COMPANY CONFIDENTIAL

March 11, 1960

FILE MEMORANDUM: FBW-20.4

Outline of Proposed Book on

"Data Transmission"

The attached outline is an estimate of what type of a data transmission book could be started in about April, 1961, as a cooperative effort. The outline is prepared on the basis of a group of co-authors from the ASDD Data Transmission Project in San Jose, together with some of the IBM-World Trade Corporation engineers working on data transmission.

No committment has been made for writing such a book. The philosophy of this proposal is that in the course of the next year we will be working on the important technical problems that must be solved to insure satisfactory data communication. The successful solution of the problems would fill in the gaps in the technical knowledge needed to write a book on data transmission.

The estimated professional time to write the book after the technical problems are all solved is:

Preparation of Revised Outline, Sample Chapter, and Bibliography
2 man months
Writing of First Draft of Text - 9 man months
Writing of Second Draft - 4 man months
Final Revising of Manuscript - 2 man months.

The tentative list of joint authors is:

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(To be determined.)

It is recommended that no commitment to write such a book be made now. The status of the technical problems should be reviewed a year from now to determine whether conditions are ripe for proceeding with the book project at that time.

F. B. Wood

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Outline of Proposed Book on Data Transmission

I. Introduction and History of Digital Transmission Techniques

- A. Telegraph
- B. Teletype and Paper Tape Devices
- C. Card-to-Card Transceiver
- D. SAGE Data Links over Telephone Lines

II. Requirements for Digital Data Transmission to Computers

- A. Types of Computer-Data Communication Systems
- B. Accuracy and Speed Requirements
- C. Clocking Requirements
- D. Need for Special Modulation-Demodulation Equipment

III. Data-Transmission Methods Now Available (January, 1961)

- A. Theoretical Comparison of Methods
  1. Theoretical Analysis of Signal/Noise Ratio and Its Influence on Error Rates
  2. Theoretical Limits of Different Modulation Systems
- B. Practical Systems
  1. Two-Phase, Single Channel
  2. Four Phase
  3. Amplitude Modulation
  4. Frequency Modulation
  5. Multi-Frequency System

(Mention particular manufacturers in appropriate places, i.e., A.T. and T. Co., Rixon, Stromberg Carlson, Kineplex, IBM, etc.)

IV. Computer Input-Output Devices for Data Links

- A. Multiplexing Theory
- B. Optimum Block Length Theory
- C. Interpretation of theoretical analysis of effect of buffer size as it effects efficiency through optimum block length.
- D. Types of Buffers and Input-Output Channels

V. Remote Terminal Devices

- A. Input Devices
  1. Keyboard
  2. Card Readers
  3. Tapes
  4. Voice Input
  5. Composing Typewriter

B. Output Devices
   1. Display devices including oscilloscope
   2. Printer, mechanical
   3. Card Punch
   4. Electric Typewriter
   5. Printers, electrostatic
   6. Voice Output

VI. High Speed Transmission Over Cables

   A. Channel Capacity of Cables
   B. Pulse Code Modulation for Voice and Digital Data

VII. Wireless Data Transmission

   A. High Frequency Radio Links
   B. Microwave Links
   C. Infra-Red Links

VIII. Error-Detecting and Error-Correcting Codes

   A. Simple Parity Codes
   B. Hamming-Type Codes
   C. Burst-Error-Correcting Codes
   D. Combinations of Vertical and Horizontal Parity Checking and Interlacing of Messages and Sub-Groups of Messages.
   E. Analysis of Impulse Noise
   F. Theoretical Probability of Undetected Errors and Different Conditions.

IX. Standardization in Data Transmission

   A. Areas to be standardized
      1. Bit Rates
      2. Codes
      3. Common Interface, Voltage Levels, Characteristic 7.
      4. Modulation-Demodulation Systems
   B. U. S. Standards by E.I.A., F.C.C., etc.
   C. International Standards b C.C.I.T.T.

