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July 19, 1999

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

VIA HAND DELIVERY

Ms. Magalie Roman Salas
Secretary
Federal Communications Commission
455 12th Street, S.W., TW-A325
Washington, DC 20554

RE: *Ex Parte* Notice: *In the Matter of Amendment of Parts 2 and 25 of the Commission's Rules to Permit Operation of NGSO FSS Systems Co-Frequency with GSO and Terrestrial Systems in the Ku-Band Frequency Range* and *Amendment of the Commission's Rules to Authorize Subsidiary Terrestrial Use of the 12.2-12.7 GHz Band by Direct Broadcast Satellite Licensees and Their Affiliates*; ET Docket No. 98-206, RM-9147 and RM-9245

Dear Ms. Salas:

This is to advise you that on Friday, July 16, 1999, the undersigned and Kevin Kelley, Mark Epstein, Jennifer McCarthy, Marc Sands, Len Schiff, and Judd Erlenbach of QUALCOMM Incorporated ("QUALCOMM") met with Harold Ng and Thomas Tycz of the International Bureau (collectively "the Staff") to discuss certain spectrum sharing issues relating to the entry of non-geostationary orbiting satellite systems operating in the Ku band on QUALCOMM's OmniTRACS® mobile information management system. Attached hereto is a copy of QUALCOMM's presentation to the Staff, which outlines the company's most recent interference calculations and spectrum sharing concerns.

The Staff provided QUALCOMM with an update on the outcome of the JTG 4-9-11 and the current status of the WRC-2000 preparatory process.

Sincerely,

J. Breck Blalock

cc: Thomas Tycz, Chief, Satellite and Radio Communication Division
Harold Ng, Engineer Advisor, Satellite and Radio Communication Division

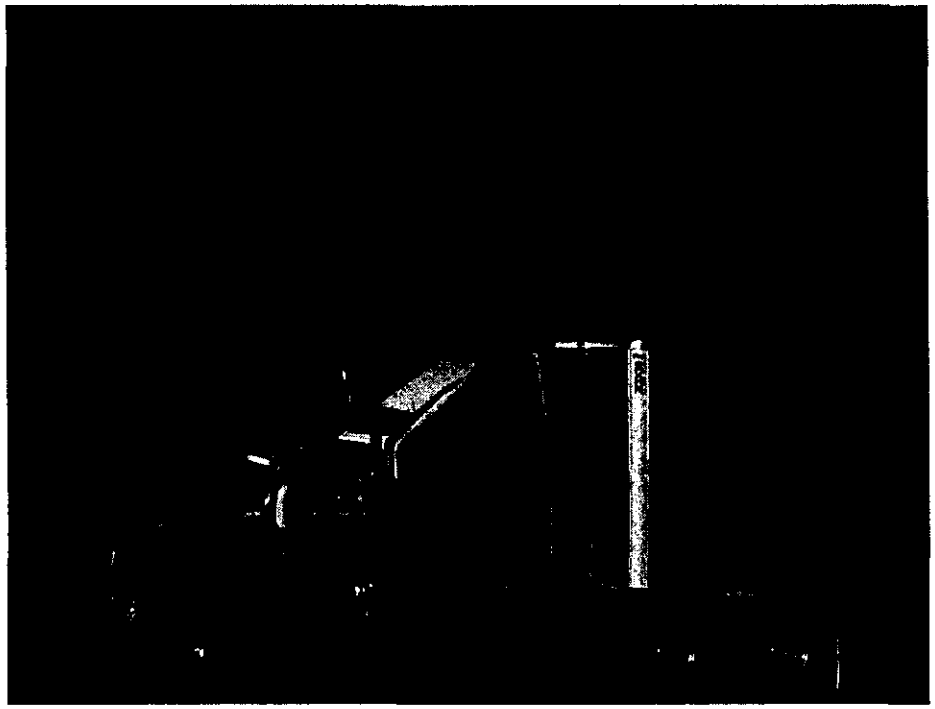
OmniTRACS

[illegible] Regulating [illegible]

