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ORIGINAL

November 14, 2003

NOTICE OF EX PARTE COMMUNICATION

Marlene H Dortch, Secretary
Federal Communications Commission
The Portals
445 12th Street, S.W., TW-A325
Washington, DC 20554

RECEIVED

NOV 14 2003

FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

Re: IB Docket No. 00-248

Dear Ms. Dortch

On November 13, 2003, John Lane and Gene Cacciamani of Aloha Networks, Inc., ("Aloha") and Lewis J. Paper and Jacob S. Farber, Aloha's attorneys, met with Robert Nelson, Karl Kensinger, John Martin, Andre Rausch, Steven Spaeth and Frank Peace, all of the FCC's International Bureau and Bruno Pattan of the FCC's Office of Engineering Technology.

We discussed Aloha's views with respect to several of the VSAT licensing and interference issues under consideration by the Commission in the above-referenced docket. The substance of those views is set forth in the attached presentation handed out at the meeting.

Sincerely,

Jacob Farber

Jacob S. Farber

Enclosure
cc: Robert Nelson (w/o encl.)
Karl Kensinger (w/o encl.)
John Martin (w/o encl.)
Andre Rausch (w/o encl.)
Steven Spaeth (w/o encl.)
Frank Peace (w/o encl.)
Bruno Pattan (w/o encl)

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FCC Discussion on Notice of Proposed Rulemaking, IB Docket No. 00-248
13 November, 2003

Aloha Networks, Inc
1001-A O'Reilly Ave
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San Francisco, CA

Introduction

- We are
  - John Lane- Director RF Engineering Aloha Networks Inc.
  - Gene Cacciamani- Board Member and Special Technical Adviser Aloha Networks Inc.
- Aloha Networks is S.F. based start-up (1994)
  - Manufacture and sell SkyDSL SAMA modems (CPE and Hub) to network operators
  - 20 Employees and full time contractors, 50% engineering
  - Deployed Operating Network (150 remotes) for Navajo Nation
  - Small networks in US, Europe, South America, and Africa
  - Installed small networks for government agencies
  - Production ramp up with 2nd Gen. product in Q1 of 2004

Topics of Discussion

- Focus on growth of Very Small Aperture Terminals (VSATs) for internet access applications
- A successful VSAT alternative to cable and other internet access last-mile solutions depends on controlling Adjacent Satellite Interference (ASI)
- Internet Browsing over VSAT requires newer Multiple Access Methods
- Current Internet VSAT solutions generate excessive ASI and are too inefficient to be competitive with terrestrial solutions
- Field measurements of an operational Internet VSAT network show that misaligned antennas generate a significant amount of this interference
- Antenna Pointing Issues
- Automatic Antenna Pointing Monitoring Methods
- Aloha Networks' SkyDSL Networks with Spread Aloha Multiple Access - SAMA are part of the next generation of Internet VSATs that provide higher thruput and lower latency while reducing the ASI and its sensitivity to antenna pointing
- ASI Regulation should focus on total ASI and allow variations in Power Spectral Density (PSD), antenna sidelobes, sidelobe starting angles, and pointing (installation/monitoring) requirements

The VSAT Alternative to Last-Mile Internet Access

- Both Direct TV and Dish Network are expanding VSAT video offering to include internet access, with existing ISPs and eager to expand their broadband offering
- The successful VSAT solution will have low equipment cost, installation cost, good bandwidth efficiency, low latency, and high return link data rates
- In order to reach a broader population, VSAT terminals will be cheaper, less obtrusive, and easier to install
  - Smaller antenna sizes (beamwidth and sidelobe gain)
  - Lower power amplifiers: 2W and below
  - Semi-automated installation (pointing error)
- The success of VSAT internet access depends on the ability of large numbers of inexpensive VSATs operating in adjacent non-interfering networks

