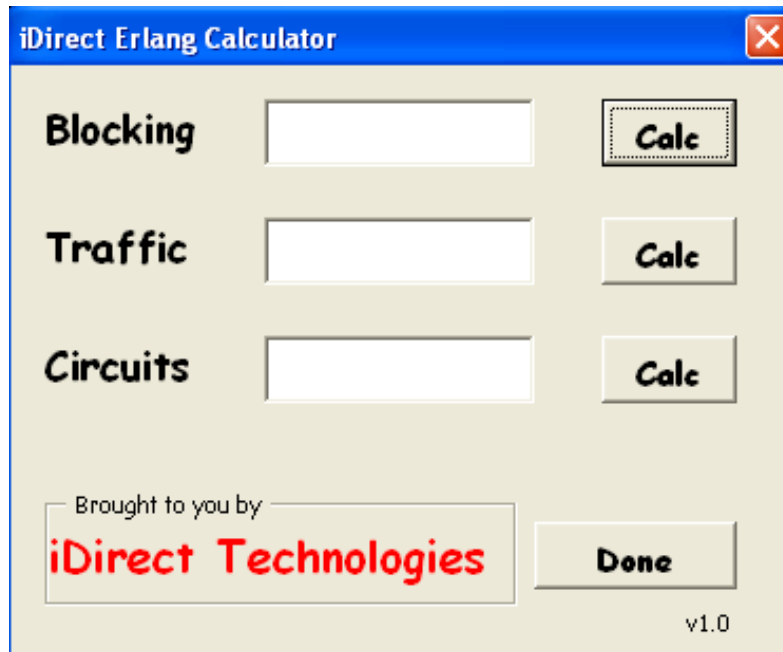


- **Given Assumptions Herein:**
  - 10 BTS
  - 10 Erlangs per BTS
  - 1% Grade of Service
  - 16 kbps full duplex per line
  - 1 bit/second/Hz for TDMA modem
- **Implications:**
  - 1 and only 1 satellite carrier
  - 117 lines in the 1 satellite carrier
  - 117 lines in the entire network
  - 1872 kbps downstream in network
  - 1872 kbps upstream in network

**35% gain** →

# Erlang Calculator

- Determine the number of voice circuits required to support a traffic of:
  - 5 Erlang (e.g. 10 SCPC links)
  - 50 Erlang (single TDMA network)
  - Compare
- Assuming blocking of 0.01



The screenshot shows a software window titled "iDirect Erlang Calculator" with a standard Windows-style title bar (blue background, close button). The main area is light beige and contains three rows of input fields and buttons:

- Blocking:** A text input field followed by a button labeled "Calc".
- Traffic:** A text input field followed by a button labeled "Calc".
- Circuits:** A text input field followed by a button labeled "Calc".

At the bottom of the window, there is a section for attribution:

- A text label "Brought to you by" above a box containing the "iDirect Technologies" logo in red.
- A button labeled "Done" to the right of the logo box.
- The version number "v1.0" in the bottom right corner.

# iDirect GSM Planning Service

- GSM Backhaul Planning tool estimates IP throughput and transponder MHz needed – and calculates all the benefits

**iDirect GSM Backhaul Network Design Tool**  
Version 1.5.1  
19 July 2007

**Step 1: Set Basic Traffic Parameters for the RA**

%age of Traffic in Busy Hour:	28%
Target Grade of Service (Blocking):	1%
Number of Hours Close to Zero Use:	8

**Step 2: List the BTSs to be Included and their T**

Total # BTSs	Total # TRXs	Total # TCHs	Total Signalling (kbit/s)	Total M
57	75	525	3616	148.95

**iDirect Erlang Calculator**

Blocking:  **Calc**

Traffic:  **Calc**

Circuits:  **Calc**

Brought to you by  
**iDirect Technologies** **Done**

BTS Identifier	Number of TRXs	Number of TCHs	Signalling Capacity (kbit/s)	Maximum Hourly Erlangs	Busy Hour GPRS EDGE Downlink Traffic (kbit/s)	Busy Hour Time (hh:mm)	Theoretical Maximum TCH Traffic (Erlangs)	Actual Blocking (%)	Voice Traffic Contribution to Busy Hour (Erlangs)	Total Bothway B/W Required for SCPC (kbit/s)
BTS-0 1010	0	0	32	3	0.00	21:00	0.00	100.00%	3.00	64
BTS-1 1020	1	7	64	2.74	12.00	20:00	2.50	1.50%	1.45	334.4
BTS-2 1040	1	7	64	0.77	12.00	20:00	2.50	0.00%	0.41	334.4
BTS-3 1050	2	14	64	6.46	24.00	22:00	7.35	0.40%	3.41	604.8
BTS-4 1051	2	14	64	3.09	24.00	22:00	7.35	0.00%	1.83	604.8
BTS-5 1060	1	7	64	0.67	12.00	21:00	2.50	0.00%	0.67	334.4
BTS-6 1061	1	7	64	1.44	12.00	19:00	2.50	0.05%	0.68	334.4

