Technology update from Worldcast Systems

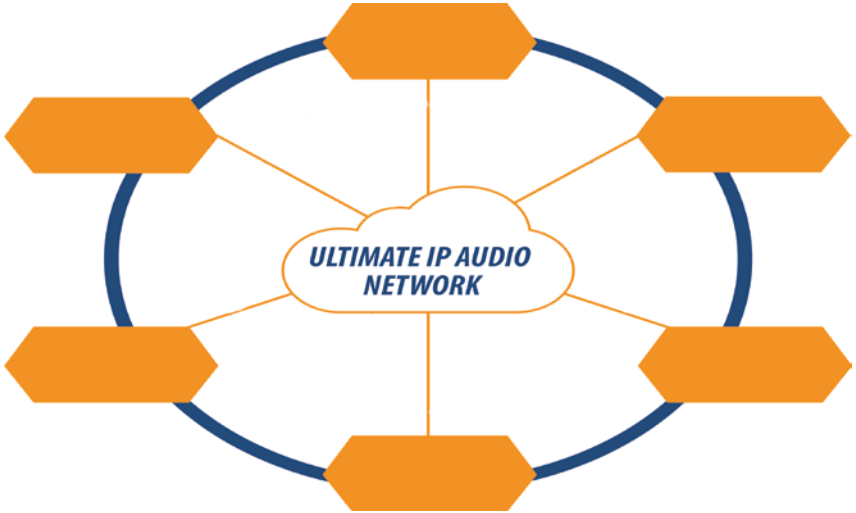
October 2016

Delivering Content Beyond the (Fire) Wall

OR – The Packers entering Lambeau Field in January

ELEMENTS OF AN ULTIMATE IP AUDIO NETWORK

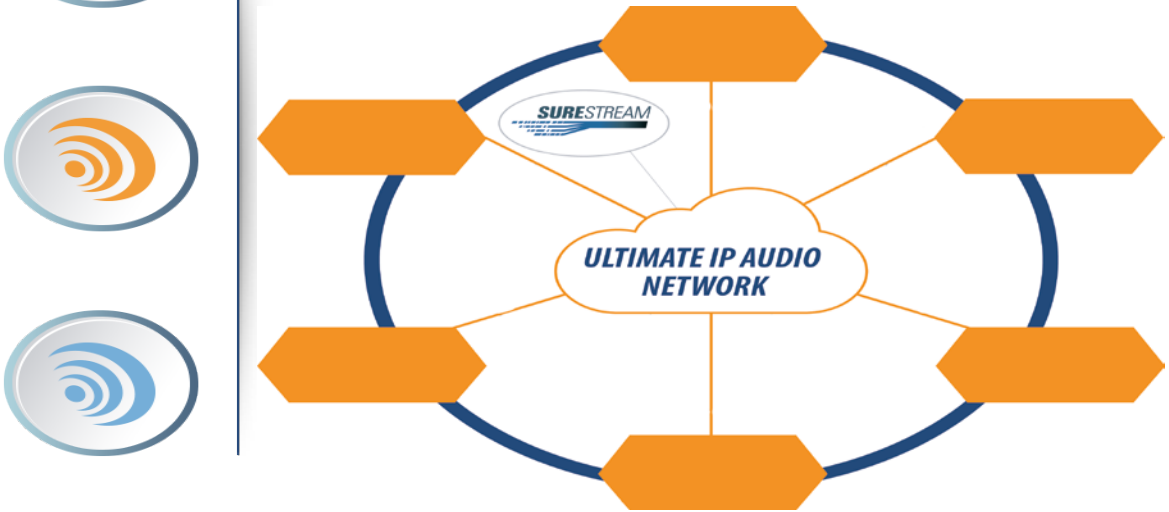
- **An Ultimate IP Audio Network must be:**
  - Highly resilient
  - Inherently redundant
  - Self-healing
  - Intelligent / self-governing
- **Reliability of T1**
- **Make easy connections like ISDN**
- **Flexibility & affordability of IP**
- **However, not “One Size Fits All”**
- **Select the Tools to suit YOUR Network**



Design Goals

- #1 – The content must arrive - on time and intact
  - Redundant Streaming
  - Real-world performance statistics
- #2 – Network communication and control
  - Distributed Intelligence
  - Scripteasy & SNMP
- #3 – Alternate Sources and large scale distribution
  - Packet Forwarding
  - Customer Spotlight #2 – National Basketball Association

REDUNDANT STREAMING



Redundant Streaming

SURESTREAM

SureStream

- Software option first available on APT Audio Codecs in **2011**
- 1000+ licenses globally

What does it offer?

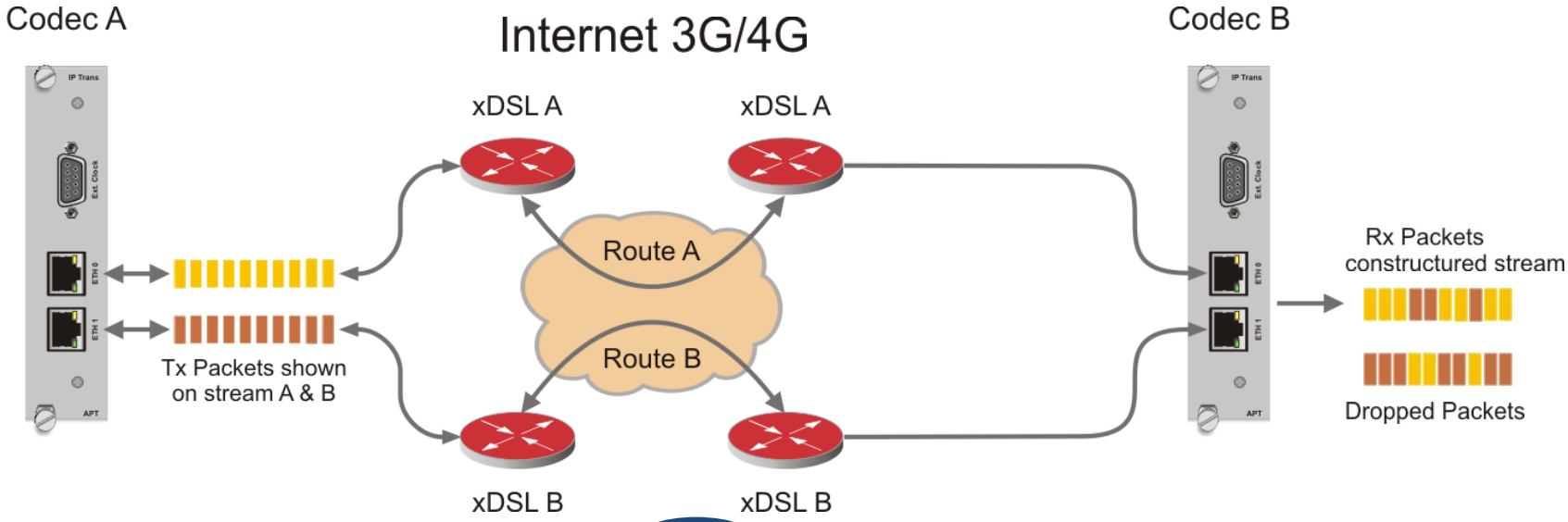
- Flawless audio transmission over any network link
- Constant link delay
- Lower link latency
- Minimizes large swings of delay jitter

Redundant Streaming – how does it work?

