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INWG 1 INTERNATIONAL PACKET NETWORK WORKING GROUP
REPORT OF SUBGROUP 1

ARPA NETWORK INFORMATION CENTER
STANFORD RESEARCH INSTITUTE
MENLO PARK, CALIFORNIA 94025

INWG 1
24 OCTOBER 1972

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INTERNATIONAL PACKET NETWORK WORKING GROUP:
REPORT OF SUBGROUP 1 ON COMMUNICATION SYSTEM REQUIREMENTS
TUESDAY, 24 OCTOBER 1972, 9:30 A.M.

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INTRODUCTION

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THE WORKING GROUP CONSISTING OF D. DAVIES (NPL, BRITAIN), P. SHANKS (UKPO), F. HEART (BBN), B. BARKER (BBN), R. DESPRES (FRENCH PTT), V. DETWILER (UNIVERSITY OF BRITISH COLUMBIA, CANADA), AND O. RIML (BELL-NORTHERN RESEARCH, CANADA) AGREED ON THE FOLLOWING TERMS OF REFERENCE AS ITS OBJECTIVE FOR FURTHER WORK:

4

(1) TO CONSIDER WHAT REQUIREMENTS MUST BE MET BY THE PACKET SWITCHING NETWORKS TO ALLOW CONVENIENT COMMUNICATIONS BETWEEN COMPUTERS AND TERMINALS WHEN THAT COMMUNICATION TAKES PLACE THROUGH MORE THAN ONE NETWORK.

4A

IT WAS AGREED THAT INTERWORKING BETWEEN PACKET-SWITCHING NETWORKS SHOULD NOT ADD COMPLICATIONS TO THE HOSTS, CONSIDERING THAT NETWORKS WILL PROBABLY BE DIFFERENT AND THUS GATEWAYS BETWEEN NETWORKS WILL BE REQUIRED. THESE GATEWAYS SHOULD BE AS UNCOMPLICATED AS POSSIBLE, WHILST ALLOWING AS MUCH FREEDOM AS POSSIBLE FOR THE DESIGN OF INDIVIDUAL NETWORKS. PART OF THE FUTURE WORK MUST BE TO DETERMINE THE EXTENT OF THIS FREEDOM.

4B

(2) TO CONSIDER WHAT RECOMMENDATIONS TO MAKE ON PACKET-SWITCHING NETWORKS, AND HOW TO PROVIE FOR ACCEPTANCE OF THESE RECOMMENDATIOS THROUGHT CCITT AND OTHER INTERNATIONAL ORGANIZATIONS SUCH AS IATA.

4C

PACKET SWITCHING NETWORKS AS EXEMPLIFIED BY THE ARPANET AND SITA NETWORK, MAY BE EITHER PRIVATE NETWORKS OR PUBLIC NETWORKS. SOME PRIVATE NETWORKS WILL NOT FACE THE INTERWORKING PROBLEM, THEREFORE OUR PRINCIPAL CONCERN SHOULD BE WITH PUBLIC NETWORKS, OR MULTI-PURPOSE PRIVATE NETWORKS.

4D

SPECIFIC TECHNICAL FACTORS

5

IN THE TIME AVAILABLE, THE SUBGROUP COULD DO NO MORE THAN LIST SOME OF THE PRINCIPAL TECHNICAL FACTORS AFFECTING INTERWORKING BETWEEN PACKET-SWITCHING NETWORKS AS FOLLOWS:

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FUNCTION OF THE NETWORK 6A

THE NETWORK COULD PROVIDE ONLY A PACKET TRANSPORT SERVICE, OR IT COULD, LIKE THE ARPA NETWORK, ACCEPT MESSAGES WHICH IT DIVIDES INTO PACKETS FOR TRANSPORT AND REASSEMBLES WITHIN THE NETWORK. THE DECISION HAS A BIG INFLUENCE ON INTERWORKING. IT IS CLOSELY RELATED TO THE WORK OF SUBGROUP 2. 6A1

THE NETWORK'S USER-INTERFACES 6B

TWO KINDS OF INTERFACE SHOULD BE DEFINED: 6B1

(A) AN INTERFACE WHICH EXCHANGES PACKETS OR MESSAGES WITH A PROCESSOR OR INTELLIGENT DEVICE. THERE ARE TWO POSSIBLE ARRANGEMENTS: 6B1A

(1) THE NETWORK AUTHORITY INSTALLS A STORE-AND FORWARD DEVICE (SPUR-IMP) ADJACENT TO THE USER'S EQUIPMENT, (HOST) ALLOWING THE INTERFACE TO BE A LOCAL ONE, POSSIBLY MULTI-WIRE. 6B1A1

(2) A LINK IS MADE, OVER A DISTANCE, BETWEEN THE NEWEST WORKING CENTER (IMP) AND THE USER'S EQUIPMENT (HOST) AND THE INTERFACE IS DEFINED BY A PROCEDURE OVER THIS LINK. 6B1A2

IN EITHER CASE, ERROR CONTROL SHOULD BE PROVIDED ACROSS THE INTERFACE. AS FAR AS POSSIBLE, FEATURES OF THE DRAFT CCITT INTERFACE FOR THE NEW DATA NETWORK SHOULD BE ADOPTED. THIS MAY BE EASIER WITH ARRANGEMENT (2), BUT A GENUINE ATTEMPT SHOULD BE MADE TO ADOPT THE SYNCHRONOUS LINE FACILITIES DEFINED BY CCITT IN BOTH CASES. 6B1B