Page GoS	Total Effective Busy Hour Erlangs	Total Bothway SCPC BW (kbit/s)
2.03%	88.98	23928

Ready

# Customer information collection

- Number of Base stations and Locations
- Traffic Per Base Station (Voice and Data) --- Voice codec, silence percentage, etc.
  - Existing BTS: Measurement
  - Future deployment: Projected number of subscribers, and Average Erlang per subscriber
- Base Station Sizing
  - Number of TRXs
  - Total number of TCHs
  - Signaling Channels
  - Number of Physical Interfaces
- Cellular Network Vendor (When possible use IP-BTSSs)
- Preferred/Existing Mediation Device
- Existing/New deployment?
- Handover requirement?
- Available Power Supply per Base Station + Integrator Choice
- Critical Sites (Need for Uplogix)
- Other services ?

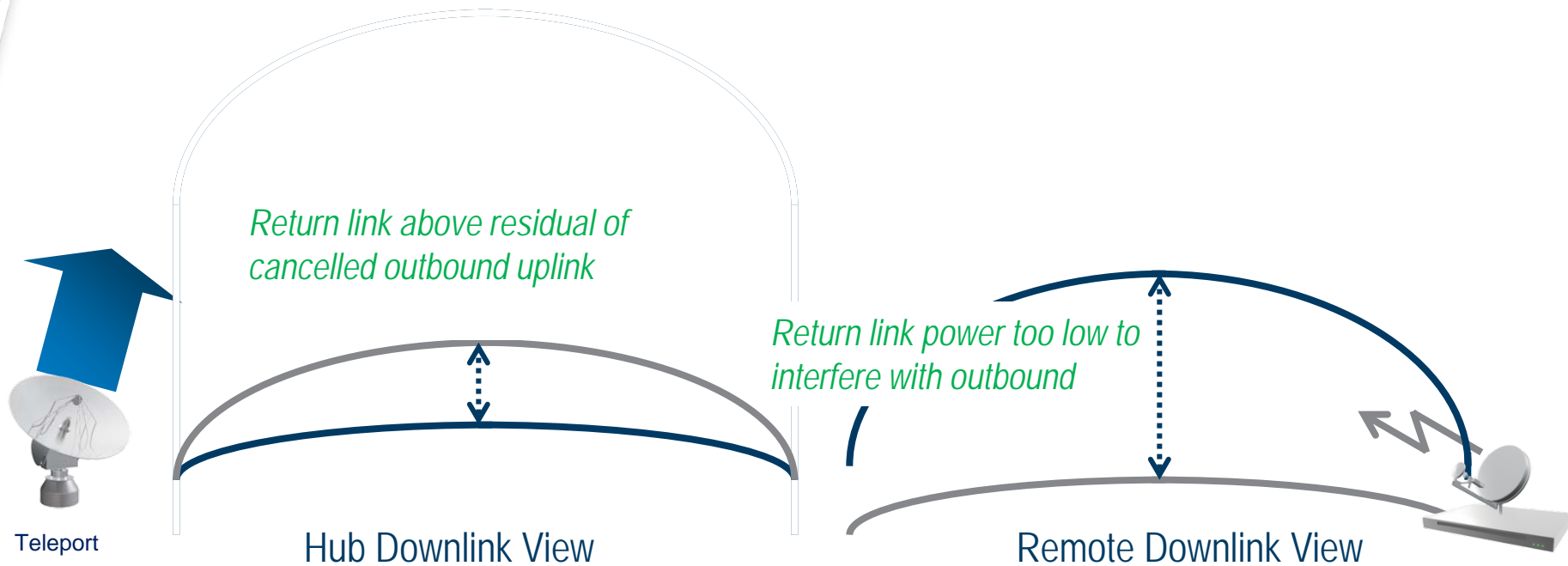
# PCMA Cancellor

- Uses Paired Carrier Multiple Access (PCMA) to combine the uplink and downlinks transmissions into the same bandwidth
- Reduces satellite space segment costs and frees up bandwidth for new applications
- Works with Evolution DVB-S2/ACM and iNFINITI TPC satellite networks
- Located at hub location as an add-on technology enhancer