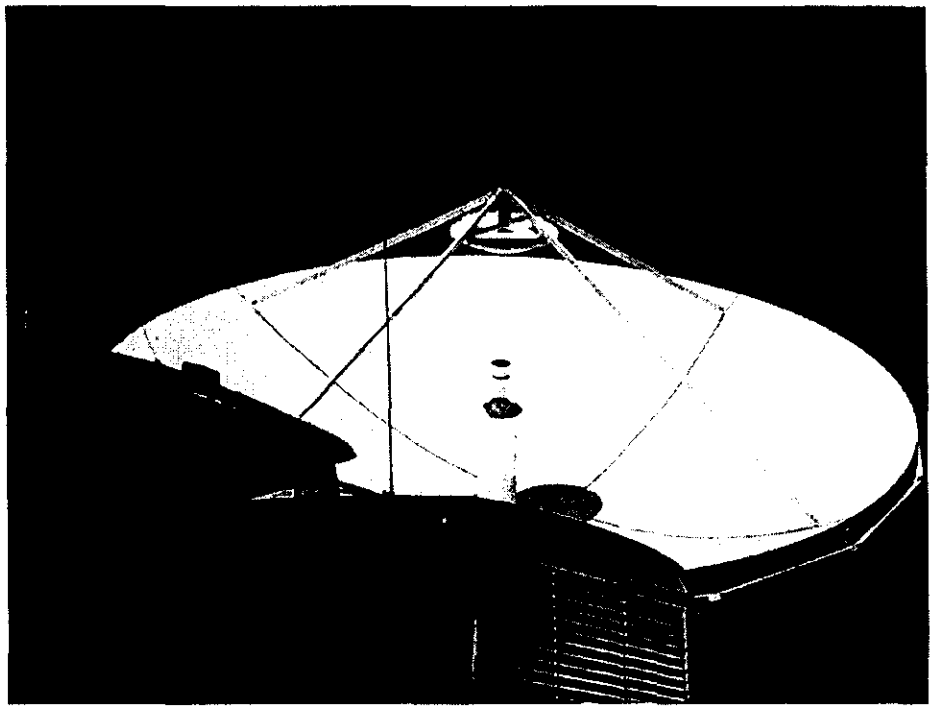
Spectrum Sharing

July 16, 1999

QUALCOMM

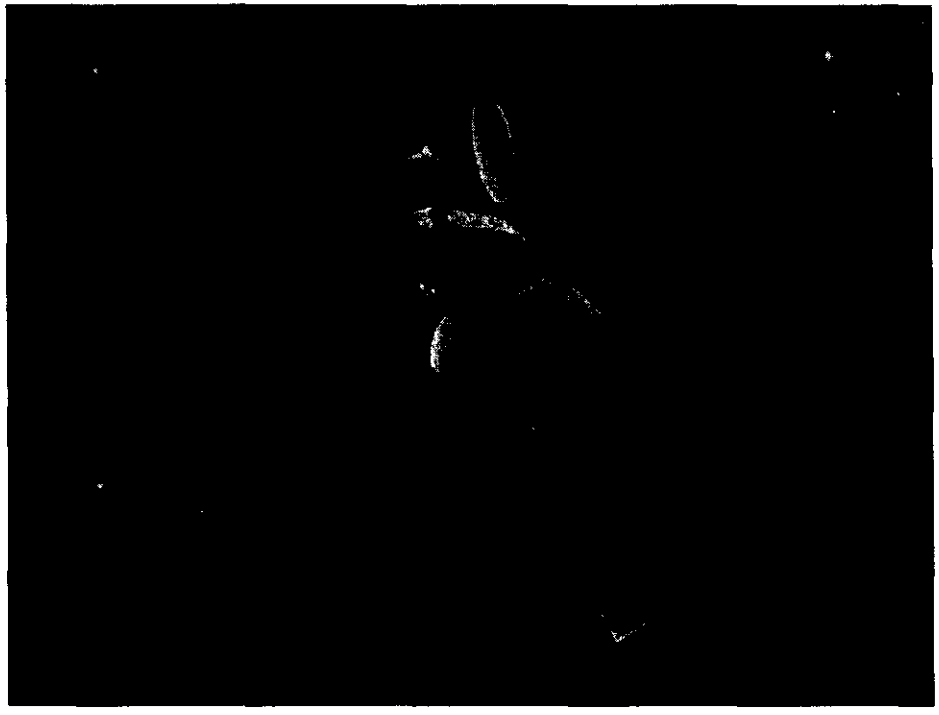


OmniTRACS is an information management system including two-way mobile communications, satellite tracking and fleet management software.



