



# AnaCom Inc.

## Kromos Satellite Network Systems

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# About Us

- AnaCom Inc. was founded in 1991, is located in San Jose, California, USA the center of Silicon Valley.
- One of world's leading satellite communications equipment manufacturers and system integrators.
- AnaCom produces over three thousand sets of large telecom equipment;
- Products are widely used in:
  - Television broadcasting
  - Data transmission
  - Telephony
  - Distance Learning
  - Telemedicine
  - Emergency Response
  - Government and Military Communications



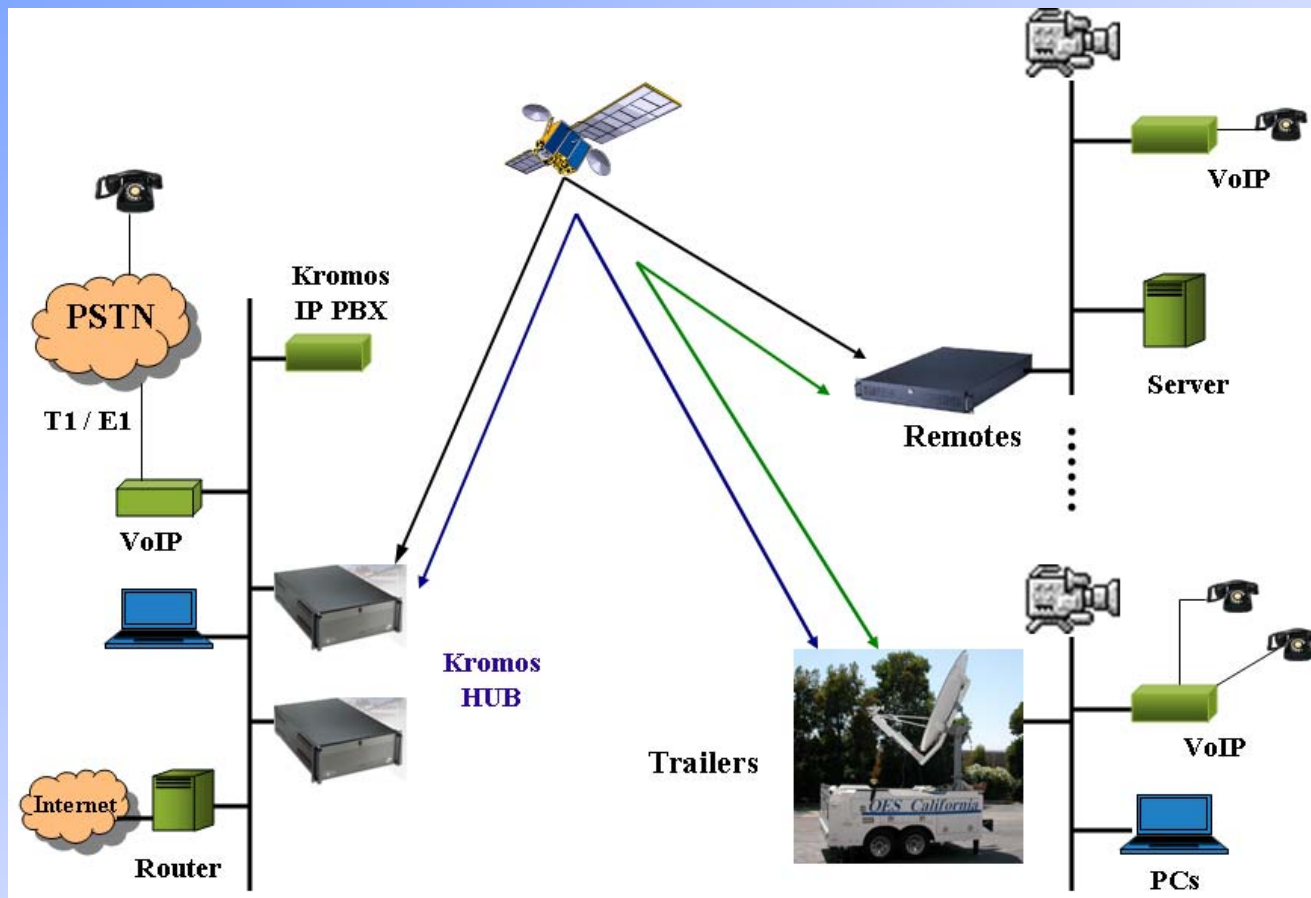


# Advanced technology

- AnaCom uses Advanced Design, Uniform Production Technology and Automated assembly & test methods
- We achieve High quality products at Low cost
- R & D team continue to develop newer and better products



# Kromos System Introduction





# Kromos Basic concepts of system

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- AnaCom Kromos Platform is a native IP solution consisting of: Intelligent routing, TCP acceleration, Satellite modem, QoS (voice/video priority) and advanced network management feature all in a single box.
- Kromos is the only package providing a complete VoIP solution. Our VoIP Gateways provide phone lines as well as PSTN connectivity through IT1/E1 or discrete lines. Kromos IPX switch at the Hub provides call routing & termination as well as billing information to the network operator.