SURESTREAM

“Always on” Redundancy – send 2+ streams

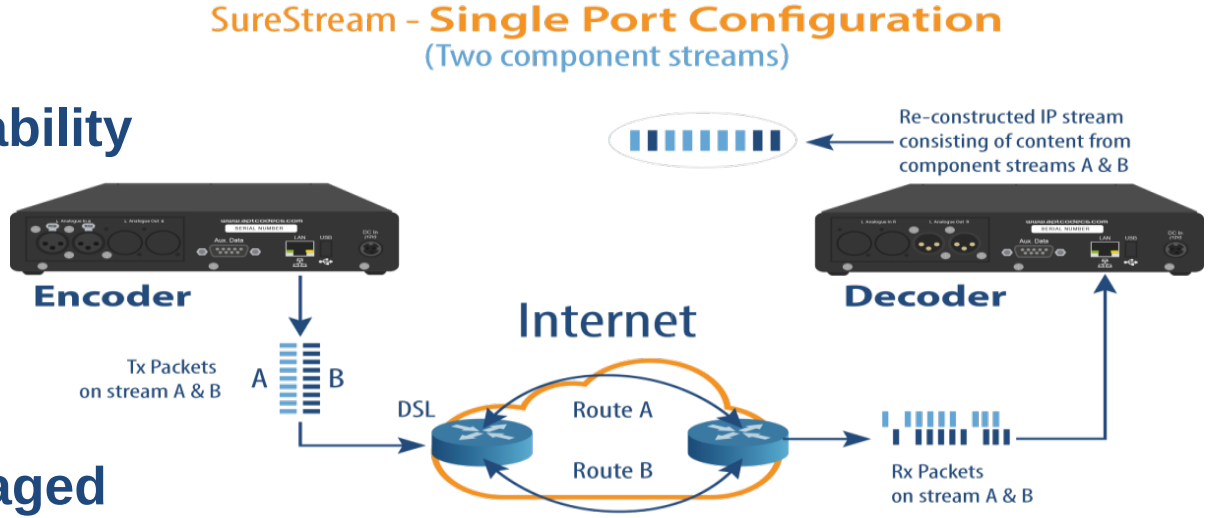
- **No link switching, streams are merged at the packet level**
- No bitrate changes, best audio quality is maintained



SureStream on a single network link

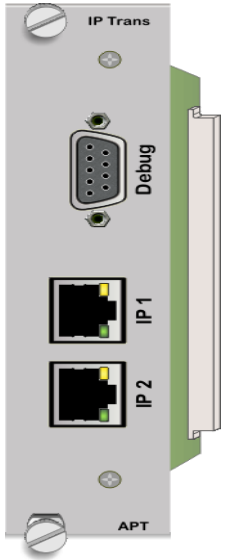
SURESTREAM

- Copes with network packet losses
- Increases the link reliability significantly (99.999%)
- Developed for unmanaged networks (Internet, 3G/4G)

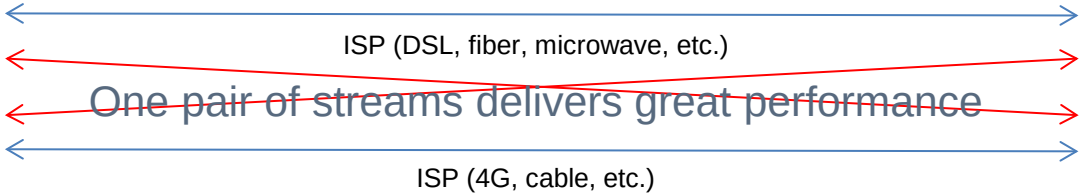


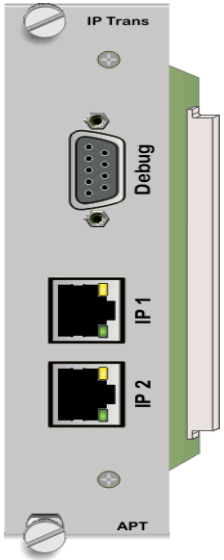
Streaming with Even More Redundancy

SURESTREAM



- Imagine a pair of codecs, each with two network ports connected to 2x public IP addresses – if from different providers, that's even better!





- Adding additional crossing streams means that even if an ISP crashes, you still have redundancy!

Advantages of Redundant Streaming

SURESTREAM

- **First, do no harm to your content**
  - Use any algorithm, any bitrate, send any kind of data – even MPX!
  - Consistent audio quality, consistent playout delay

- **Use any kind of network bandwidth – DSL, Microwave, Cable, 4G**
- **Send to multiple destinations with multicast or multiple unicast**
- **Causes no significant additional delay in the link**
- **Redundant streaming is totally scalable**
- **Performance approaches 99.999% on single IP link**
- **Performance approaching perfection on multiple diverse links**

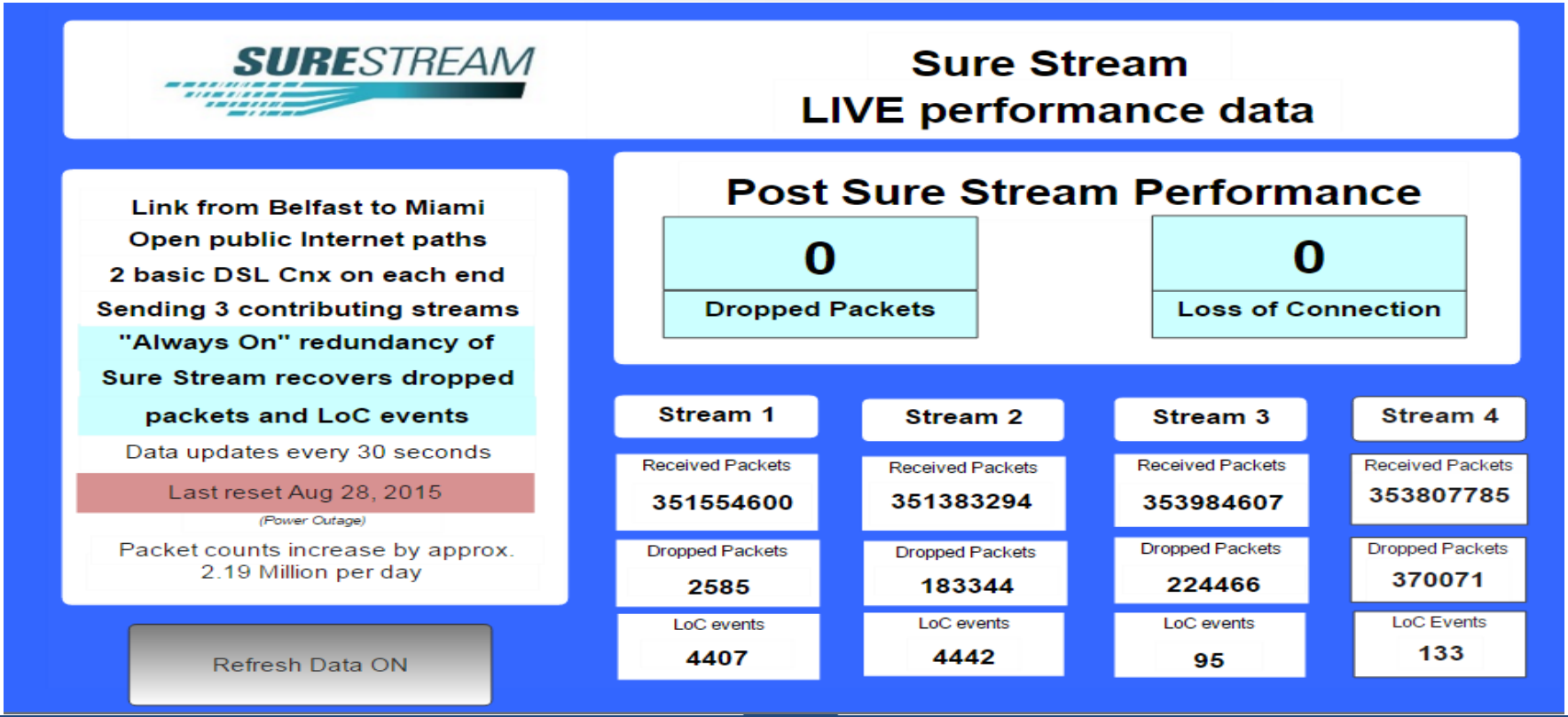
Real World Performance - Belfast to Miami link