Excessive ASI Reduces VSAT Industry Competitiveness

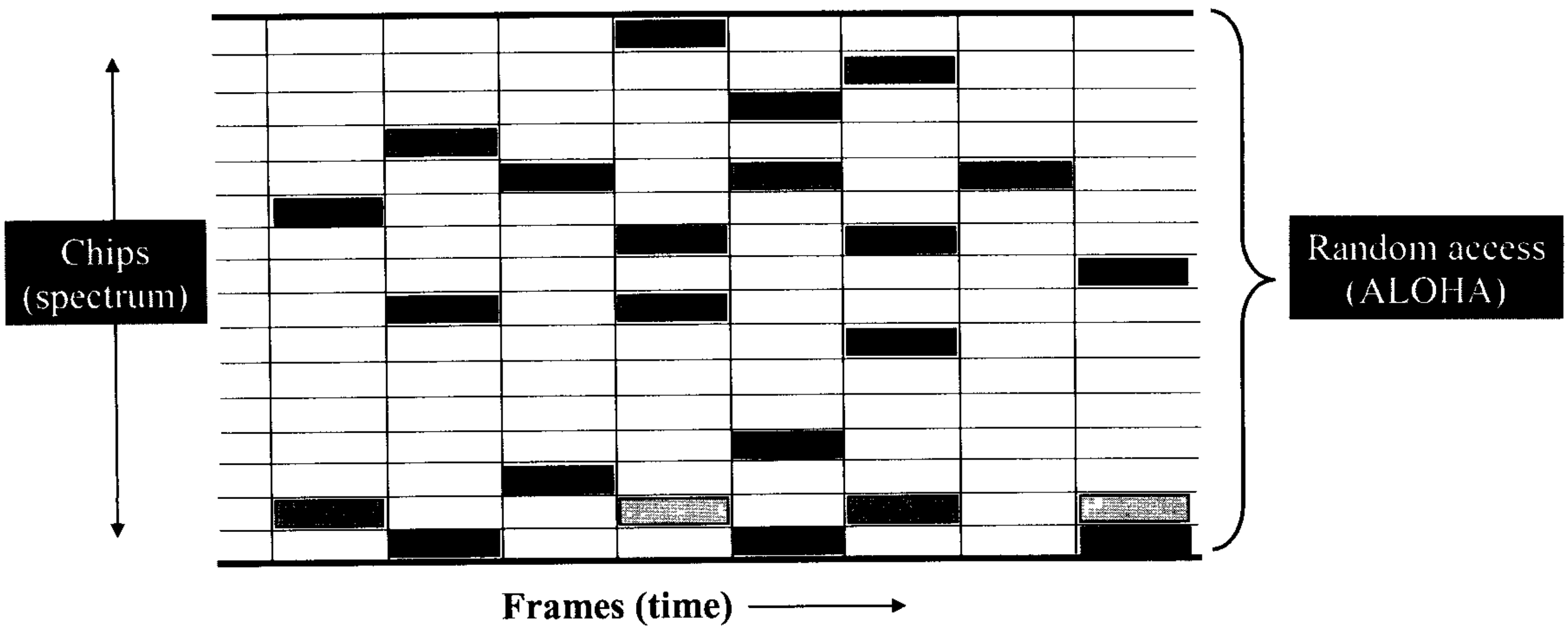
- Low EIRP reduces internet VSAT cost/ obtrusiveness
  - Less obtrusive Sub meter antennas have lower antenna gain
  - Even lower power PAs (below 2W) are most expensive VSAT component
- Low EIRP return links require lower Satellite Saturation Flux Densities (SFD) making them more susceptible to ASI and Cross Polarization Interference (XPI)
- Lower ASI and XPI allow the use of smaller Power Amplifier PA sizes, Antenna gains, or higher data rates
- Uncontrolled ASI will require an extreme amount of coordination/troubleshooting for neighboring networks in identifying the problem transmitters
- A successful VSAT alternative to cable and other internet access last-mile solutions depends on controlling ASI