# Features and functions

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## Reliability

- Field Proven-- Has been deployed in extremely harsh environments.
- FEC (forward error correction) ensures bit-error-rate (BER) of less than  $10^{-9}$  bit error rate while optimizing bandwidth (BW).
- Robust TCP Acceleration provides good throughput even when the BER goes to  $10^{-6}$  or below.



# Easy Installation and Maintenance

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- Easy to install, operate and maintain. Compared to other similar products, Kromos System can be operated by personnel with minimal training.
- Comprehensive suite of Network management allows management of Remote site without visiting them.
- Plug and Play feature allows off-the-shelf IP devices to be deployed with Kromos without special expertise.

# Supports all Network Topologies

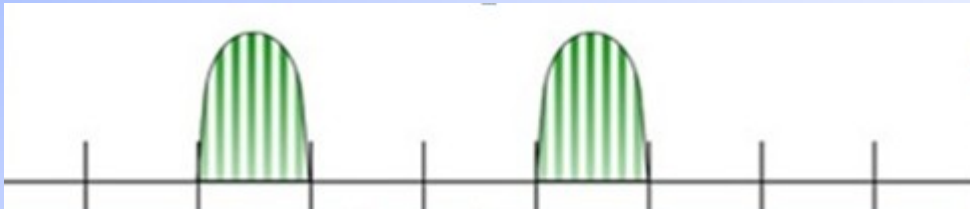
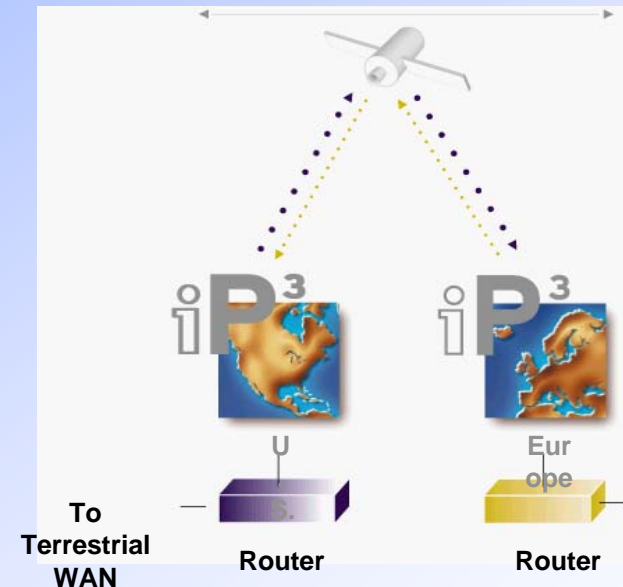
## We Support all Topologies

- Point to Point
- Dynamic Point to Point, Bandwidth on Demand (BOD)
- TDM-FDMA
- TDM-FDMA DAMA
- Full Mesh
- Modular and Scalable platform makes expansion or change of network easy.



# Point to Point scpc

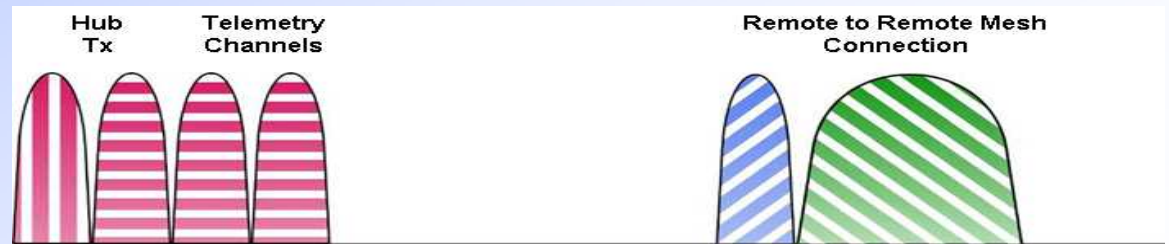
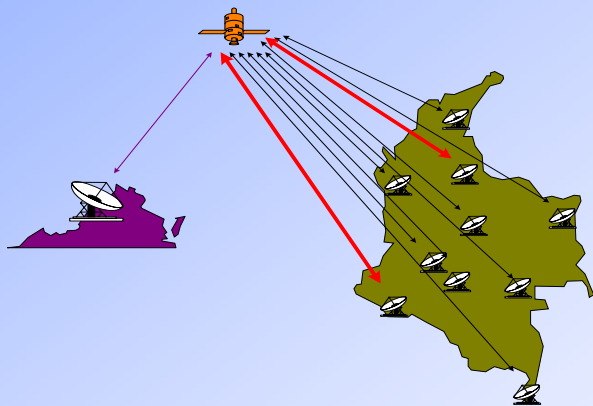
- Any two sites on a Satellite IP network can be configured on a Point-to-point link This link can be used for internet backbone or PSTN connectivity.