(B) AN INTERFACE (OR SEVERAL ALTERNATIVE INTERFACES) FOR SIMPLE TERMINALS. THIS (OR THOSE) SHOULD ALSO ADOPT THE DRAFT CCITT INTERFACE AS CLOSELY AS POSSIBLE. PROBLEMS OF EXTENDING ERROR CONTROL AND FLOW CONTROL TO SIMPLE TERMINALS WERE RECOGNIZED, BUT NO CONCLUSIONS REACHED AS TO THE NEED FOR THESE FACILITIES. 6B1C

THE PACKET SIZE MAXIMUM 6C

IN AN IDEAL WORLD, ALL THE INTERCONNECTED NETWORKS WOULD HAVE THE SAME MAXIMUM PACKET SIZE, BUT THIS IS UNLIKELY TO BE THE CASE. 6C1

WITH A SMALL VARIATION OF THIS PARAMETER, AMONG EXISTING NETWORKS, IT WOULD BE FEASIBLE TO ENFORCE AN UPPER PACKET SIZE LIMIT THAT WOULD ANSWER EFFICIENT HANDLING BETWEEN NETWORKS. THIS WOULD THEN BECOME A LOWER LIMIT FOR THE MAXIMUM PACKET SIZE OF FUTURE NETWORKS. 6C2

WITH A LARGE VARIATION, WE COULD CONCEIVE OF CUTTING UP PACKETS AND REASSEMBLING (A KIND OF MESSAGE FUNCTION) BUT THIS MIGHT CREATE VERY COMPLEX PROBLEMS FOR HOST-HOST PROTOCOL, PARTICULARLY FOR HOSTS IN INCOMPATIBLE NETWORKS. CLEARLY, THE UNIFORM STANDARD IS MUCH TO BE PREFERRED. 6C3

OPTIMUM PACKET SIZE IS INFLUENCED BY THESE FACTORS: 6C4

(A) PACKET TRANSIT TIME, SINCE PACKET SIZE AFFECTS THE STORAGE DELAY IN NODES. 6C4A

(B) MAXIMUM DATA RATE, SINCE IT AFFECTS THE SIZE OF BLOCK WHICH IS ACKNOWLEDGED ACROSS THE NETWORK. 6C4B

[CHAIRMAN'S NOTE: HOWEVER, END-TO-END ACKNOWLEDGEMENT OF EACH BLOCK IS NOT A NECESSARY FEATURE OF NETWORKS. IF HOSTS HANDLE MESSAGE REASSEMBLY, THE NETWORK COULD HAVE SEVERAL PACKETS IN FLIGHT AT ONE TIME, PROVIDED THAT A PACKET SEQUENCE METHOD AND THE PRE-RESERVATION OF ASSEMBLY SPACE ARE ENGINEERED.] 6C4C

(C) THE USE OF A METHOD OF SATELLITE RELAY WHICH HAS FIXED LENGTH TIME SLOTS WHICH ARE SHARED BETWEEN A NUMBER OF POINT-TO-POINT LINKS. THERE IS PRESSURE TO REDUCE THE SIZE OF THESE SLOTS. 6C4D

[IF THE LINKS CONCERNED ARE IMP-IMP LINKS, THE "SEGMENTS" CONTAINED IN THESE SLOTS NEED ONLY AN IMP ADDRESS, THUS SAVING ON ADDRESS OVERHEAD. THE PACKET CAN BE MADE UP FROM A NUMBER OF SUCH "SEGMENTS", AND IT WILL HAVE A NORMAL PACKET FORMAT INCLUDING A HEADING WITH THE FULL DESTINATION ADDRESS. IN THIS WAY PACKET SIZE AND SATELLITE REQUIREMENTS CAN BE DECOUPLED.] 6C4E

FLOW CONTROL 6D

THIS CAN HAVE TWO RELATED FUNCTIONS TO PREVENT GENERAL CONGESTION OF THE NETWORK AND TO GIVE END-TO-END CONTROL SO THAT A DATA SOURCE IS CONTROLLED BY THE DESTINATION'S CAPACITY TO ABSORB DATA. A NETWORK MUST BE ABLE TO PROTECT ITSELF AGAINST CONGESTION WITHOUT DEPENDING COMPLETELY ON

THE CORRECT OPERATION OF OTHER NETWORKS WITH WHICH IT IS INTERCONNECTED. THE END-TO-END FLOW CONTROL IS RELATED TO HOST-HOST PROTOCOL. THEREFORE SOME ASPECTS OF FLOW CONTROL EXTEND ACROSS INTER-NETWORK BOUNDARIES AND SOME MAY NOT. 6D1

OTHER TECHNICAL FACTORS MENTIONED BY THE GROUP 6E

THE NETWORK HEIERARCHY 6E1

THE NUMBERING PLEX AND INTERNATIONAL ROUTING. 6E2

HOW SHOULD THE QUALITY OF SERVICE BE SPECIFIED IN PACKET-SWITCHING SWITCHING SYSTEMS? 6E3

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