Multiple Access for Internet Browsing

- FDMA- Frequency Division Multiple Access- users assigned small frequency band within which to transmit
- TDMA- Time Division Multiple Access-data is grouped in small packets and interspersed with packets of other users in a sequential periodic way
- CDMA-Code Division Multiple Access-users transmit a unique sequence of sub-bits (called "chips") for each bit of information
  - Direct Sequence (DS) CDMA- each bit is sent as a sequence of chips at a higher data rate
  - Frequency Hopping (FH) CDMA- each bit is sent as a sequence of frequency "hops" at a higher data rate
  - Receiver Correlates multiple signals with local code to reject undesired signals.
- Narrowband Aloha – Simple Aloha- users divide message into packets and transmit whenever packet is ready
  - Collision occurs when 2 or more users transmit simultaneously
  - User detects collision when acknowledgement of successful transmission is not received and retransmits packet after waiting a short (random) amount of time
  - Thruput is improved with Slotted Aloha –where users send packets only on synchronized start times
- SAMA- Spread Aloha Multiple Access – data is Direct Sequence spread using one or a small number of codes, divided into packets, and sent whenever packet is ready
  - Only simultaneous transmissions that are sent at exactly the same "chip" time cause collisions
  - Thruput is improved by with Slotted SAMA- in which users transmissions occur within a sequence number of chips from that start time

SAMA-Spread Aloha Multiple Access

SAMA divides the spectrum into chips and frames



Using a single code, SAMA divides the 3Mhz spectrum into a chipping sequence, each chip carrying 129Kbits. SAMA puts more active users (represented by different colors) on the spectrum.

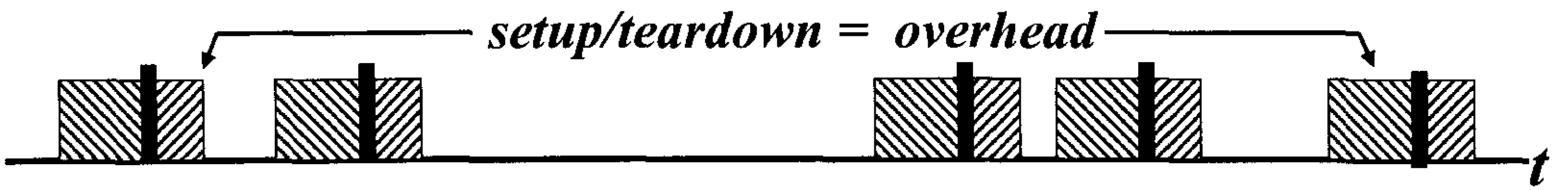
Random Access and Connection Oriented Protocols

- SCPC- Single Carrier per Channel- user is statically assigned a channel (frequency, time, code, slot) forever
- Connection-Oriented Protocols- a user is assigned a channel according to a protocol
  - Periodic- channel access is sequenced through registered users
  - Round Robin- channel access is passed from one user to the other
  - DAMA – Demand Assigned Multiple Access- channel access is assigned upon "demand" from the user
    - User "demands" access through an "order-wire" channel- typically a narrowband Aloha channel
    - Connection time may depend on network loading

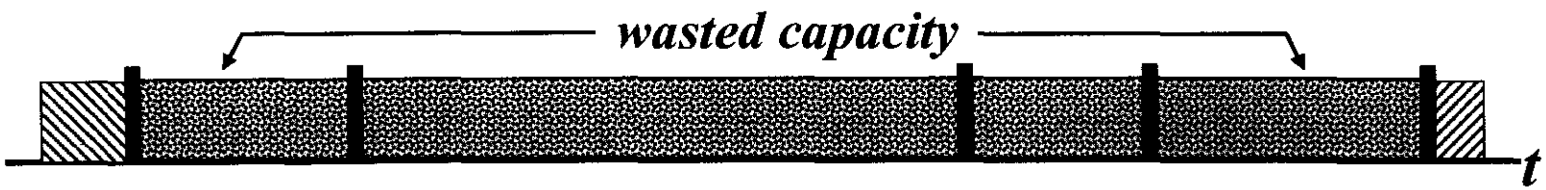
Connectionless-Random Access Transmission