F. B. Wood
3/8/60

List of Relevant IBM Reports and
File Memoranda

I-II Introduction and Requirements

Special Report, "IBM and Electrical Communication," Vol. 2, Appendix D, Feb. 17, 1959. (F. B. Wood)

III. Data Transmission Methods

RJ-DR-523.019, "High Speed Voice Frequency Data Transmission System for Telephone Network Applications," E. Hopner and H. G. Markey, Jan. 24, 1958.

RJ-MR-13, "Inter-Pulse Interference and Noise in a Synchronous Pulse Detection System." N. M. Abramson, April, 1958.

Proc. Eastern Joint Computer Conference, Dec., 1958, "An Experimental Modulation Scheme for High Speed Data Transmission." E. Hopner, Also in IBM Journal, Jan., 1959.

M-159, "A Transistorized Data Set for Operation Over Telephone Lines," C. M. Melas, May 20, 1959.

IV. Computer Input-Output Devices

RJ-137, "Analysis of a Multiplexing Problem in Data Transmission," N. M. Abramson, August 15, 1958.

AIEE 58-1181, "Optimum Block Length for Data Transmission with Error Checking," Jan., 1959. F. B. Wood. Also in Communications and Electronics, Jan., 1959, pp. 855-861.

RJ-168, "Supplementary Notes on Optimum Block Length for Data Transmission," May 27, 1959.

V. Remote Terminal Devices

203.112.106, "Comparison of Methods of Magnetic Recording," F. B. Wood, March 20, 1956.

203.113.108, "A High Resulution Perpendicular Magnetic Recording Head," J. J. Hagopian and F. B. Wood, Nov. 1, 1956.

SJA-35, "A Proposal for a Computer Output Display Device," F. B. Wood, Dec. 4, 1956.

RJ-DR-523-024, "High Density Recording and Information Recovery," E. Hopner, Aug. 13, 1958.

RJ-169, "Integrated RAMAC Processor Drum," C. E. Schlaepfer, Jan. 1959.

VI. High Speed Transmission Over Cables

RJ-DR-523-020, "Cable Installation Costs," April 9, 1958. F. B. Wood

RJ-134, "Survey of Formulas for Primary Cable Constants," Oct. 21, 1958. F. B. Wood.

RJ-163, "Time Domain Digital Techniques," F. C. Chiang.

File Memorandum: FBW-11.30, "Survey of Cable Characteristics for Data Transmission," F. B. Wood, Dec. 11, 1959.

AIEE CP 60-482, "Survey of Cable Characteristics for Data Communications," F. B. Wood, Feb. 5, 1960.

VII. Wireless Data Transmission

VIII. Error-Detection and Error-Correcting Codes

SJA-16, "Theoretical Error Frequency in Different Data Transmission Codes," F. B. Wood, July 5, 1956.

File Memos: FBW-10.1/10.11, "Probability of Undetected Errors in Various Data Transmission Systems," F. B. Wood, Oct. 15, 1957.

File Memos: FBW-10.12/10.13, "Comparison of 7-Bit and 4-out-of-8 Code," F. B. Wood, Nov. 27, 1957.

RJ-MR-8, "Seminar on Decision Theory and Its Application to Communication," N. M. Abramson, Jan., 1958.

Stanford Electronics Laboratory, Tech. Rep. 51, "A Class of Codes for Non-Independent Error," N. M. Abramson, Dec. 30, 1958.

RJD-1002, "Noise Sources of Significance in Data Transmission," Mar. 6, 1959. F. B. Wood

RJD-1005, "Some Examples of Single and Double Adjacent Error Correction," F. B. Wood and W. J. Johnson, Jr., April 14, 1959.

RJ-170, "Bibliography on Error-Detecting and Error-Correcting Codes," F. B. Wood, June 11, 1959.

RJ-174, "A New Group of Codes for Correction of Dependent Errors in Data Transmission," C. M. Melas, June, 1959. Also in IBM Journal, Jan., 1960.

IX. Standardization