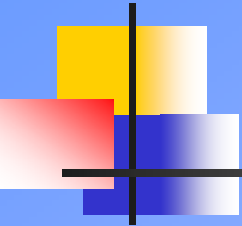


# Dynamic point to point SCPC Mode

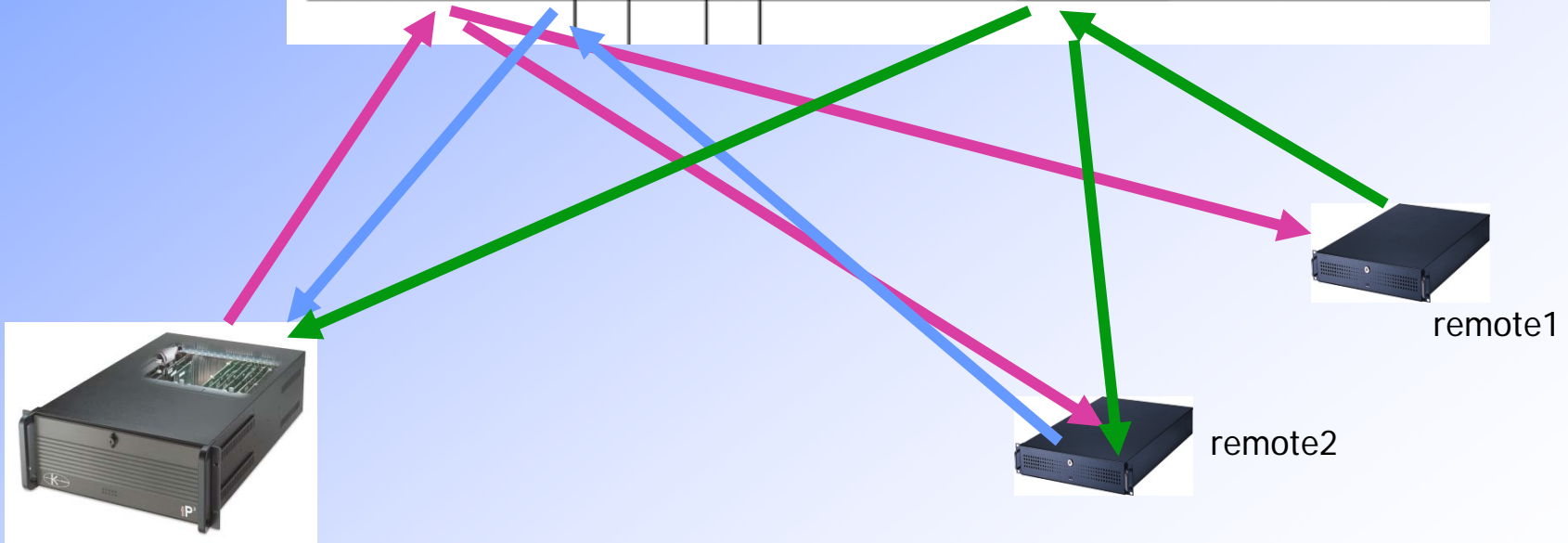
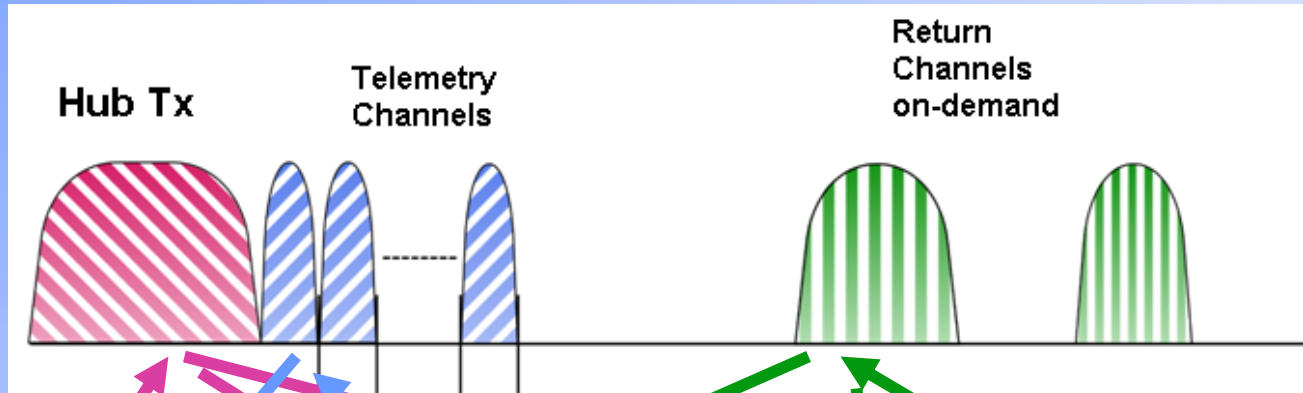
Allows setting up of point-to-point link between any two remotes at desired data rates *"on demand"*. This feature also allows for setting a BW lease duration. The links will be torn down at the end of the lease period. Links can be asymmetric.

- Narrow-band management channels allow efficient Telemetry of remotes with high BW efficiency.
- Hub assigns carrier frequency and bandwidth to intended Remote station.
- Any Remote can request BW for such a link with another remote for a certain leased duration.





# Dynamic SCPC



Hub

remote1

remote2

# Dynamic SCPC Single-hop set

Figures show Hub console and Remote console for setting up SCPC "on demand" links.