SURESTREAM

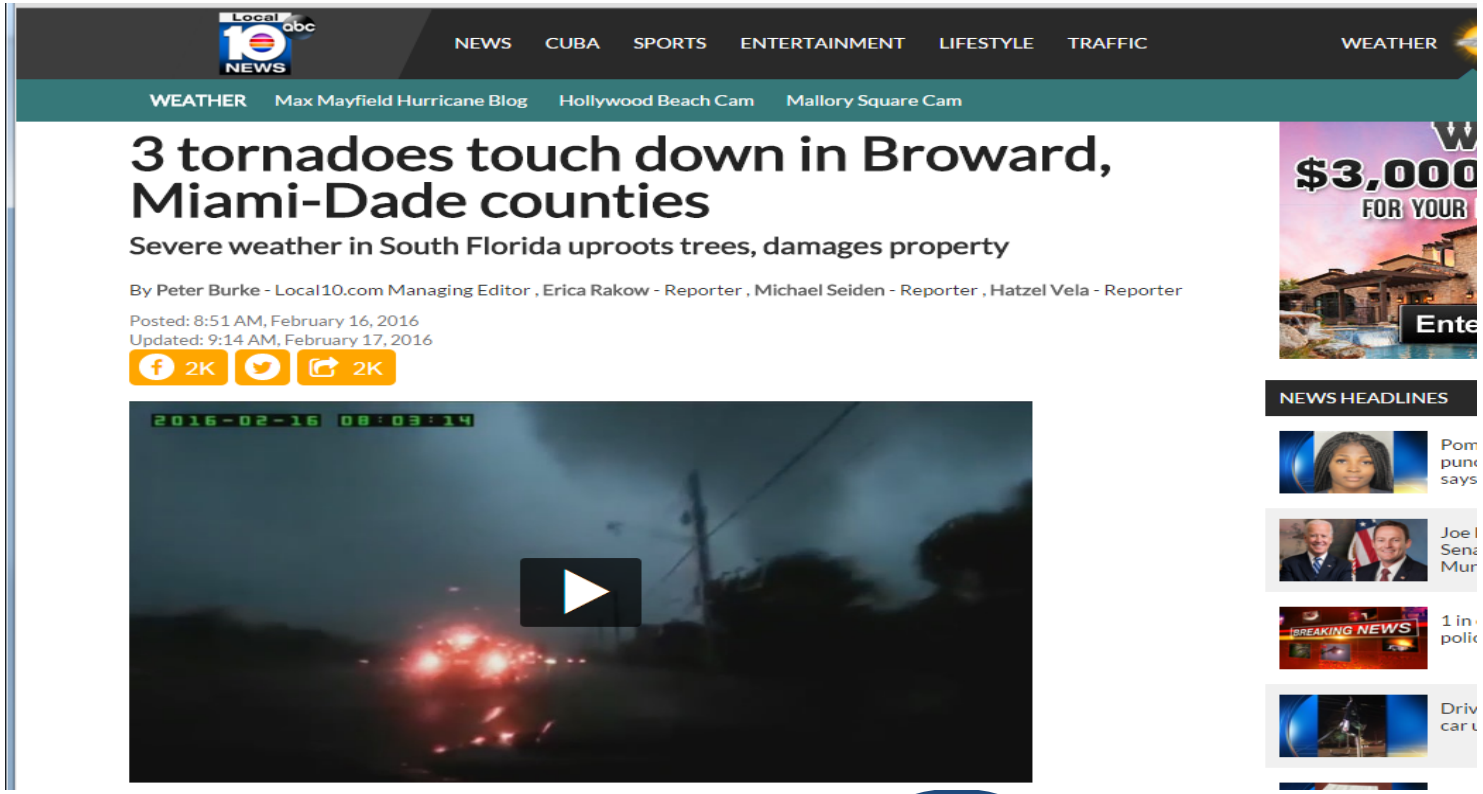
- Established in 2011 for testing redundant streaming on a real world link
- Inexpensive DSL and Cable Internet service on each end
- Bidirectional stereo 15 kHz audio, E-APTX compression, 750ms buffer
- Back in late August 2015 we decided to let it run until it lost a packet.

Can you hear me now?

