OPENING REMARKS
Recent Accomplishments and Future Plans

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The NASA Propagation Experimenters (NAPEX) meeting is a forum for NASA investigators and other researchers to discuss topics in earth/space propagation. Research conducted during the last year and plans for the coming year will be reported here. We have also invited presentations by international speakers and members of the satellite communications industry.

The objective of the NASA Propagation Program is to enable the development of new Earth/space applications. This program supports studies and experiments that will assist industry to utilize space for telecommunication services. In fact, our plans are developed with input from industry.

I will now review the achievements of our program during the last year and report the plans for the coming year. Your feedback is sought to direct our efforts to best meet industry needs.

An important milestone was achieved last year. The Olympus propagation experimenters completed their work. Olympus with its three-frequency beacon package was used in a propagation campaign in the early 90s for Ku- and Ka-band measurements. The Olympus Propagation Experimenters (OPEX) completed their work last November by publishing the OPEX reports. Virginia Tech, supported by the NASA Propagation Program, was the U.S. participant in this experiment. Copies of the OPEX reports were provided to us courtesy of ESA and were distributed among NASA experimenters in January 1995.

The Advanced Communications Technology Satellite (ACTS) K_a-band campaign is currently a major element of our program. A two-day workshop is dedicated to this effort following today's meeting. During the last year, data were collected from several sites in North America. We also experienced a few growing pains. Hardware problems were corrected. A new preprocessing software was written, and later had to be revised. But we managed to collect data without interruption, and experimenters are now processing and analyzing the collected data. A new site also began operation at Georgia Tech to collect wideband data using ACTS.

The ACTS mobile propagation experiments concluded last year and the data have been analyzed. Measurements resulting from these experiments constitute the largest body of K_a-band propagation data to date. Later today we will hear the results of the ACTS mobile experiments from our investigator at the Applied Physics Laboratory.

Power control is an attractive means of propagation loss mitigation for K_a-band applications. To enhance our knowledge of this technique, an uplink power control experiment was successfully concluded by COMSAT Labs in Clarksburg, MD. We will hear a presentation on this topic by Dr. Dissanayake later today.

Another important element of the NASA Propagation Program is personal/mobile satellite communications. During the last year, our experimenters conducted a number of studies, and we have stayed abreast of industry advances in this area. As you may recall, last year the University of Texas introduced a concept known as "photogrammetric mobile satellite service prediction." This is a simple low-cost approach to characterizing user environment in a mobile/personal link. Images are taken through a fish-eye lens with 180° field of view. Recent efforts have been directed toward analyzing fisheye video sequences for predicting fading. A presentation on this topic is scheduled for this afternoon.

The University of Texas began a series of measurements using a six-channel GPS receiver for personal satellite communication applications. This effort provides an inexpensive approach for making shadowing, blockage, and multipath fading measurements. The effect of satellite path on signal availability can also be observed. A talk on this topic will be given this afternoon.

As is evident from the above two efforts, we are seeking inexpensive means to determine service availability and characterize the user environment for mobile/personal satellite communication applications. These efforts are in response to an industry need to assess quality of service over vast coverage areas.

During the last year, a series of in-building L- and S-band measurements were completed. During this experiment, several buildings were used for taking measurements. The results of this effort will be reported today. Similar measurements were also made using Tracking and Data Relay Satellite (TDRS) signals, the results of which will also be reported today. These efforts are in support of mobile satellite and direct broadcast satellite applications.

In collaboration with INTELSAT, the NASA Propagation Program is supporting an 11-GHz experiment at the University of Texas to collect long-duration statistics on low-elevation angle paths. This experiment is planned for eight years, and it will complete in June 1996. Results of this campaign have been previously published and the final report will be available in late 1996.

Most of you are familiar with the *Database for Propagation Models* for PC and Macintosh machines. An update to the software will be distributed in this meeting. This update includes new propagation models and contains an

enhanced user interface. This may be the last EXCEL release of the software. We are thinking of changing the software development platform from EXCEL to C++ for future releases.

Our work with the International Telecommunication Union (ITU) continued during the past year. I participated in Task Group 3/1 in September. The purpose of this task group was to address urgent issues on mobile/personal satellite propagation effects. It was recognized in this task group that there is an urgent need for data on non-geo satellite systems and links with hand-held receivers. Improvements to ITU-R Recommendation 681 were suggested. I provided the task group with an input document to clarify certain parts of the recommendation. I feel our program has obtained enough data in the last two years to make important contributions to Rec. 681. The NASA Propagation Program will provide the ITU with a document to improve this recommendation in the next year. Figure 1 shows the models included in Rec. 681, and Figure 2 shows the organizational chart of the ITU.