- (Narrowband) Aloha
  - a user transmits message whenever it needs to
  - Collisions occur when 2 or more user's transmissions overlap
  - If the user doesn't receive verification of successful transmission then it retransmits the message after waiting a short random amount of time
  - Burst rate must be increased to increase the potential number of users on the channel
- Ethernet – "Collision Sense" Multiple Access
  - Users avoid many possible collisions by sensing the channel before transmission – Satellite delay prohibits this method
- SAMA- Spread Aloha Multiple Access
  - Shares channel among many more users than Narrowband Aloha
  - Due to correlation "gain", required power is dependent on burst data rate and NOT burst chip rate
  - SAMA achieves exceptional thruput by avoiding collisions in most simultaneous transmissions with code autocorrelation properties

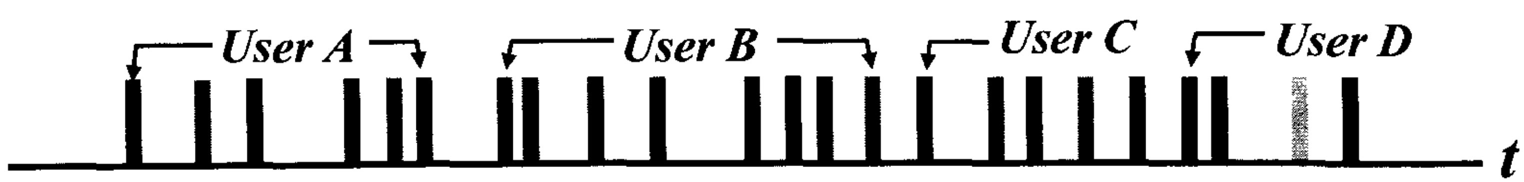
Connections are Inefficient for Internet Browsing



Packet Connections: add 1-2 seconds of latency



Session Connections: utilize 1-3% of channel capacity



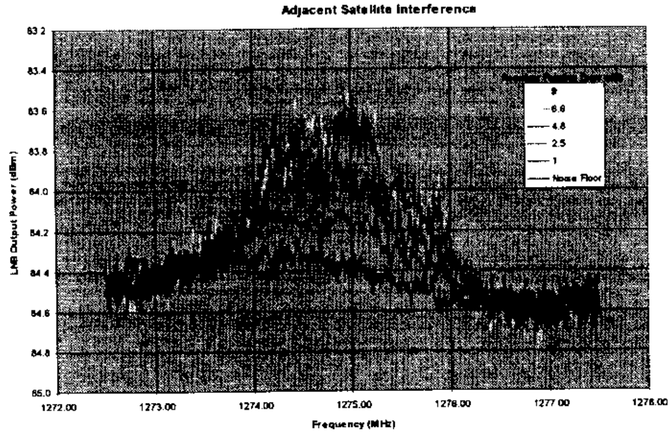
SAMA is connection-free: resulting in 8 times the capacity with ~ ½ second latency