Screenshot Feb 8, 2016 – 160+ days, ZERO LOSSES



9 days later…..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Hollywood Beach Cam
Mallory Square Cam
3 tornadoes touch down in Broward, Miami-Dade counties
Severe weather in South Florida uproots trees, damages property
By Peter Burke - Local10.com Managing Editor , Erica Rakow - Reporter , Michael Seiden - Reporter , Hatzel Vela - Reporter
Posted: 8:51 AM, February 16, 2016
Updated: 9:14 AM, February 17, 2016
2K
2K
2016-02-16 08:03:14
$3,000
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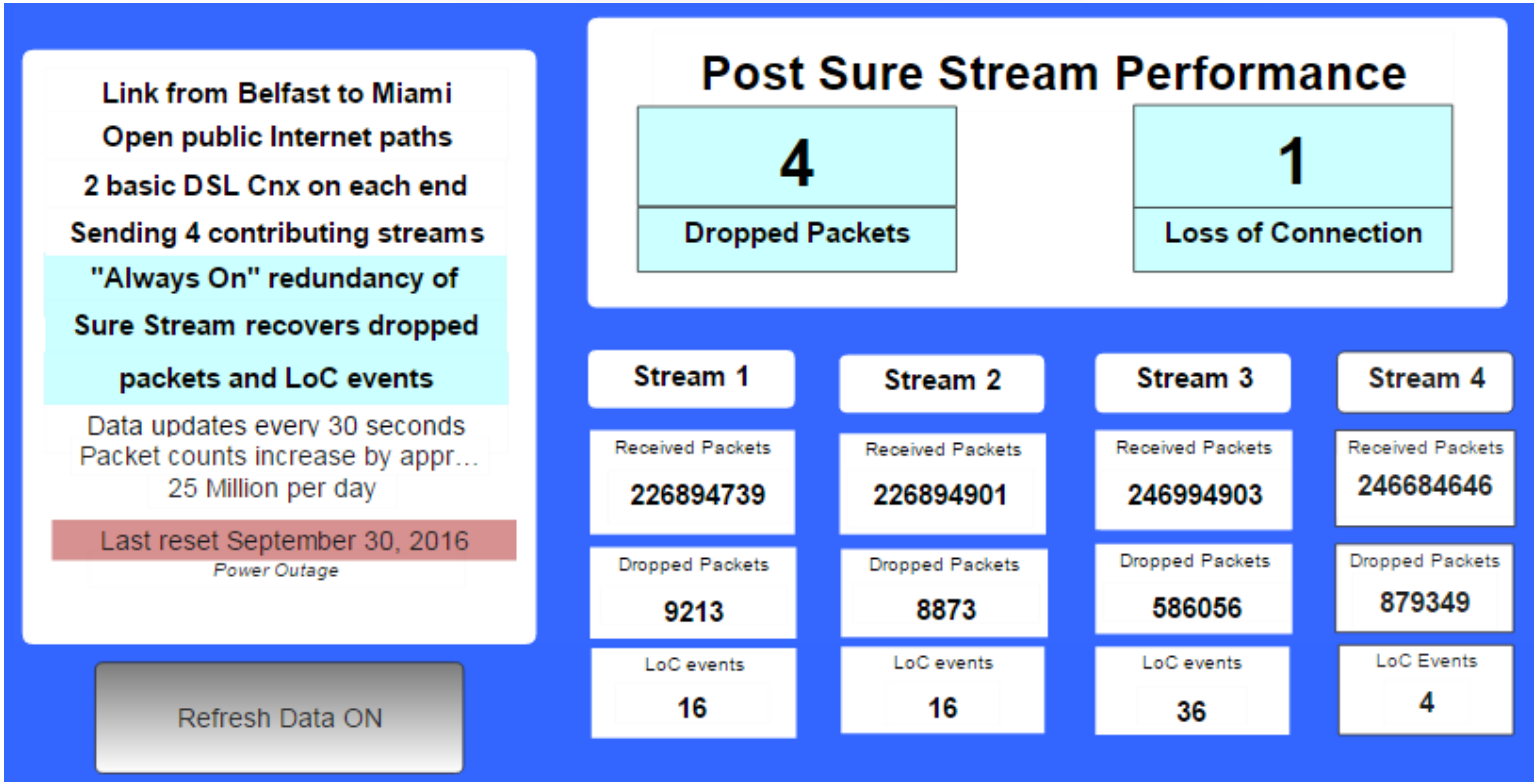
Stats as of Monday 10/10 (reset 9/30)

SURESTREAM

4 packets lost
out of
220 MILLION
99.99999%

INCLUDING
the effects of
Hurricane
Matthew

(Comcast side
of link down
> 24 hours)

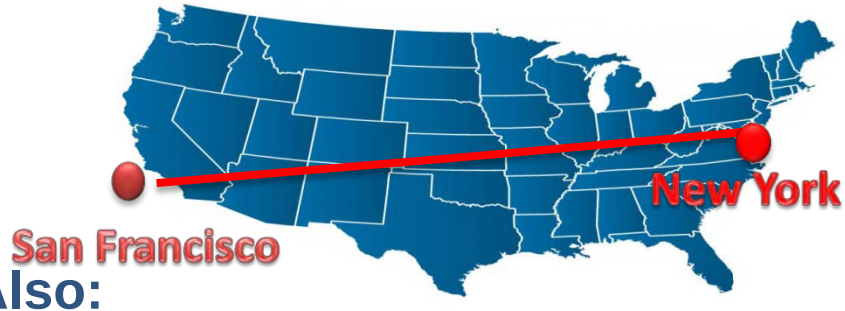


Customers Using SureStream

SURESTREAM

Cumulus – Michael Savage Link

- Audio Connection with 2 x APT MULTI-CHANNEL AoIP CODECs (*Oslo 1U)*
- 24 hour connection between San Francisco studio & Media Networks distribution facility in NYC
- **Main Purpose:** transport audio & closures of The Michael Savage Show for satellite distribution
- Also audio of KNBR sports to NYC
- Nash FM
- Robin Meade CNN



Also:

- **Mood Media**
  - World's #1 provider of background music for businesses - Muzak, DMX
  - Sending 120+ stereo feeds from Fort Mill SC to Denver, Cheyenne and Raleigh
- **CBS Radio, iHeartRadio, EMF, WNYC**

The APT SURESTREAMER

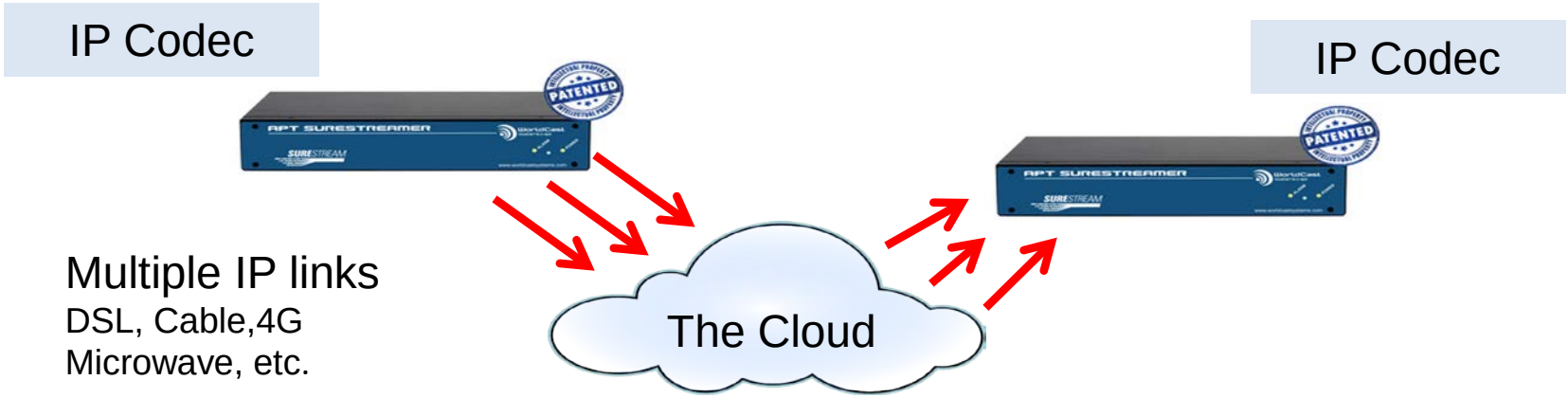
SURESTREAM

- Stream relay
- Accepts one IP stream, creates multiple SureStreams across IP links

SURESTREAMER with existing IP codecs

SURESTREAM

- Connect a pair of APT SURESTREAMERs in an existing IP link
- Add “Always On” redundancy and reliability to current codecs