TWO-WAY COMMUNICATIONS

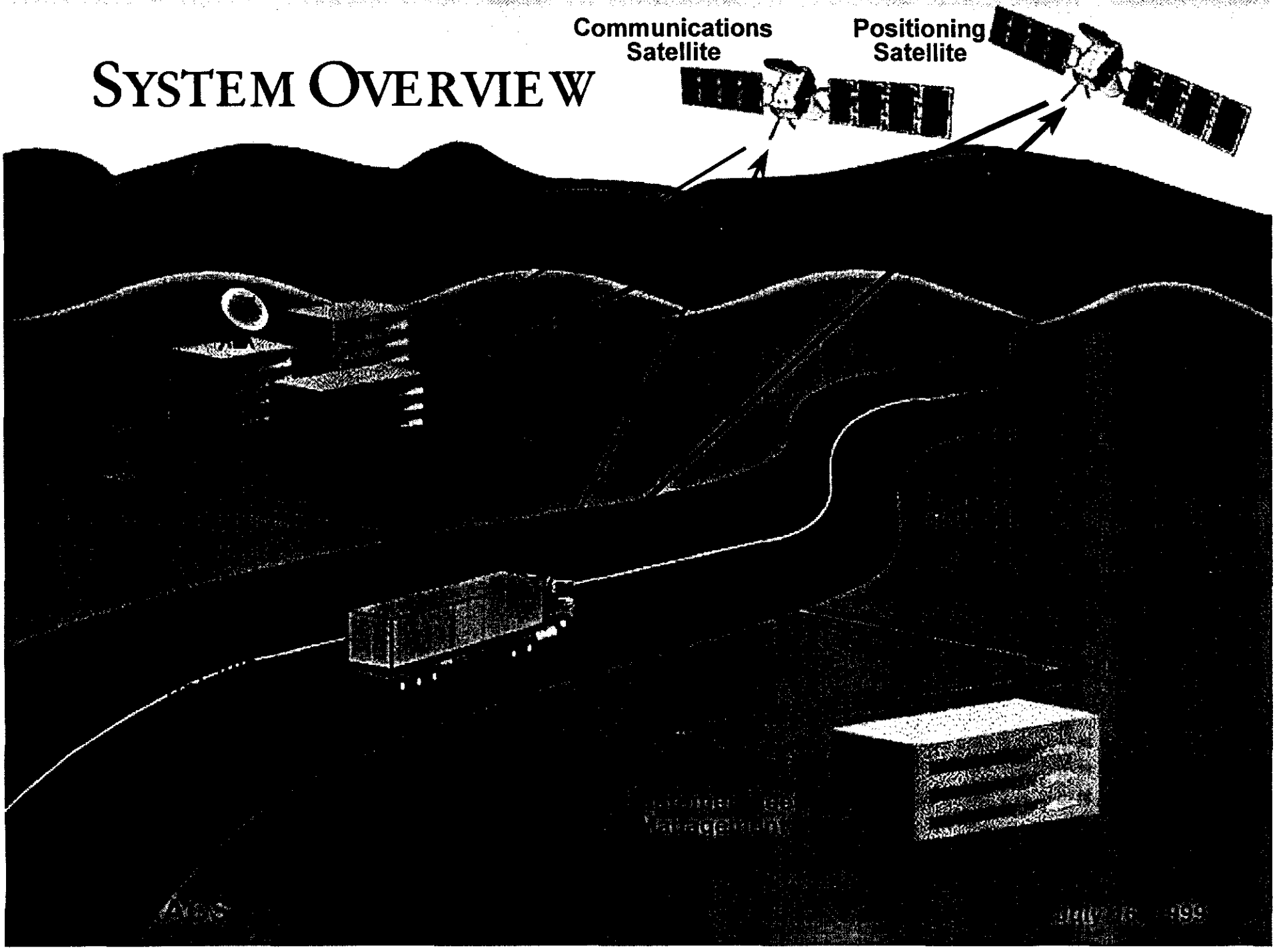
- Freeform "Email" Messages
- Formatted "Fill-in-the-Blank" Messages
- Vehicle Information