Current Internet VSAT Solutions

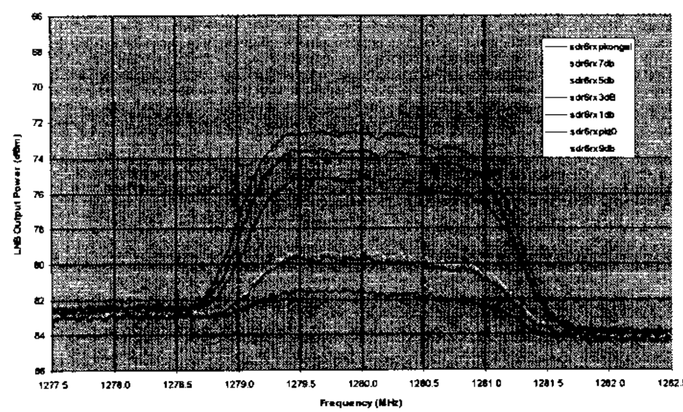
- Connection Oriented Systems
  - Narrowband ALOHA channel used for channel reservation
  - TDMA channel used for payload
- Spectrally Inefficient for competitive Internet Browsing Application
  - VSAT internet browsing requires low latency (1 hop) to be competitive with terrestrial solutions
  - Reservation systems require 2 hops to transmit for new connections; for existing connections, the channel remains idle most of the time
  - For loaded conditions, user experience is high latency and reservation channels are excessively loaded
  - Provide about 1K simultaneous users per 36 MHz transponder for acceptable user experience
- Uplink speed is relatively slow compared to burst rate due to TDMA
- Generate Excessive ASI
  - Narrowband Aloha reservation channel
  - Smaller Aperture higher sidelobe antennas
  - Inadequate monitoring capability

Smaller dishes increase ASI sensitivity to pointing errors

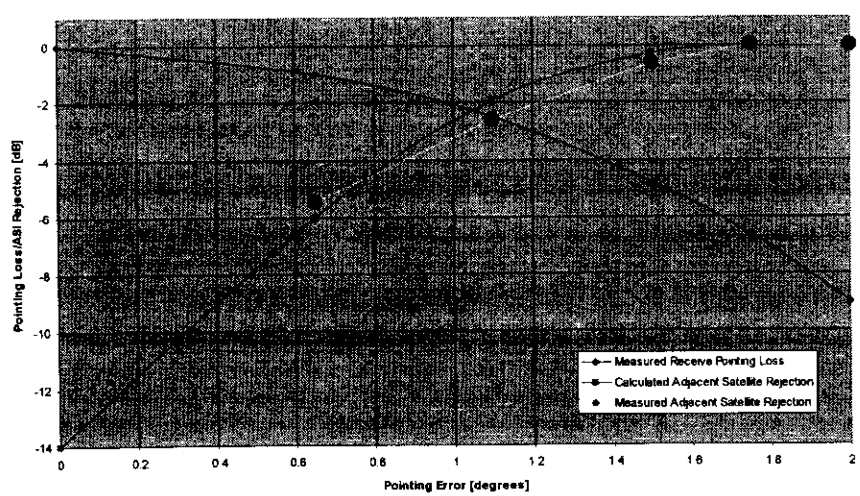
Adjacent Satellite Interference



Receiver Pointing Error

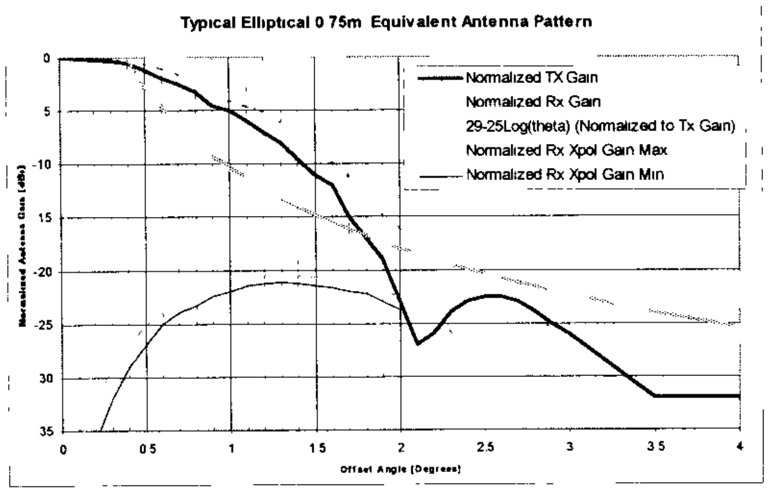


0 75m Remote to 2 4m Hub Adjacent Satellite Interference Measurement



Antenna Pointing Issues

- Typical gain patterns are plotted below for a 0.75m equivalent aperture (0.62 x 0.89m) antenna