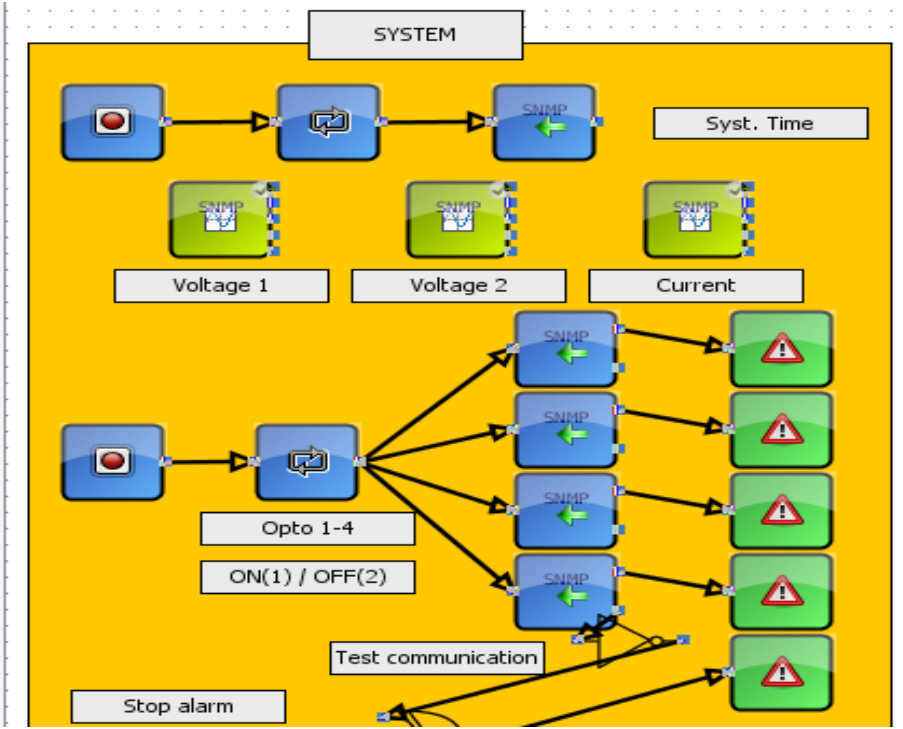


DISTRIBUTED INTELLIGENCE IN CODECS

Distributed Intelligence

SCRIPTEASY

- ScriptEasy facility control software is included in most APT Codecs
- ScriptEasy controls other codecs and other devices
- ScriptEasy can detect problems and perform automatic actions
- ScriptEasy can alert staff via Email



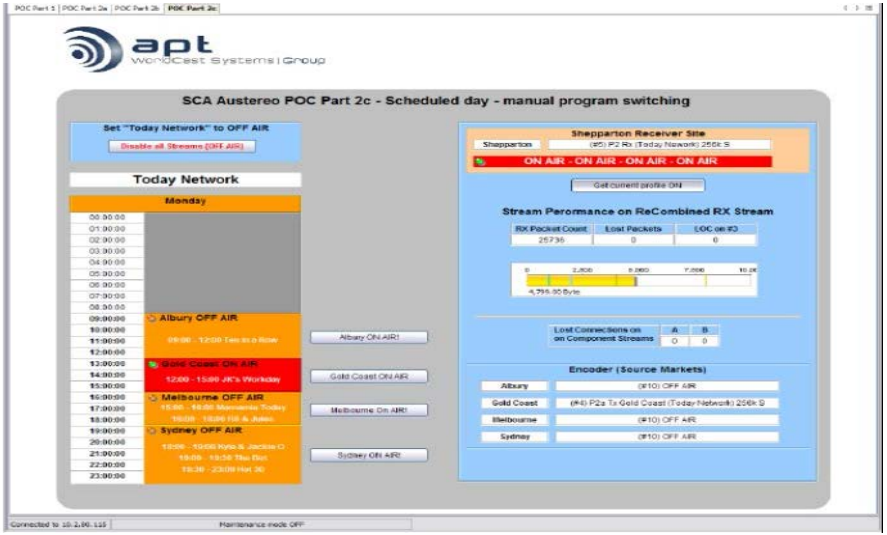
Distributed Intelligence

SCRIPTEASY

- In addition to reacting to network changes, ScriptEasy can also function on operator input or a schedule
- Insert local content
- Activate a new cnx profile

- Distributed intelligence means control and monitor capabilities are deployed in many small systems around the network

- No Single Point of Failure



Uses of Distributed Intelligence

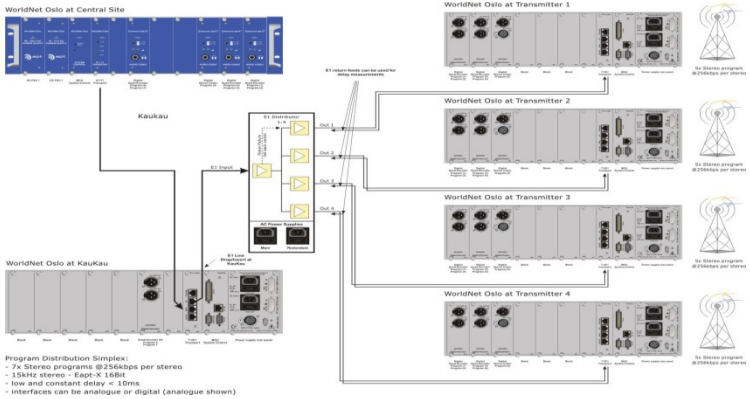
- **Not only for reliability, ScriptEasy can also function as a control system for a network of codecs**

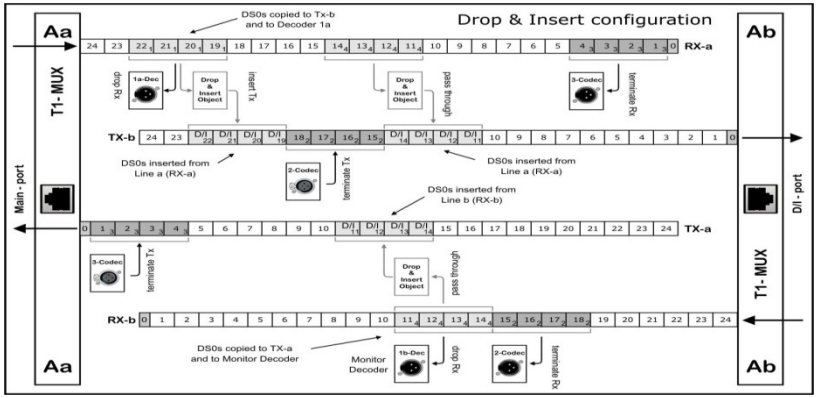
- Make and break point to point connections (similar to ISDN) for contribution, recording sessions, news reports
- Or feed multiple locations at the same time via multicast or multiple unicast

PACKET FORWARDING

Packet Forwarding Protection (PFP)

- Similar concept to Drop/Insert in T1/E1 (SONET / SDH)
- Any active codec on network can become a packet forwarding audio node