SATELLITE TRACKING

- Latitude/Longitude Coordinates
- Nearest "Landmark" References
- Mapping

SYSTEM OVERVIEW



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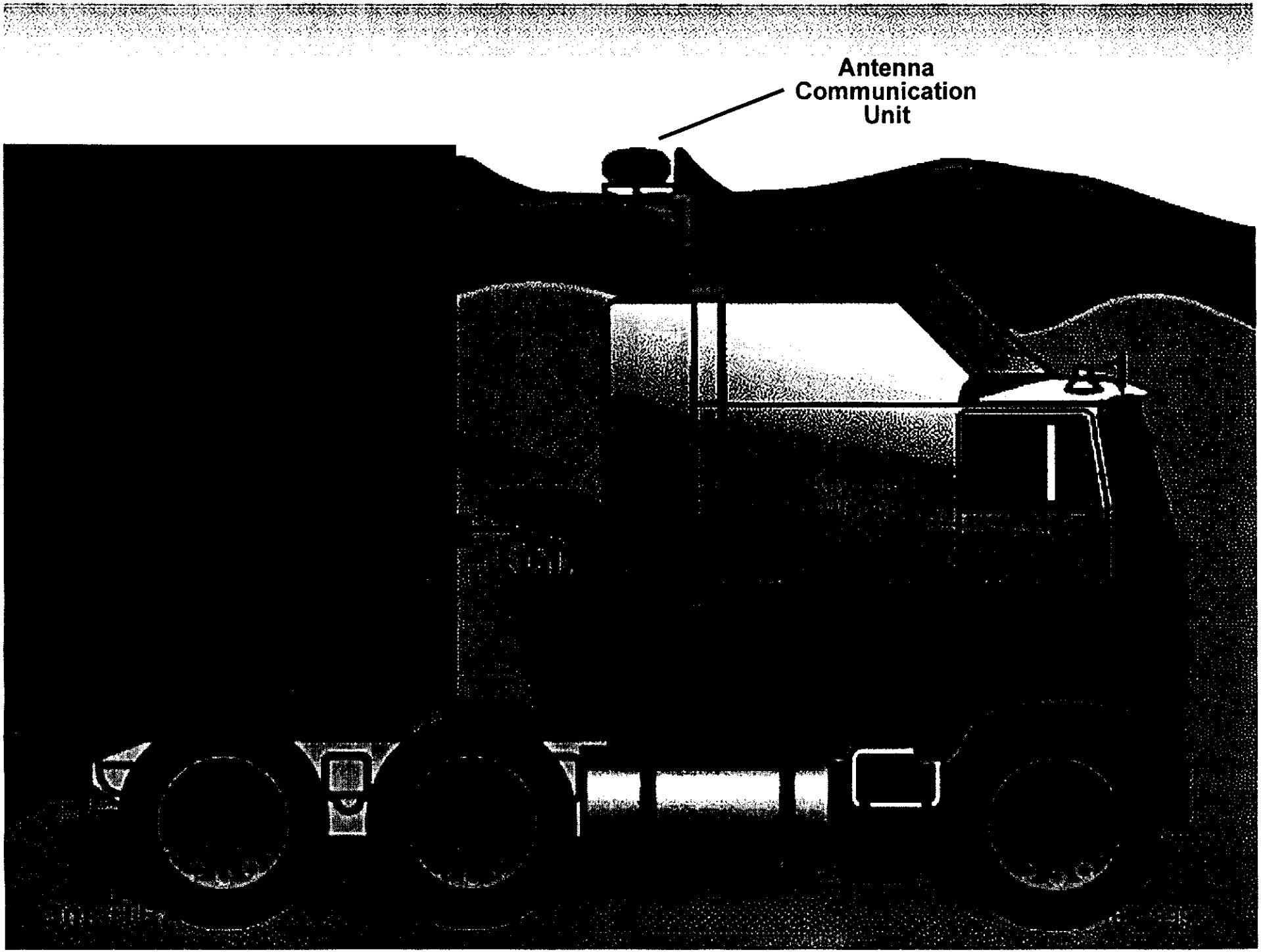