Figure 1. Recommendation 681

- Empirical roadside shadowing model
  - Valid for a frequency of 1.5 GHz; $\theta \geq 20°$; $1\% \leq P \leq 20\%$
- Attenuation frequency scaling model
  - Valid for a frequency range of 0.8–3.0 GHz; $30° \leq \theta \leq 60°$; $1\% \leq P \leq 30\%$
- Fade duration distribution statistics
  - Valid for a 5-dB fade threshold, and a frequency of 1.5 GHz
- Non-fade duration distribution statistics
  - Valid for a 5-dB fade threshold, and a frequency of 1.5 GHz
- Fading due to multipath model(fade depth)
  - Two models for mountainous and road-side tree environments, UHF and L-band
    - $1\% \leq P \leq 10\%$ for mountain, $1\% \leq P \leq 50\%$ for roadside tree
- Special consideration of hand held terminals (user blockage)

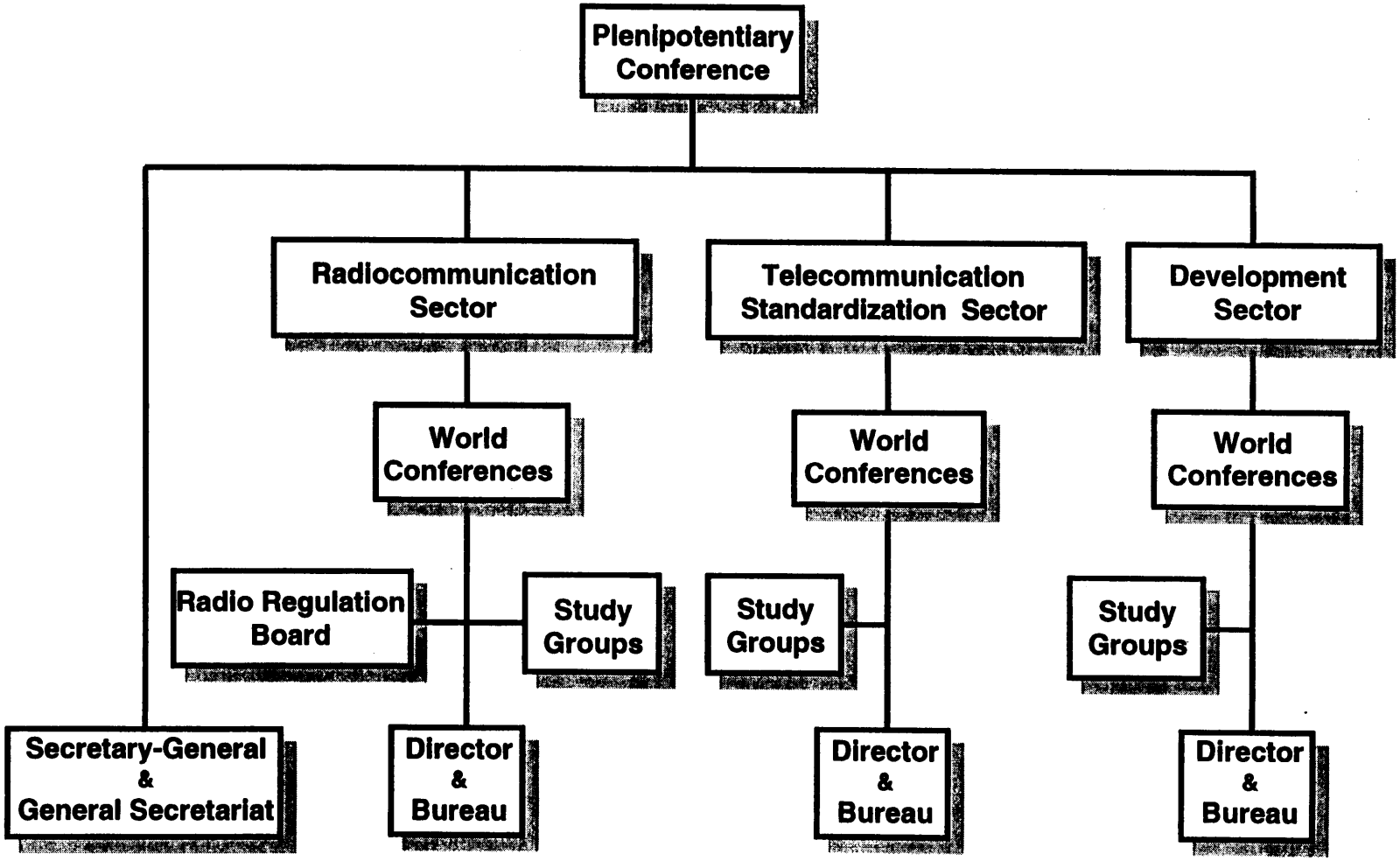

Figure 2. The Organizational Structure of the International Telecommunications Union