Gateway IP address: 192.168.1.14

Polling (idle) Enable, every 1 minutes

| Channel ID   | GW Type     | HostName | SW Ver | Locked to | Lease Left | Status | Status description  |
|--------------|-------------|----------|--------|-----------|------------|--------|---------------------|
| 192.168.10.1 | Master Hub  | u10hub   | 7.49   |           |            | 0x2100 | IP3INIT, DAMA1      |
| 192.168.10.2 | Remote Unit | remote1  | 7.49   | remote2   |            | 0x2001 | bcst, DAMA1         |
| 192.168.10.6 | Remote Unit | remote2  | 7.49   | remote1   |            | 0xA001 | bcst, DAMA1, DynR2R |

remote1 status: bcst, DAMA1

| port | IF Freq    | Baud Rate | power | TXon | IFEC | OFEC | diff | scram | SpInV | Fault | Test | Lock | Eth if | Eb/N0 |
|------|------------|-----------|-------|------|------|------|------|-------|-------|-------|------|------|--------|-------|
| TX0  | 1500145000 | 192000    | -22.0 | 1    | 5    | 0    | 1    | 1     | 0     |       |      |      | 0      | 0.0   |
| RX1  | 1300000000 | 64000     | -61.0 |      | 5    | 0    | 1    | 1     | 0     |       |      |      | 0      | 0.0   |
| RX2  | 1500447500 | 210000    | -54.0 |      | 5    | 0    | 1    | 1     | 0     |       |      |      | 0      | 0.0   |

Information / Suggestions

dynCh: Bringing up mhub RX2: F1500447500 B210000  
Okay, I am done reading system data.  
You can click on any of the remote units in the listview control, to see detailed information about that gateway's settings in the central portion of the dialog.

dama mode=traditional Dama, rx=0, freq\_offset=0

Remote IP address: 172.18.100.18 ONLINE

Dama state: ONLINE

Connection params

Baudrate Out (Hz): 192000

Target remote: remote2

Baudrate In (Hz): 210000

Lease Time (Hours): 0

End this Connection

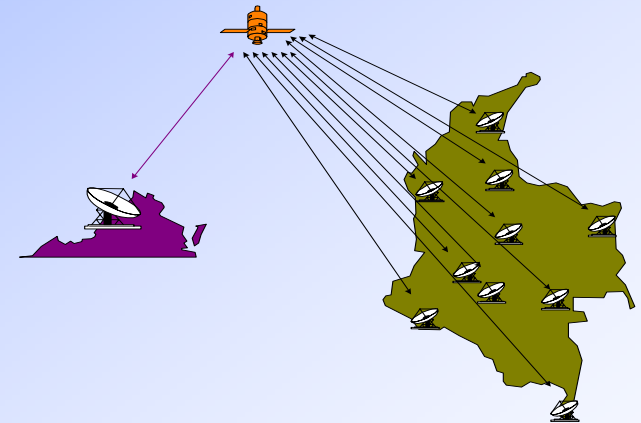
Information / Suggestions

We are currently connected to another Remote gateway. Press 'End this Connection' to break the connection.

# STAR Network - Fixed BW Allocation

The key aspects of this mode are as follows:

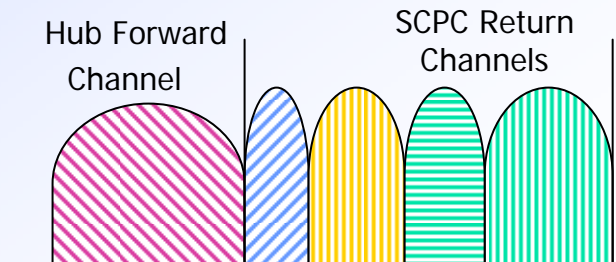
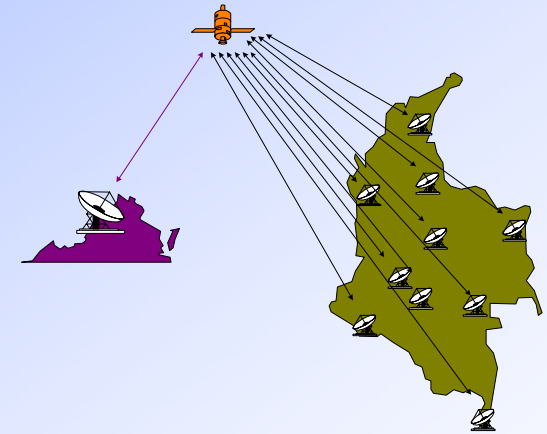
- Hub forward channel TDM mode
- Fixed SCPC return channels for Remotes that are fixed.
- Remote to Remote connectivity through Hub in two hops – Remotes can also access PSTN and internet through Hub.
- AnaCom's IPX switch facilitates phone connectivity. Also keeps billing records.
- Advantages: Uninterrupted service, Guaranteed connection, Good for Mission Critical Applications.  
Disadvantages: Not BW Efficient – Carrier stays ON even when no data to send.



# STAR DAMA Mode

The key features of this mode are as follows:

- Hub forward channel has TDM data for all remotes. The remotes carriers are down by default.
- Remotes request a return channel whenever they need to send data/voice or video. The Hub allows the remote to occupy a return channel upon request. The remote carrier is torn down as soon as data transfer is over making the channel available for others.
- The network operates in STAR architecture where remote to remote connectivity is in two hops. Remotes can access the internet or PSTN through the Hub.
- Available BW is shared by all remote on demand (BOD). The available BW can be oversubscribed by a factor 5 or 7 depending upon network requirements
- The remotes can be assigned *“Priority”* to allow preferential access to available BW.