Antenna
Communication
Unit

Customers - Install Base

- Over 270,000 mobile units installed worldwide
- Approximately 1000 customers with 200,000 trucks installed in the U.S.
- International systems used in Canada, Mexico, Europe, Brazil (C-band), Japan, Malaysia (C-band), Korea, China (demo)

Importance to U.S. Transportation and Logistics

- U.S. Carriers Installed include:
- 22 of 30 largest truckload
- 8 of 10 largest refrigerated
- 6 of 6 largest tank truck
- 5 of 7 largest household goods

Importance to U.S. Government

- Defense Transportation Tracking System, over 1,000 vehicles hauling nearly 50,000 munitions loads a year
- U.S. Army, over 500 units for operations in Europe and Bosnia
- Sandia National Labs, nearly 50 units for sensitive movements

Mobile Unit FCC License Status

- Initial MSS license issued 2/14/89 (Call Sign E880423)
- Secondary noninterference status in Ku band frequencies (14000-14500 MHz and 11700-12200 MHz)
- Ten year renewal license granted in February 1999
- Modification pending to increase mobile units from 250,600 to 400,600

NGSO Spectrum Sharing Background

- The FCC has prepared rule making for NGSO Satellite Service at Ku band in which the NGSO service would operate as co-primary with GSO
- OmniTRACS operation in the FSS band is secondary
- Considering the vital role OmniTRACS serves for the 200,000 terminals in the US, it deserves protection from a newly proposed primary service

NGSO Spectrum Sharing Background (cont.)

- QUALCOMM is not opposed to the establishment of new NGSO service. We only seek adequate protection

- One concern is with the potential interference of NGSO Satellites into OmniTRACS terminals
  - The epfd rules

OmniTRACS and Skybridge

- QUALCOMM has had discussions with Skybridge and we believe our interference protection needs relative to Skybridge are relatively easy for Skybridge to meet
  - This is true because of the spread spectrum nature of the OmniTRACS signal

- For example, the actual proposed flux density of the Skybridge satellites is -155 dBW/m^2 /4KHz

- Our calculations show that if such a radiating satellite were in the bore sight of an OmniTRACS mobile antenna it would have to produce even more interference power (-153.2) to produce a 6% rise in total noise in the OmniTRACS mobile unit receiver

OmniTRACS and Skybridge (cont.)

- However, Skybridge has multiple satellites viewable by the OmniTRACS mobile antenna
  - And there are now multiple systems being proposed for use in this band

- OmniTRACS and its users should not have to bear a heavy economic or performance cost to make room for these new entrants

The Work of JTG 4-9-11

- This committee seems to have agreed on several rules that update and improve upon the provisional rules drafted at WARC'97 (and mentioned in the FCC's NPRM)

- Most important for us is that there seems to be agreement that there will be epfd limitations on the aggregate interference produced by all satellites of all systems sharing the band

- There also appears to be agreement on three different restrictions that the entire fleet of NGSO satellites must meet

Three Restrictions

- Long Term Interference
  - The epfd must be such that 90% of the time or more, the entire NGSO fleet will increase the total noise at GSO receivers by 6% or less
- Short Term Interference
  - The epfd must be such that the NGSO fleet produces system unavailability less than 10% of the time compared to what unavailability would be without the NGSO interference
  - Unavailability without NGSO interference is due to rain
- Synchronization
  - The epfd must be sufficiently low that the victim system never (or almost never) loses synchronization

Epfd and OmniTRACS

- We are in agreement with these principles. What we want is for these principles and that protection level to apply to OmniTRACS receivers

- The results of our calculation based on these restrictions produce epfd restrictions that look very high compared to those for other (larger) antennas
  - So high that it may appear that by providing protection for the other antennas that protection is automatically being provided for OmniTRACS

But that is not the case...