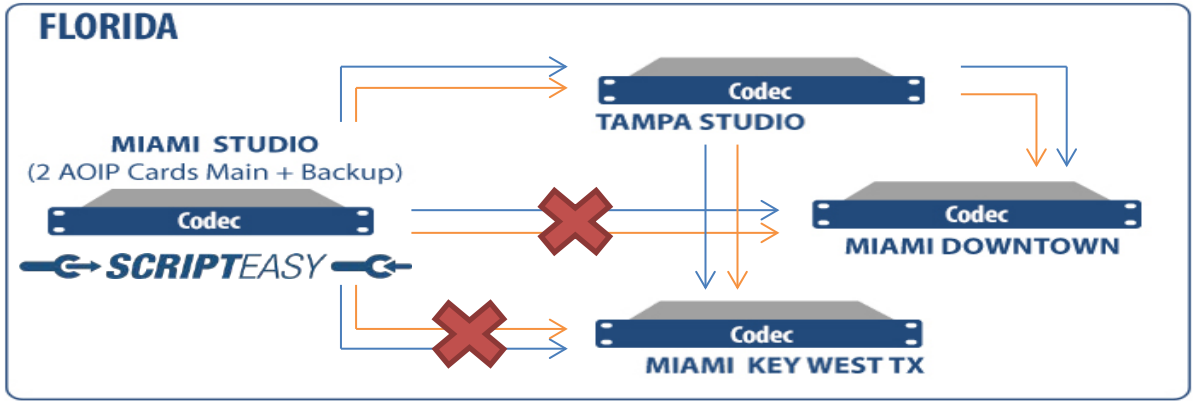
Packet Forwarding Protection (PFP)

- **Decoders become backup audio sources**

- **PFP relies on two things**
  - Distributed Intelligence (ScriptEasy) to interpret the problem and take action
  - Alternative network paths into the site

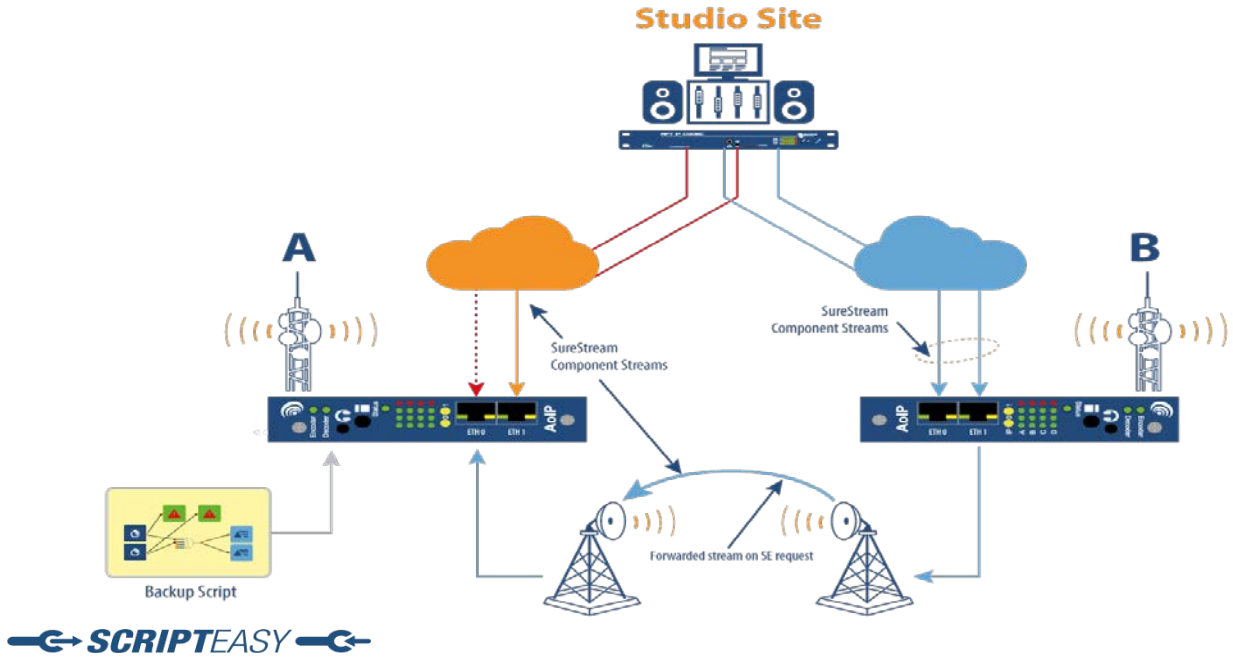
Lets look at some theoretical and real world examples of PFP in action…..

Packet Forwarding – Theoretical Example



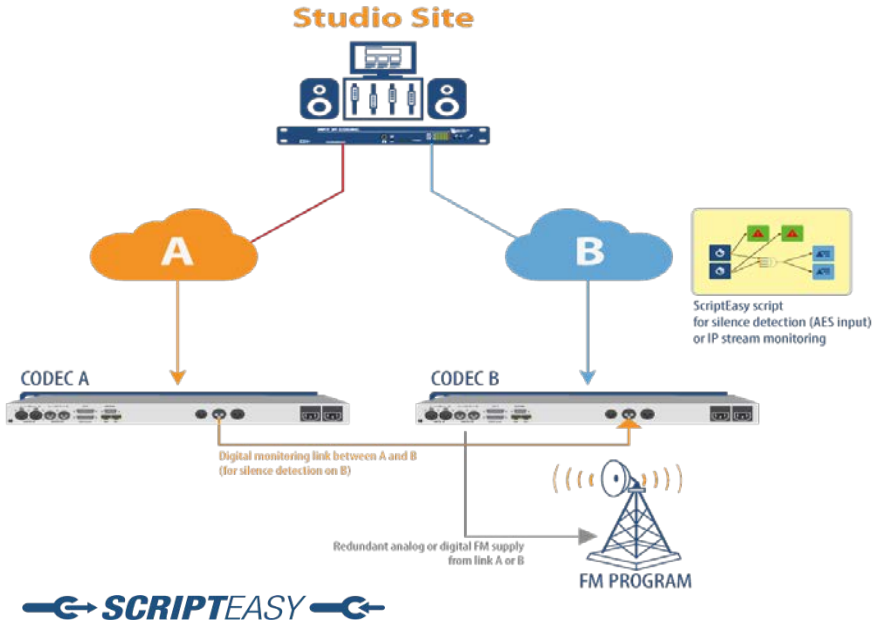
- If path to transmitter sites lost, audio can be sourced from Tampa Studio
- Tampa Studio will Packet Forward the audio to both Transmitter Sites
- No encode/decode cycle is required at Tampa