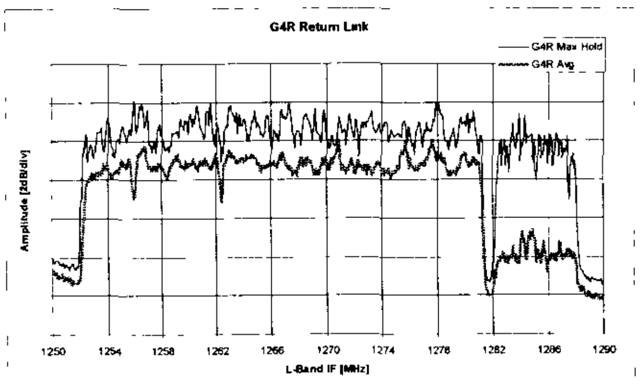
- As verified by the pattern, this antenna has a specified starting angle for the 29-25Log(theta) response at 1.8 degrees.
- For no pointing error, the relative gain at the adjacent satellite is 25 dB below that to the desired satellite
- For a 0.4 degree pointing error (which corresponds to about 1.2cm movement at the edge of the antenna) the relative gain at the adjacent satellite is only 17dB below that to the desired satellite

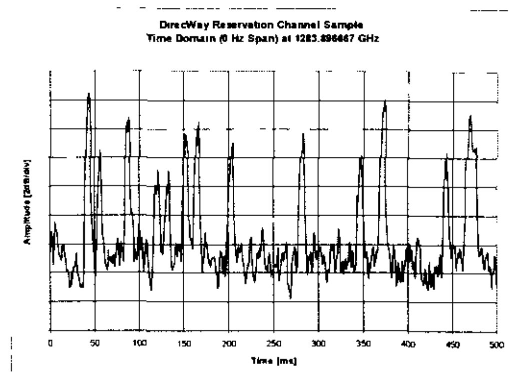
Antenna Pointing Issues

- The other statistical component in the ASI equation is the transmitter pointing distribution
- For identical burst rate networks operating at the –14 dBW/4kHz network limit, the SAMA transmitter PSD is 7-8 dB lower than the narrowband Aloha transmitter PSD
- Even though no statistical VSAT network pointing data exists in the public domain, some commenters have converged on 0.4 degrees as an achievable pointing error; assigning a 0.4 degree variance to a normal distribution of pointing errors can give information on the percentage of users that will exceed the ASI limits and by how much
- Any variance requirement should be based on the percentage of time misaligned antennas are expected to transmit; in light of the ongoing PSD statistical discussion, number ranging from 0.1% to 1% may be viewed as acceptable
- Any normal distribution exceeds 1.6x var 10% of the time, 2.6 x variance 1.0 % of the time, and 3.3 x variance 0.1 % of the time. Therefore, 10% of their terminals will have 0.6 degrees pointing error, 1% of the terminals will have 1.0 degrees pointing error, and 0.1% of the terminals will have 1.3 degrees pointing error.
- For the 0.75m elliptical antennas used, this puts the adjacent satellite well within the main beam at 1.6, 1.2, and 0.9 degrees offset respectively, with 5, 10 and 13 dB higher antenna gain at the adjacent satellite.
- The distribution may deviate from normal at the higher offsets, as the main receive lobe degradation may cause the user to realign his dish. However, for 10% of the users expected to see 0.6 degrees pointing error, this should not be a factor. The additional 5dB of sidelobe gain these terminals exhibit has significant impact on the total ASI generated.