EPFD Definition

- **The epfd limits are specific to the antenna it is calculated for. Because of the definition of epfd it's hard to infer protection levels of one antenna from protection level of another**

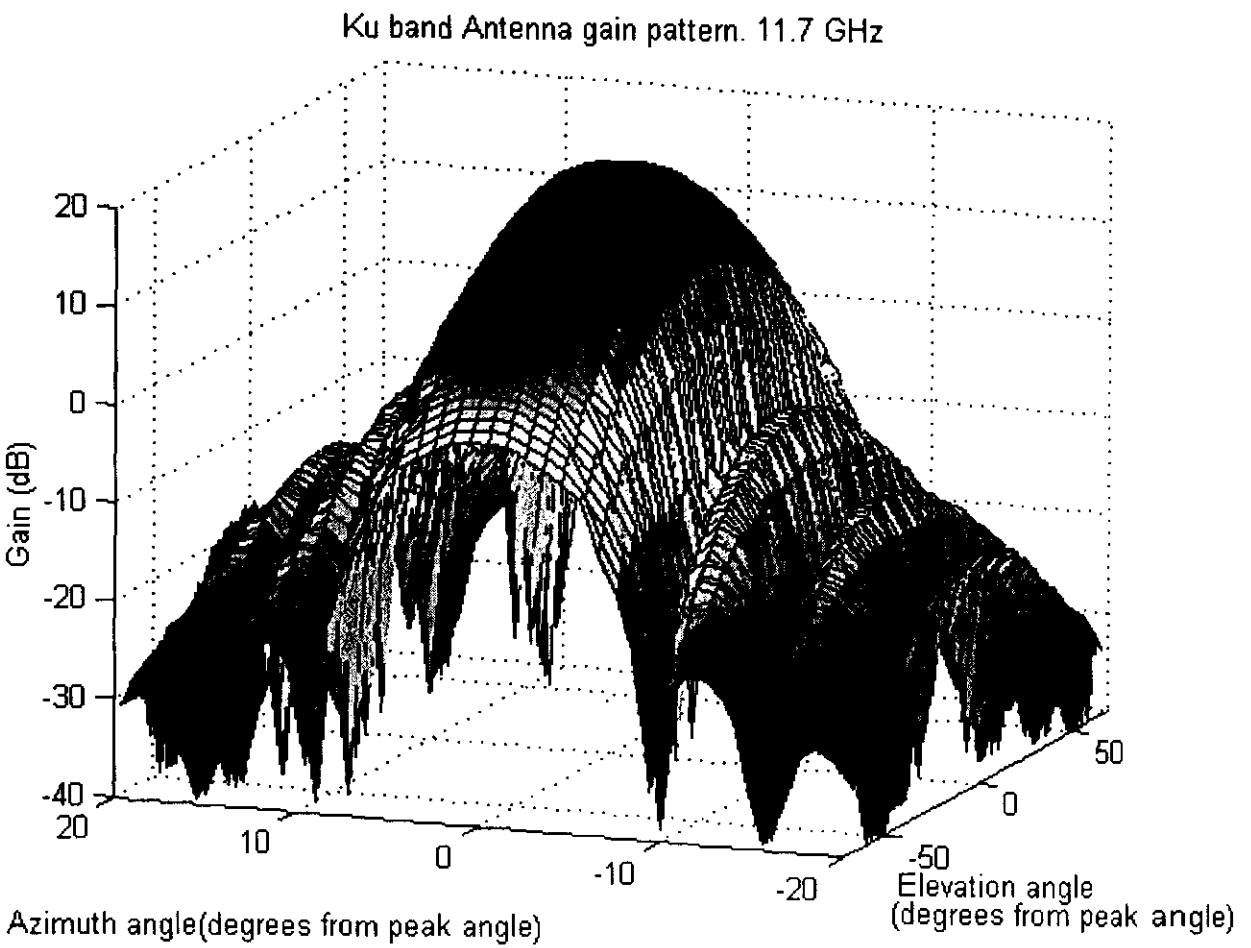
$$epfd = 10\log\sum_{i}^{N} 10^{pfd(i)/10} x \frac{G_r(\theta_i)}{G_{\max}}$$