Packet Forwarding Example 1– STL Path Protection



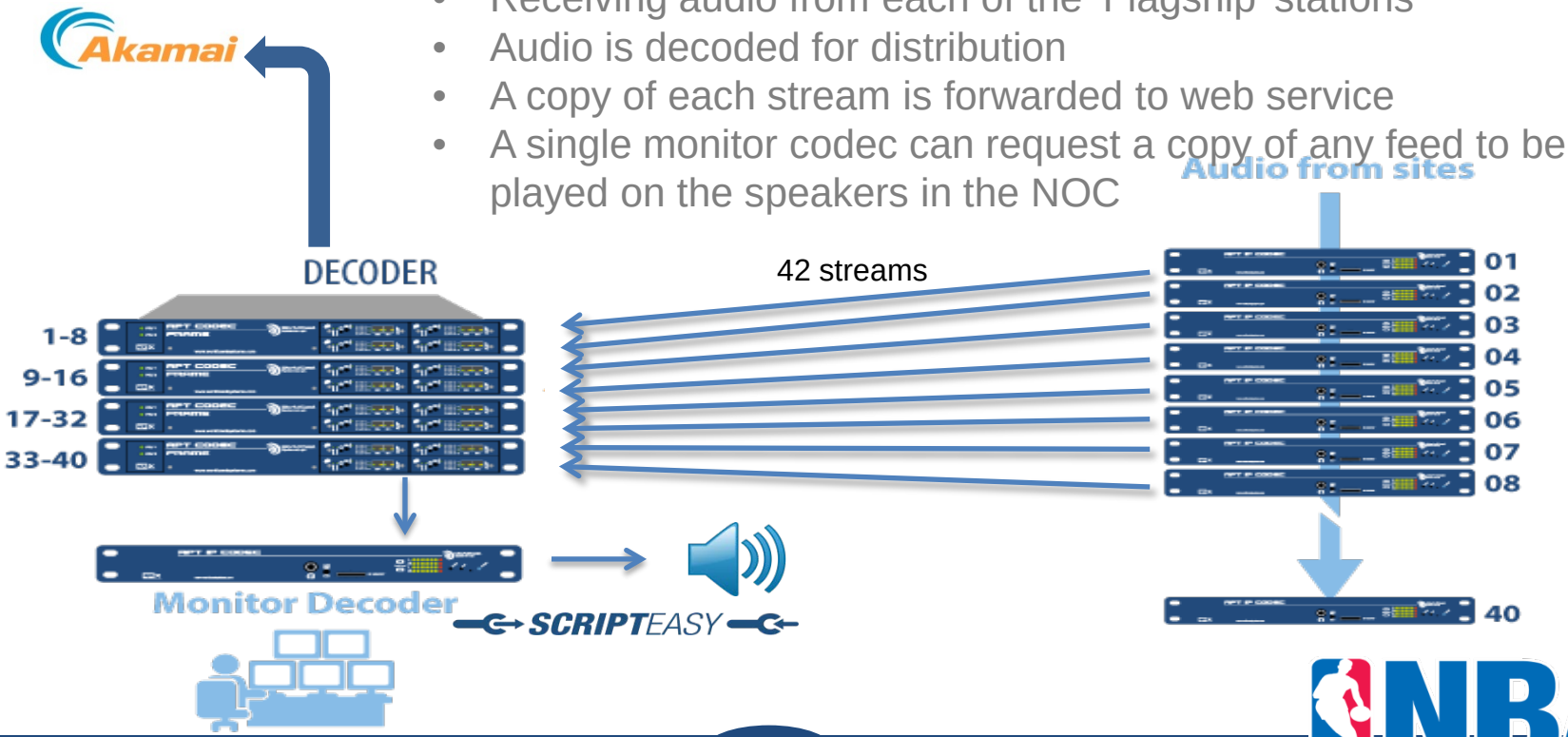
Packet Forwarding Example 2 – Decoder Redundancy

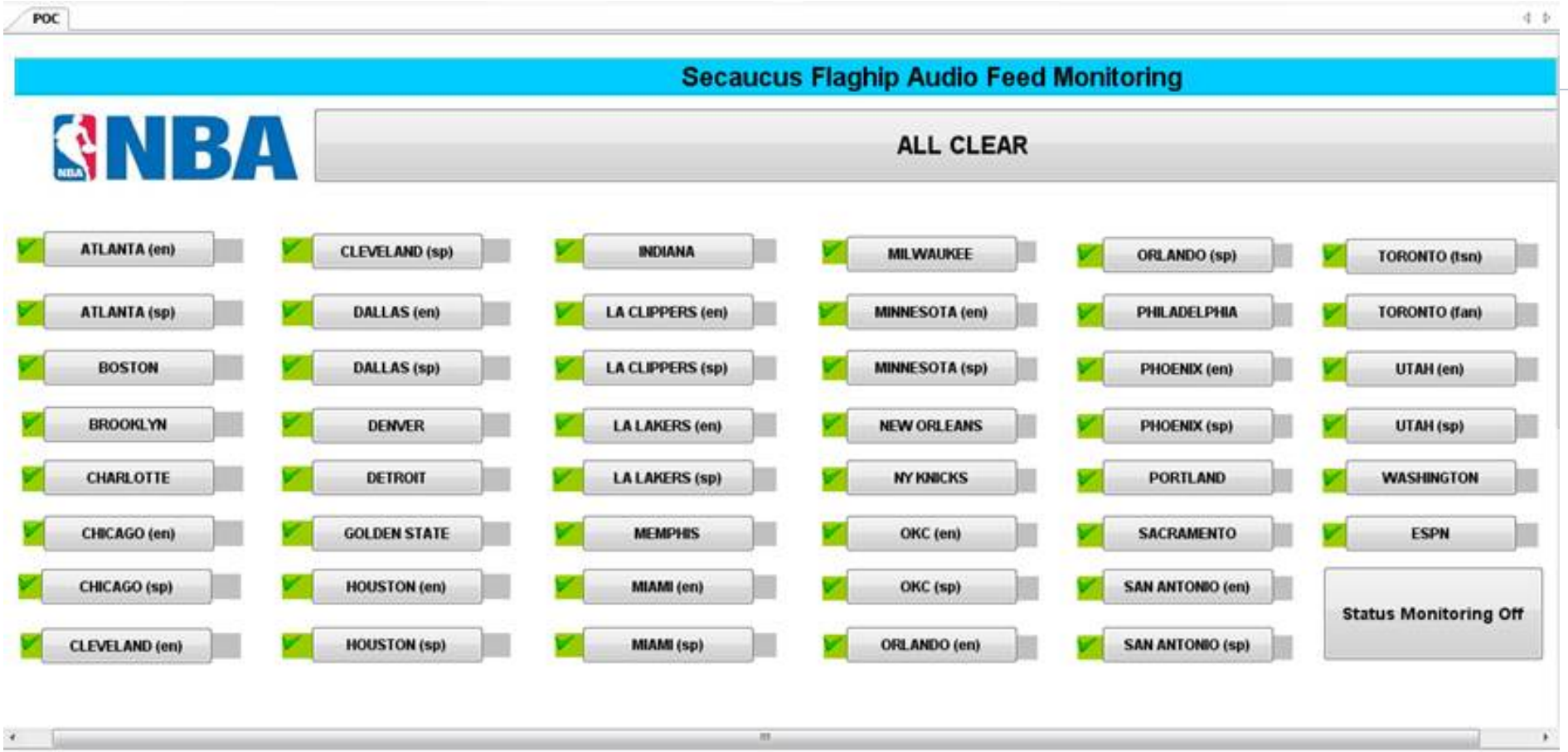
- Multiple decoders
- Each decoder receives in SureStream
- Main decoder connected to FM Transmitter
- Backup decoder connected to Backup Transmitter
- Backup Decoder can packet forward to main decoder and vice versa



Packet Forwarding Example 3 – Decoder Monitoring

- Receiving audio from each of the ‘Flagship’ stations
- Audio is decoded for distribution
- A copy of each stream is forwarded to web service
- A single monitor codec can request a copy of any feed to be played on the speakers in the NOC