# NMS Centralized Network Management Interface

http://kromosnms.oes.com - Navigate - Mozilla Firefox

-- enter search term --

Map  
Hybrid  
Satellite  
Roster

55 Sites on map  
Waiting for kromosnms.oes.com...

http://kromos.ip3.com - Navigate - Mozilla Firefox

anacom\_test | gateway

64.169.29.243

Summary Ports Details ODU

| Port              | 1                  | 2               | 3                 | 4              |
|-------------------|--------------------|-----------------|-------------------|----------------|
| Type              | Modulator          | Demodulator     | Modulator         | Demodulator    |
| Description       | 70 MHz Transmitter | 70 MHz Receiver | LBand Transmitter | LBand Receiver |
| Fault             | Normal             | Normal          | Fault             | Normal         |
| Test Mode         | Off                | Off             | Off               | Off            |
| Synthesizer       | ---                | Not Locked      | ---               | Not Locked     |
| Decoder           | ---                | Not Locked      | ---               | Not Locked     |
| Scrambler         | On                 | On              | On                | On             |
| Diff Encoding     | On                 | On              | On                | On             |
| Spectral Inv.     | Off                | Off             | Off               | Off            |
| Transmitter       | On                 | ---             | Off               | ---            |
| Frequency (MHz)   | TX 71.000          | RX 77.000       | TX 1,350.000      | RX 1,200.000   |
| Baud Rate (ksps)  | 2,048.000          | 1,024.000       | 2,048.000         | 2,048.000      |
| Power Level (dBm) | -14.30             | -88.56          | -15.00            | -86.00         |
| IP Interface      | ETH1               | ETH1            | Unassigned        | Unassigned     |
| Inner FEC         | Rate 3/4           | Rate 3/4        | Rate 3/4          | Rate 3/4       |
| Outer FEC         | None               | None            | None              | None           |

Read kromos.ip3.com

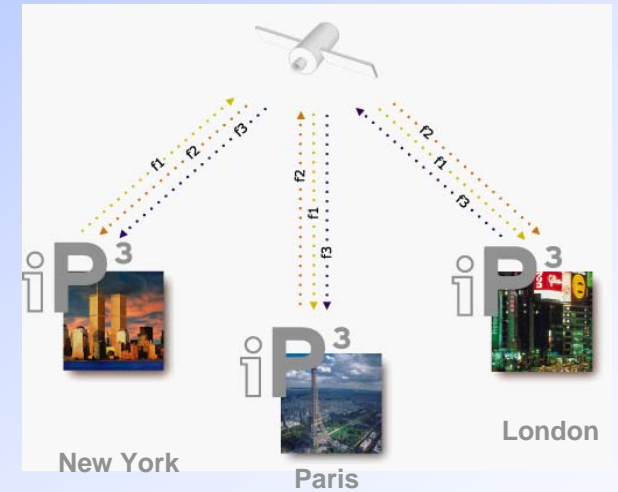
# Remote Station priority setting

- Console for DAMA control.
- System can give different Levels of Priority to Remotes

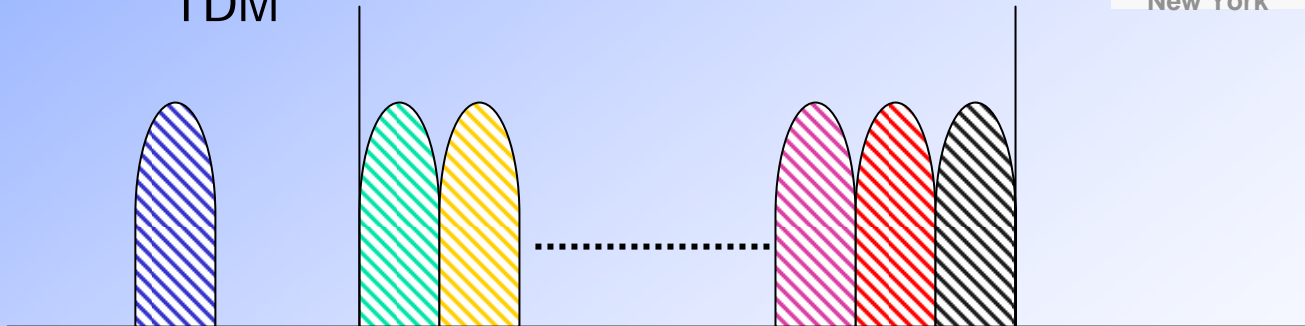
```
IP3 Dana monitor, 01.05                               Mon, 04/09/20, 15:56:56
+! Module Status !
Master Hub, 16 tasks
tx= 0, bx=16
+! Port stati !
Task chan. ID port txi dana state
-----
 1 00000000  2  0 1:idle
 2 00000000  3  1 1:idle
 3 00000000  4  2 1:idle
 4 00000000  5  3 1:idle
 5 00000000  6  4 1:idle
 6 00000000  7  5 1:idle
 7 00000000  8  6 1:idle
 8 00000000  9  7 1:idle
 9 00000000 10  8 1:idle
10 00000000 -1  9 1:idle
11 00000000 -1 10 1:idle
12 00000000 -1 11 1:idle
13 00000000 -1 12 1:idle
14 00000000 -1 13 1:idle
15 00000000 -1 14 1:idle
16 AC120102 -1 15 3:online
+! Hub stati !
available-channel broadcast (MSB-LSB)
00007FFF
individual hub stati
=====
hub0, mask=0x000001FF, bits=9
hub1, mask=0x0000003F, bits=7
```