- **In particular the beam pattern of the OmniTRACS antenna is unique**

$$\frac{G_r(\theta_i)}{G_{\max}} \cong 1 \quad \textit{for many angles } \theta_i$$

$$epfd \cong actual\ \ pfd$$

Omni Mobile Antenna Pattern



Epfd and Conventional Services

- **Conventional services are not spread and can tolerate only very low <u>actual</u> pfd at boresight**
  - **And because of the way epfd is calculated, the tolerable epfd is the same low value**
  - **But because the antenna gain falls off rapidly off axis, the <u>actual</u> pfd values off axis can be quite large and relatively easy to meet**

$$\frac{G_r(\theta_i)}{G_{\max}} << 1 \quad \textit{for many angles } \theta_i$$

$$epfd << actual\ pfd$$

Epfd and OmniTRACS

- OmniTRACS mobile units can tolerate much larger <u>actual</u> pfd <u>on axis</u>
- But <u>off axis</u> the Omni mobile antenna gain does not fall off rapidly and the <u>actual</u> pfd values that are tolerable off axis don't get that much larger
- The point is that the mobile OmniTRACS service is quite different from conventional fixed services
  - You can't infer performance in one system from another

Calculation Methodology

- **Long term interference**
  - For long term interference we simply calculate the level of total noise supplied by thermal noise and adjacent satellite interference in clear air at antenna boresight
  - We then calculate an interference (NGSO) level that would increase the total by 6%

- **Estimated long term interference effect on OmniTRACS mobile units is approximately 0.25 dB**
  - We will accept this