POC
Secaucus Flaghip Audio Feed Monitoring
NBA
ALL CLEAR
ATLANTA (en)
ATLANTA (sp)
BOSTON
BROOKLYN
CHARLOTTE
CHICAGO (en)
CHICAGO (sp)
CLEVELAND (en)
CLEVELAND (sp)
DALLAS (en)
DALLAS (sp)
DENVER
DETROIT
GOLDEN STATE
HOUSTON (en)
HOUSTON (sp)
INDIANA
LA CLIPPERS (en)
LA CLIPPERS (sp)
LA LAKERS (en)
LA LAKERS (sp)
MEMPHIS
MIAMI (en)
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MILWAUKEE
MINNESOTA (en)
MINNESOTA (sp)
NEW ORLEANS
NY KNICKS
OKC (en)
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PHILADELPHIA
PHOENIX (en)
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PORTLAND
SACRAMENTO
SAN ANTONIO (en)
SAN ANTONIO (sp)
TORONTO (tsn)
TORONTO (fan)
UTAH (en)
UTAH (sp)
WASHINGTON
ESPN
Status Monitoring Off

MULTICAST / MULTIPLE UNICAST RELOCATION

USING APT SURESTREAMER AS A NODE

Multicast / Multiple Unicast Relocation

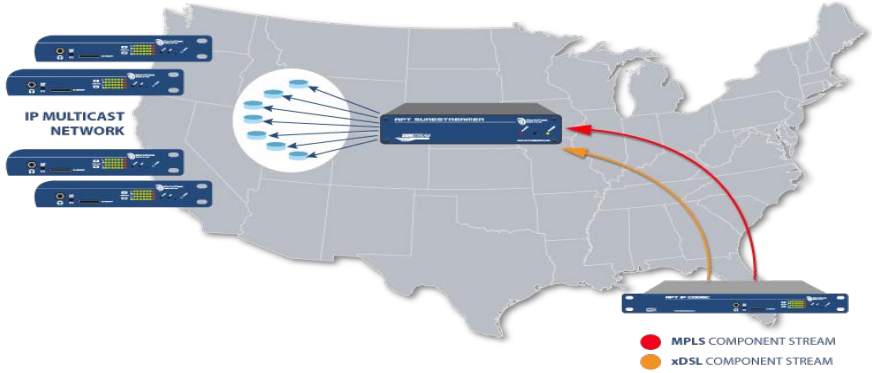
- **Definition / Distinction**
  - **Multicast:**
    - Can be deployed only on a private network
    - Uses IGMP protocol
    - Decoders join and leave groups
    - Unlimited decoders can be reached
  - **Multiple Unicast:**
    - Can be used on any IP connection *(including open Internet)*
    - Packets replicated on encoder
    - Limited decoders can be reached *(dependent on egress bandwidth and processing power)*

Multicast / Multiple Unicast Relocation

- APT SURESTREAMER allows the multicast function to be divorced from the encoder
- Locating multicast function closer to decoders can reduce Telco link costs significantly
- Ideal alternative to satellite delivery for syndicated content

Multicast / Multiple Unicast Relocation

- Encoder located in Florida
- APT SURESTREAMER placed closer to the Decoders in California
- Mixed component streams possible
- Telco cost reductions

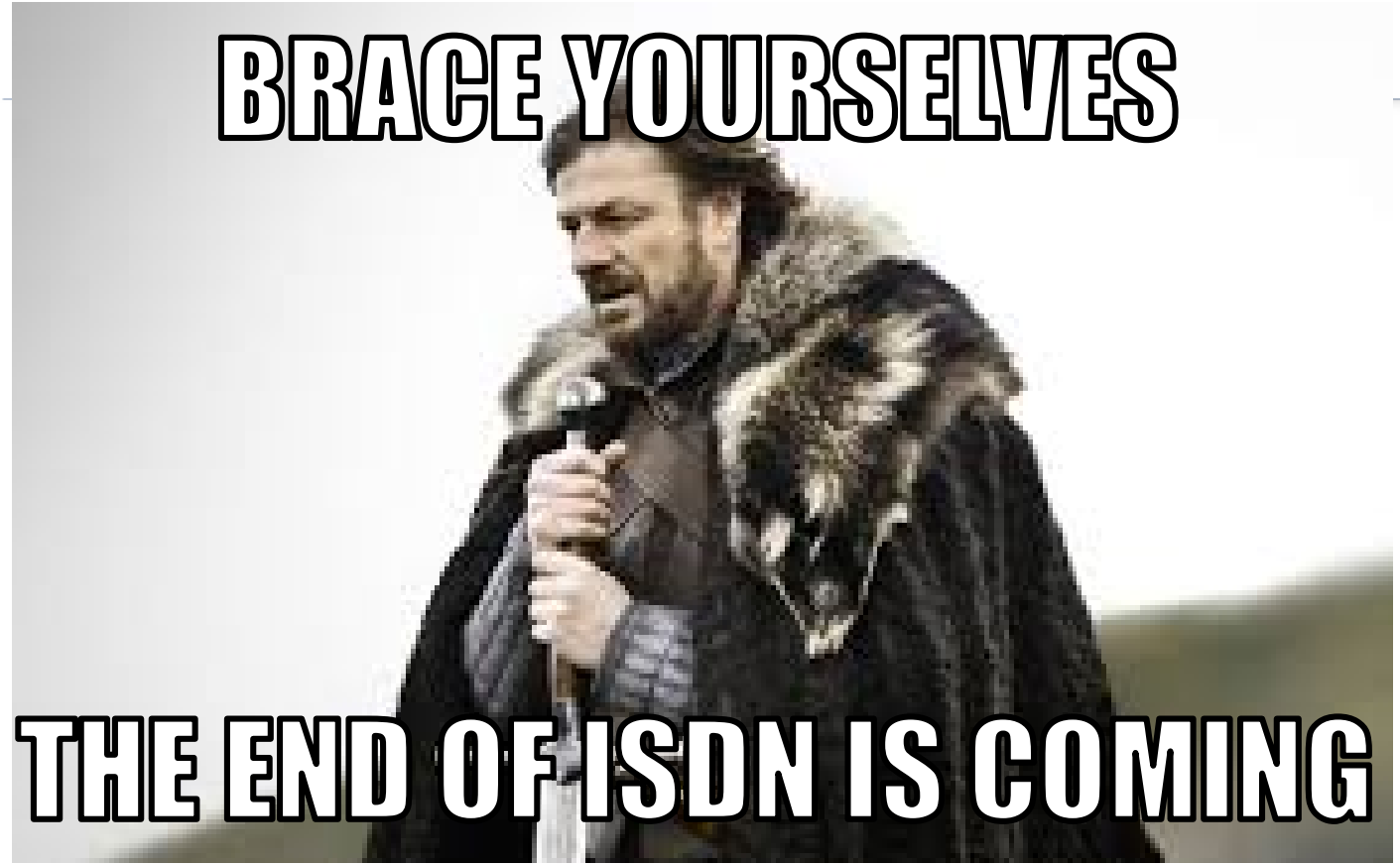


IP Transport now a realistic alternative to replace traditional satellite syndicated content

Multicast / Multiple Unicast Relocation

Number Of Decoders	Local MPLS Cost Per Link	National MPLS Cost Per Link	ADSL	Total Monthly Telco Costs	Savings
	$500	$1,500	$50		
4		4	4	$6,200	
4 (SureStreamer Node)	4	1	4	$3,550	$2,650 / 43%
10		10	10	$15,500	
10 (SureStreamer Node)	10	1	10	$7,000	$8,500 / 55%

- Telco savings in excess of 55% are achievable
- Savings on satellite distribution dependent on Economy Of Scale


BRACE YOURSELVES
THE END OF ISDN IS COMING

ANY QUESTIONS?

THANK YOU!

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