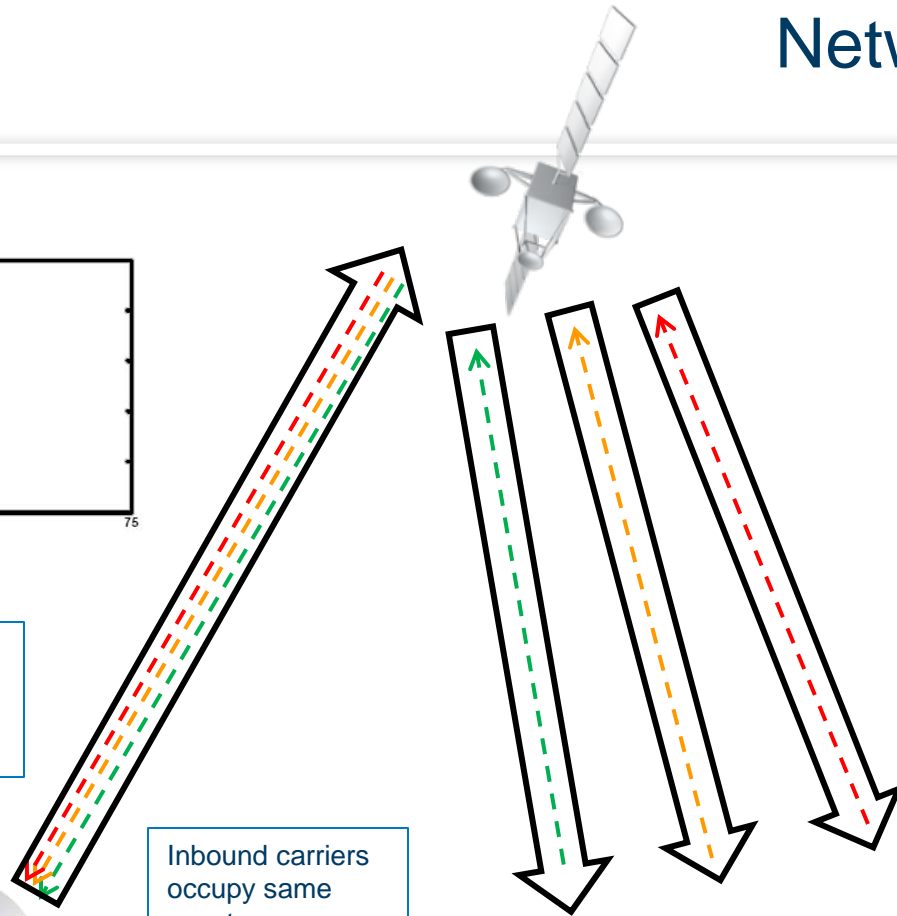
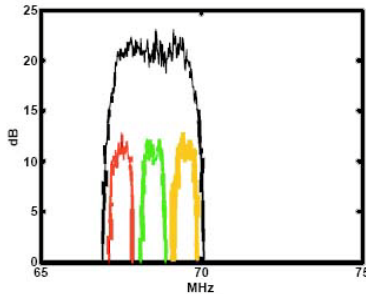
Cost-effective solution for capacity constrained networks that need to enhance utilization efficiency resulting in increased capacity of your iDirect network.

# How It Works

1. Hub transmits uplink signal
2. Hub cancels its received signal
3. Remote transmits a return link
4. Hub receives inbound return links from VSATs



# Network Example



PCMA Hub Cancellor cancels out the overlaid outbound signal, leaving the inbound signals to be demodulated



VPCMA-70



Frequency Converter



iDirect Hub



Teleport

Inbound carriers occupy same spectrum as outbound

Remote sites do not need Canceller

iDirect Remotes





- **Network Qualifications**

- Operates only in loopback transponder (no cross-strap)
- Uses larger hub antennas (min. 4.8m Ku- and 7.2m C-band)
- Requires powerful beams (EIRP min. 48dBW Ku-band, 38dBW C-band)
- Ideal if downstream/upstream is asymmetric (3:1 optimal)

Analysis of deployed iDirect systems show that approximately 67% C- and 55% Ku-band networks can benefit from PCMA

- Increases efficiency of Evolution DVB/S2
- Allows existing iNFINITI networks to compete with DVB-S2/ACM

# PCMA Hub Cancellor Benefits

- **Maximizes capacity**
  - Echo cancellation technique can reduce required BW up to 50%
  - Frees up BW for expansion or new applications in existing networks
  - Ideal for capacity constraints regions or networks
  - Makes spread spectrum carriers bandwidth efficient
- **Provides security**
  - PCMA hides upstream carriers from detection
- **Superior bundled solution**
  - One-stop shop solution from iDirect
  - Fully integrated TAC support
  - Build-in remote uplink power control minimizes interference on the downstream carrier from the upstream carriers