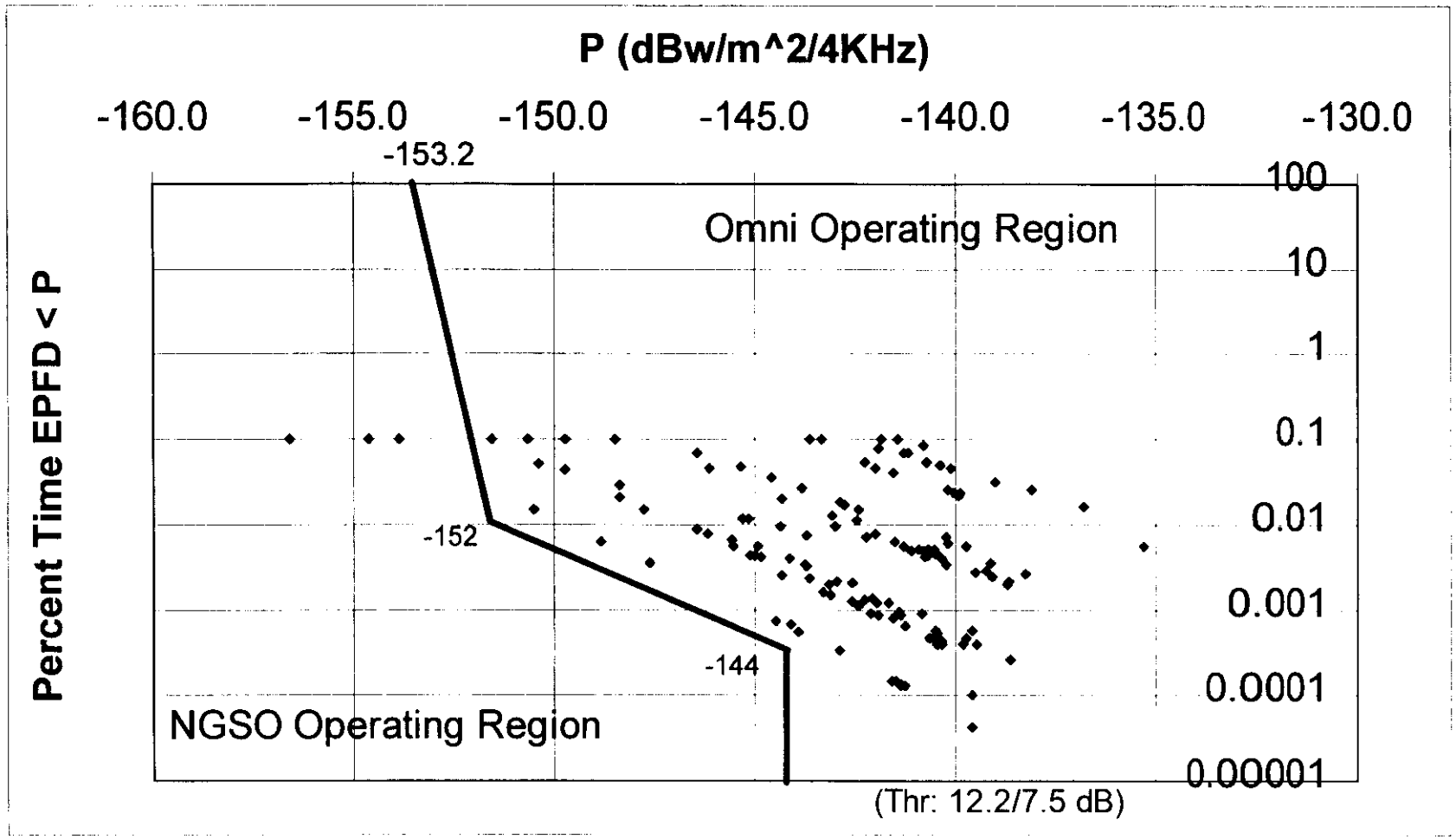
Calculation Methodology (cont.)

- **Short Term Interference**
  - We calculate the amount of rain sufficient to degrade a link (at a given point in CONUS) to an "unacceptable level" and note what percent of the time that rain level occurs at that location
    - An "unacceptable level" is that level where high rate traffic is no longer possible (where it was prior to the degradation) OR where no traffic is possible at all (where only low rate traffic was possible before)
      - Less high rate traffic reduces system capacity
  - We then calculate a level of interference (epfd) that will produce the same effect and associate it with a time percentage that is 1/10th the above percentage

Calculation Methodology (cont.)

- **Synchronization**
  - We note that at an E_b/N_o of 7dB our receivers lose sync
  - We calculate the level of interference (epfd) needed to produce that 7 dB anywhere within the OmniTRACS coverage area (CONUS)

Results


P (dBw/m^2/4KHz)
-160.0
-155.0
-150.0
-145.0
-140.0
-135.0
-130.0
-153.2
-152
-144
Omni Operating Region
NGSO Operating Region
Percent Time EPFD < P
100
10
1
0.1
0.01
0.001
0.0001
0.00001
(Thr: 12.2/7.5 dB)

Final Technical Point

- The NPRM talked exclusively about interference from NGSO Satellites on earth stations and NGSO earth stations on GSO satellites

- But if NGSO systems become Co-Primary with GSO systems, we - and perhaps other users of GSO systems - have to also be concerned about our interference into NGSO systems

- This could be an issue in the OmniTRACS case, since our antennas have been deliberately designed to be narrow in the direction of the orbital arc (azimuth) and wide perpendicular to the arc (elevation)

Conclusion

- We are seeking input and support on how best to protect our service when co-existing with NGSO Systems:
  - In the US
  - In the rest of the world in terms of the ITU-R WARC process
    - We currently have Ku-band systems in
      - Canada
      - Mexico
      - Europe
      - China
      - Korea
    - and strong prospects in South America and India

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Counsel

Breck Blalock, Nixon Peabody LLP