# Mesh

AnaCom Kromos Platform can be configured as a Hubless Mesh Network



TDM





# Other Key BOD Features

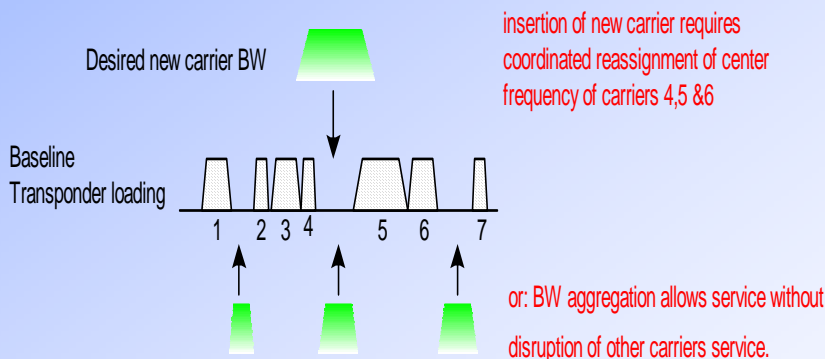
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- Asymmetric or symmetric Point-to-Point Links on demand
- Bandwidth Lease – Remotes can specify BW lease durations and required BW.
- The Hub allocated minimum (default BW) and default lease duration if no specific request made.
- Efficient Telemetry - The frequency with which remotes are polled can be controlled; Hub station can shut down the Remote carrier, other parameters can also be adjusted .

*These DAMA features offer maximum flexibility to network operator to achieve maximum bandwidth efficiency while providing "Bandwidth-on-Demand".*

# Bandwidth Aggregation

- This feature allows multiple carriers to be launched/taken down anywhere in the transponder(s) “on the fly” to either increase or decrease BW in response to varying data needs in the middle of an IP connection. Addition or deletion of an extra carrier does not result in any packet loss. The system gracefully speeds up or slows down the data transfer.
- These additional carriers can be placed anywhere in different transponders or different satellites wherever there is gap. From, data side, the connection still looks like one IP pipe.





# Why do we need TCP Acceleration?

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- TCP / IP, the most important data transfer protocol, performs very poorly over satellite channels.
- Satellite channels have a large round-trip delay. Also, communication over satellite being a wireless channel is prone to bit-errors unlike a wired channel. TCP was never designed to handle this. TCP always assumes that error in packets is due to congestion whereas congestion is not a factor in satellite channels.
- TCP uses a very inefficient Packet Retransmission Strategy which results in wastage of satellite BW (the most expensive part of satellite communication).
- TCP's Congestion Control Algorithm (not needed over satellites) also throttles the data rate down resulting in BW loss.
- Other deficiencies like the small window sizes, slow start algorithm etc make TCP unsuitable for satellite communication.