DirecWay Return Link Showing Aloha Channel Collisions

- DirecWay CPE transmissions on Galaxy 4R (G4R) at 99 degW and its uplink ASI on AMC4 at 101 degW were monitored and recorded
- A Channel Master 1.8m was used to eliminate any possible downlink ASI from the measurement (24 dB rejection of ASI downlink)

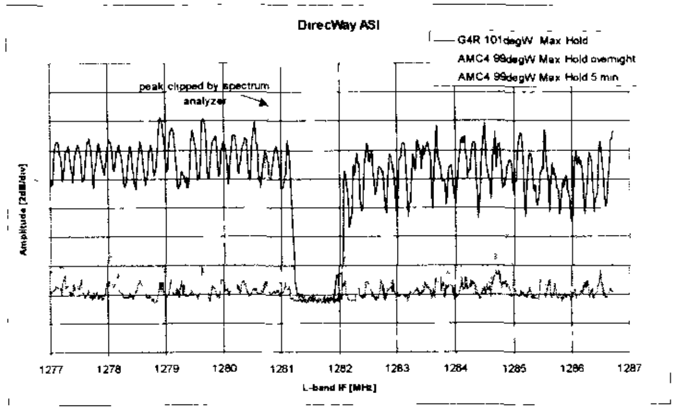




- On G4R Xpndr TP16 [LEFT] TDMA uplink traffic channels on left; reservation channels to the right
- The [LEFT] plot shows both average and maximum values of the spectrum; demonstrating the bursty nature of channel accesses
- A time domain response of one of these reservation channels [RIGHT] was taken by centering the spectrum analyzer on the Aloha channel and setting 0 span
- Over a 500ms sweep, a significant number of peaks(channel requests) were about 3dB higher than others; it's unclear how many of these peaks in the plot are due to varying power levels of the transmitters or collisions; but higher resolution sweeps (smaller time scales) indicate the presence of collisions

DirecWay Return Link ASI: Misaligned CPE Antennas

- Plots of the ASI on AMC4 (101degW) are overlaid on the plot of the G4R signals



- The corresponding guard band between the TDMA and Aloha channels on both plots reinforce that the AMC4 signal is ASI from G4R CPE transmitters
- Our measurement of this interference is striking since the noise floor of our link with a 1 8m Rx antenna is approximately 10dB above the satellite noise floor; if an actual return link was used on this transponder(9.2m Rx antenna), the composite noise floor would only be about 1 2 dB above the satellite noise floor
- Assuming comparable satellite characteristics and the typical 0 75m antenna patterns shown above, the difference of only 7 dB between the the G4R and AMC4 signals indicates many transmitters are off by as much as 1 degree. These signals would be as much as 8 dB above the noise floor of a composite return link (9.2m Rx dish) Assuming a Gaussian distribution, this would account for approximately 1% of the users
- This interfering process was of burst nature on for both the TDMA and Aloha channels, in addition, the peaks on the TDMA side are as high if not higher than on the Aloha side, further evidence that these peaks are caused my misaligned antennas.
- A larger receive dish could show the effects of a more moderate pointing error; assuming a normal distribution of 0 4degree variance, a pointing error of 0.6 degrees would correspond to 10% of the users This would generate ASI 5dB above that of the nominal pointing error (0 4 degrees) and 5 dB below that of the extreme 1% of the users This 10% would generate ASI about 3 dB above the noise floor, which is a significant degradation of link quality.
- Without an antenna pointing monitor capability in the network there is no way to automatically shut off these transmitters or even identify them

A newer generation of internet VSAT can be competitive with terrestrial solutions without generating excessive ASI

- Low latency high burst rate connectionless random access techniques for bursty internet browsing
- Instead of reserving a channel for the traffic with random access, the entire traffic is sent with random access
- The PSD is distributed over frequency with SAMA, CDMA, or fast frequency hopping spreading techniques reducing the ASI generated by the terminal.
- These spreading techniques allow a larger number of users to share a random access channel than narrowband Aloha does; providing better bandwidth efficiency for this bursty application by this economy of scale (in NB ALOHA, the bandwidth is limited by the data burst rate, which is limited by the PA size)
- The user has access to the entire burst data rate since it is not divided by the TDMA time slots.
- Without the ASI, more senstive transponder settings can be used, allowing for higher data rates, smaller Pas, or smaller antennas.
- This results in higher speed, lower latency, lower cost, smaller VSAT alternative to terrestrial last mile internet solutions
- For instance, SAMA can serve over 10 times the number of active users than