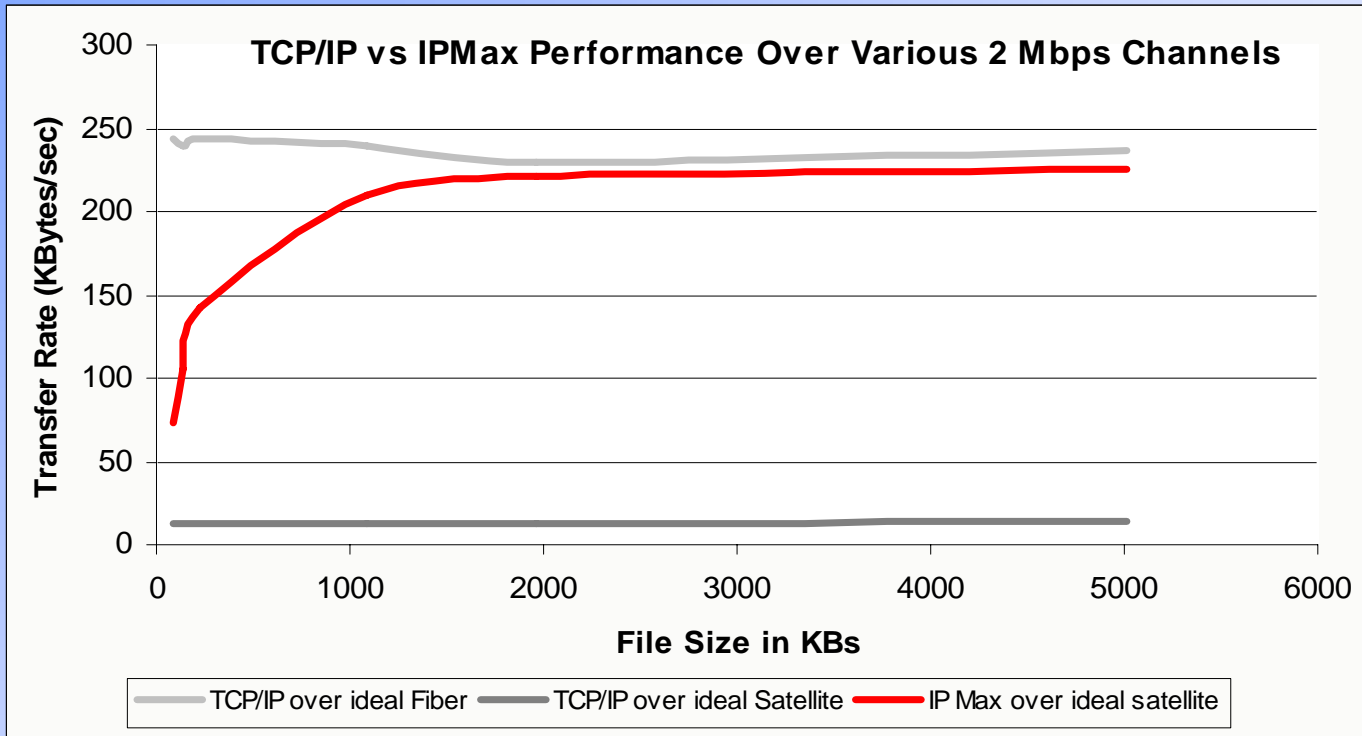
# AnaCom TCP Acceleration

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- Kromos IP gateway has the industry's most mature TCP acceleration mechanism, completely eliminating the effects of satellite channel on data throughput.
- Our proprietary IPMax protocol converts TCP over satellite to eliminate each drawback of TCP and then converts it back to TCP at the other end before the Terrestrial Ethernet interface. The resulting throughput is comparable to TCP throughput over wired links.
- IPMax achieves this by using Selective Retransmission Strategy, Large Window Sizes and Optimum Flow Control to keep the satellite pipe full at all times.
- In addition, IPMax maintains a robust link even when the BER is at  $10^{-6}$  or below, while achieving close to 60% throughput.

*(see the Figure on next slide)*

# Mature TCP Acceleration





# Quality of Service

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- The Built-in QoS in Kromos platform automatically recognized real-time applications e.g. Voice, Video etc and prioritized them over data.
- The system is fully compliant with all IP applications. All IP applications such as voice, video and data are available through a single carrier or multiple carriers.

# Verify and versatility

- ANACOM network has been deployed in California's Emergency Response Network. It provided both fixed and mobile emergency communications for disaster relief. This network has played a significant role in many disasters e.g. Hurricanes, floods and landslides.
- Anacom has gained valuable experience through these deployments.





# Flexibility and scalability

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- Fully Software Configurable – Kromos is a software driven platform that affords complete control locally or remotely for changes in network architecture.
- Scalable Hub – Hub can be upgraded as the network size increases giving a “pay as you grow” option to network operators. Additional plug-in modules or additional chassis allow easy expansion of
- Network topology can be changed without having to redo the network.
- Customers are always able to buy in proportion to their need

# User-friendly Web interface:

Each unit has a Web server running. Allows M&C of not only Kromos unit but also the Outdoor equipment via the Web interface. Users need only a Web browser to access the unit either locally or remotely (no special software required). Some screen shots of Web configuration for IDU and ODU are shown below.

| Port Data                  |   |   |
|----------------------------|---|---|
| Description                | Port 0  | Port 1  |
| Device Type                | Modulator   | Demodulator   |
| Device Description         | Transmitter 70 MHz. 64K-2M baud                         | Receiver 70 MHz. 64K-2M baud                            |
| Hardware SerialNumber      | Hardware Revision                                       | Hardware Revision                                       |
| Fault Flag                 | <span style="color: green;">●</span> OFF                | <span style="color: green;">●</span> OFF                |
| Test Mode                  | <span style="color: green;">●</span> OFF                | <span style="color: green;">●</span> OFF                |
| Decoder                    | ...   | <span style="color: red;">●</span> UnLocked             |
| Synthesizer/Transmitter ON | <span style="color: red;">●</span> Transmitter OFF      | <span style="color: red;">●</span> Synthesizer Lock OFF |
| Scrambler/Descrambler      | Scrambler<br><input type="button" value="OFF"/>         | Descrambler<br><input type="button" value="ON"/>        |
| Differential               | Encoding<br><input type="button" value="OFF"/>          | Decoding<br><input type="button" value="ON"/>           |
| Spectral Inversion         | SI<br><input type="button" value="OFF"/>                | SI<br><input type="button" value="OFF"/>                |
| Transmitter                | Transmitter<br><input type="button" value="OFF"/>       | ...   |
| Frequency (Hz)             | Transmit Freq.<br><input type="text" value="61000000"/> | Receive Freq.<br><input type="text" value="70000000"/>  |
| Baud Rate (sym/sec)        | Transmit Baud<br><input type="text" value="2048000"/>   | Receive Baud<br><input type="text" value="2048000"/>    |
| Power Level (dBm)          | Output Power<br><input type="text" value="-0.00"/>      | Input Power<br>-54.97                                   |

| Radio 0 - Anacom |                                   |              |                                     |              |                                     |
|------------------|-----------------------------------|--------------|-------------------------------------|--------------|-------------------------------------|
| Description      | Value                             | Description  | Value                               | Description  | Value                               |
| Model            | AnaSat 5EC Transceiver            | Tx Frequency | <input type="text" value="6425.0"/> | RX Frequency | <input type="text" value="4200.0"/> |
| Label            | Kromos Eval                       | Tx Channel   | <input type="text" value="501"/>    | RX Channel   | <input type="text" value="501"/>    |
| Part Number      | 30794                             | Tx Gain      | <input type="text" value="59.0"/>   | RX Gain      | <input type="text" value="82.0"/>   |
| Serial Number    | 019347                            | Tx Lock      | Locked                              | RX Lock      | Locked                              |
| Revision         | 04                                | Tx PLL       | 7.7                                 | RX PLL       | 8.0                                 |
| M&C Part Number  | 30559                             | Tx In        | -2.5                                | RX Out       | -13                                 |
| M&C Revision     | 00036                             | Tx Out       | 29                                  | OSL Lock     | Locked                              |
| Warmup           | <input type="button" value="ON"/> | Tx Peak      | 29                                  | OSL PLL      | 4.4                                 |
| Temperature      | 48                                | Tx Enabled   | <input type="button" value="ON"/>   |              |                                     |
| Alarm Status     | CLEAR                             | P 12V        | 13.3                                | N 5V         | -5.5                                |
| Alarm Flags      | 0000000000000000000000            | P 5V         | 5.1                                 | LNCV         | 13.2                                |
|                  |                                   | PA 1         | 8.9                                 | PA 2         | 8.9                                 |
|                  |                                   | PA 3         | 10.3                                | PA 4         | 10.1                                |
|                  |                                   | PA 5         | N/A                                 | PA 6         | N/A                                 |



# Telnet Access

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- **Telnet** : Telnet allows command line M&C. This is the most powerful M&C feature. This is the recommended mode for the Network Administrator. This utility can be accessed either locally or remotely. This text-based interface is very low in overhead hence very fast. It has been designed with speed of execution and user friendliness in mind.
- **Out -of-Band M&C function** : Kromos platform offers complete M&C even when the satellite link is down (or even before the link comes up) via dial-up connectivity. All they need a phone line to configure the network or troubleshoot the network in case the link goes down. Users get the Telenet interface in the dial-up mode. Following figure shows a dial-up control interface

# Dial-up Access

Dial-up control allows M&C even when satellite link is down.

```
[1018] squirrel:root / >ip3cfg
iP3cfg Version 1.54, by Daniel D. Miller
DLSSLIB shared library, version 1.41 (Jan 4 2002, 05:41:14)
Copyright (c) 1999-2002 Kromos Communications

total ports installed=8; reading port data:

          T I O d s s f t s d
          X f f i c i a e l l d l s l
port      IF freq  baud rate  power  o e e f r n l s o o i / f
          (in Mhz) (in Mbaud) (dBm)  n c c f m v t k k a s m t
=====
0 T    62,000000    2,048000   -9.8  0 6 0 1 1 0 - - - * -1
1 T    74,000000    2,048000   -9.8  0 6 0 1 1 0 - - - * -1
2 R    71,000000    2,048000  -41.0  -6 0 1 1 0 - - - - -1
3 R    68,000000    2,048000  -41.0  -6 0 1 1 0 - - - - -1
4 R    80,000000    2,048000  -41.0  -6 0 1 1 0 - - - - -1
5 R    77,000000    2,048000  -41.0  -6 0 1 1 0 - - - - -1
6 T   1329,000000    2,048000  -23.9  1 6 0 1 1 0 - - * *  0
7 R   1326,000000    2,048000  -16.0  -6 0 1 1 0 - - * *  0
=====a=====b=====c== d e f g h i = = = = ==j=

enter command (h for help) >
```



# Complete voice solution

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- Kromos provides a complete VoIP solution for satellite networks connecting remote sites to each other and PSTN using very low BW and high quality voice.
- FXS gateways offer connecting inexpensive phones to remote locations. FXO and T1/E1 gateways offer PSTN connectivity to the network from either the Hub or other locations.
- Kromos's IPX switch is designed to provide call routing and termination in addition to keeping track of all billing information.



# Centralized NMS for Network Management

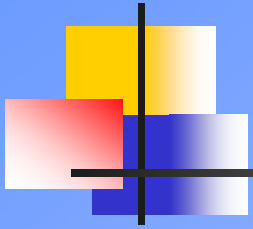
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- Kromos offers a centralized NMS platform for management of the network from the Hub location.
- The Map based interface provides convenient monitoring and control for the network operator. The network navigation is on a Web browser interface so no special software is required on the client machine.
- NMS platform can control Kromos units, VoIPs and outdoor equipment all from the same user-friendly browser interface.
- Fully compliant with SNMP standard so Kromos network can be managed with any third party SNMP based manager.

# Hub Redundancies



- **Power & Cooling Redundancy:** Master Hub unit has hot-swappable Power supplies and fans. In case of a failure, off-line power supply and fans keep the system running.
- **Redundant Plug-in Modules:** Redundant plug-in modules ensure that module failure will not disrupt service in the network.
- **Geography Redundancy of Hub:** Kromos System offers a Geographically Redundancy for Hub that can maintain continuity of service in case the primary Hub either malfunctions or struck by a disaster. The fully redundant Hub located elsewhere can take over network operations.



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Thank you!

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