Spread Aloha Multiple Access (SAMA) PSD

- Aloha Network's SAMA uses direct sequence spread spectrum to provide return link multiple access and reduce transmitted PSD
- SAMA transmitters transmit either 129 or 266 kbps burst rate over 2 MHz, lowering the PSD by 11.9 or 8.8 dB respectively over that of same rate non-spread waveforms
- This results in –27 dBW/4kHz per 1W transmitter or –24 dBW/4kHz per 2W transmitter
- Single code SAMA can achieve a loading of 3 pkts/pkt time; this results in a collision of more than 8 transmitters (9.0 dB) less than 1% of the time or a collision of more than 9 transmitters (9.5 dB) less than 0.1% of the time.
- Dual code SAMA can achieve a loading of 6 pkts/pkt time; this results in a collision of more than 12 transmitters (10.8 dB) less than 1% of the time or a collision of more than 15 transmitters (11.8 dB) less than 0.1% of the time.
- Even for the more stringent 0.1% excess collision limit, the –14-10LogN limit would be satisfied with 2W single code SAMA transmitters and 1W dual code SAMA transmitters
- By contrast, a non spread 128 kbps burst rate QPSK solution with 35% loading can transmit only 0.6W per transmitter(1% limit) or 0.4W per transmitter (0.1% limit)
- Given the low PSD per terminal of SAMA, these terminals should not be held to the same installation and terminal monitoring requirements as higher PSD terminals

Proposed Antenna Monitoring Capabilities

- Only by periodic monitoring of the antenna pointing can the pointing error be assured
- The use of non-penetrating roof mounts can reduce installation time and cost but can be more susceptible to antenna drift over time.
- Monitoring of terminal antenna pointing can also reduce the network maintenance cost of identifying misaligned antennas
- Using the cross-polarized antenna gain allows for a more precise pointing measurement. This could be performed with measurements of a tone on the remote unit, hub, or a beacon on the satellite.
- The use of a satellite beacon (though they do not exist for all satellites and their polarizations) would significantly reduce the network management complexity
- The cost of the pilot tone transmitter equipment/bandwidth can be ammortized over the whole satellite if a the beacon concept was encouraged.
- This monitoring process must be conducted periodically to assure the continued compliance of terminal antenna pointing errors

Regulations should focus on Total ASI and allow variations in the ASI components

- Key ASI components are terminal PSD, simultaneous transmission (collision) statistics, antenna sidelobes, and antenna pointing errors
- Antenna pointing errors are mitigated by installation practices and network monitoring capability
- Without a network monitoring capability, the cumulative pointing error of large number of users should follow a Gaussian distribution; the most extreme 10% of this distribution will have a pointing error 1.6 x variance of the distribution- the impact of these mispointed antennas is extreme
- For networks with terminal PSDs close to the ASI limit, a network antenna pointing monitoring capability should be required to reduce the pointing error for the extreme cases
- Networks with terminal PSDs much lower than the ASI limit should be allowed smaller antennas not require extensive monitoring capability

Conclusions

- A successful VSAT alternative to cable and other internet access last-mile solutions depends on controlling ASI
- Current Internet VSAT solutions generate excessive ASI and are too inefficient to be competitive with terrestrial solutions
- Field measurements show that misaligned antennas cause as much ASI as collisions on random access part of that network
- ASI Regulation should focus on total ASI and allow variations in PSD, antenna sidelobes, sidelobe starting angles, and pointing (installation/monitoring) requirements
- By properly regulating PSD statistics, antenna sidelobe performance, and antenna pointing accuracy, the FCC can support the emergence of a new generation of VSAT as a viable last-mile internet solution.