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January 21, 1986

MEMORANDUM TO Messrs. I Collisson
J.P. Field
C. Denenberg
M. Dealtry

FROM C.F. Smith

SUBJECT Tolerant Evaluation

On January 16, Mr. Weadock conducted an Operations Review at Christian Rovsing. One of the topics covered was the Tolerant Evaluation.

Mr. Borup stated the following :

1. The Tolerant system could not do the job of the FEP.

2. The only value of Tolerant to the CR90 is the Unix software, which is also available from other sources.

A copy of Mr. Borup's presentation to Mr. Weadock is attached.

C.F. Smith

cc: Messrs. R.W. Pryor
K. Jakobsen
J.J. Chluski

Attachment

R.C.B. 301.090
T.V.A. 400.504.488

M

TOLERANT OPPORTUNITY EVALUATION

4

CONTENTS

TOLERANT SYSTEMS INC.

US Company, San Jose

83 Employees now, in 1984 they were 150.

FUNDING

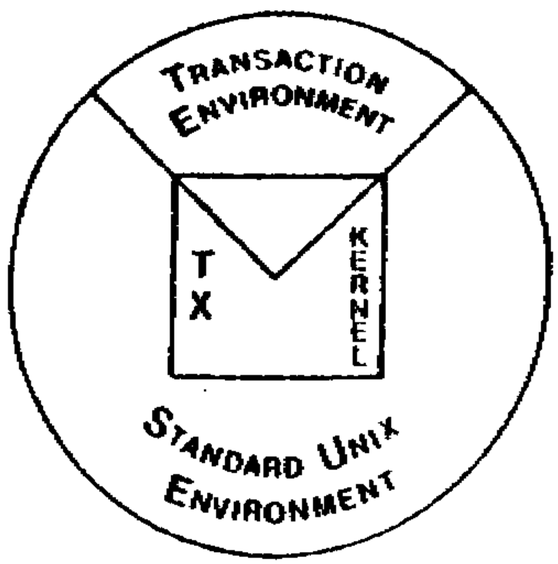
1981 $ 2M from	Adler & Company
1083 $ 9M from	Adler & Company, Accel Capital, Banc Boston Ventures, Collier Enterprises, General Instrument Corporation, Geo. Capital, Helis Investments.
1985 $3.5 M	Bull Transac., Digital Computer Ltd. (DCL).

INSTALLATIONS

Bull Transac.
DCL
Grumman Data System
General Instrument Corporation
Comsat General Corporation
Case Communications Ltd.
Hospital in Oklohama City.

Tolerant
systems

THE TX OPERATING SYSTEM



TRANSACTION EXECUTIVE

UNIX BASE

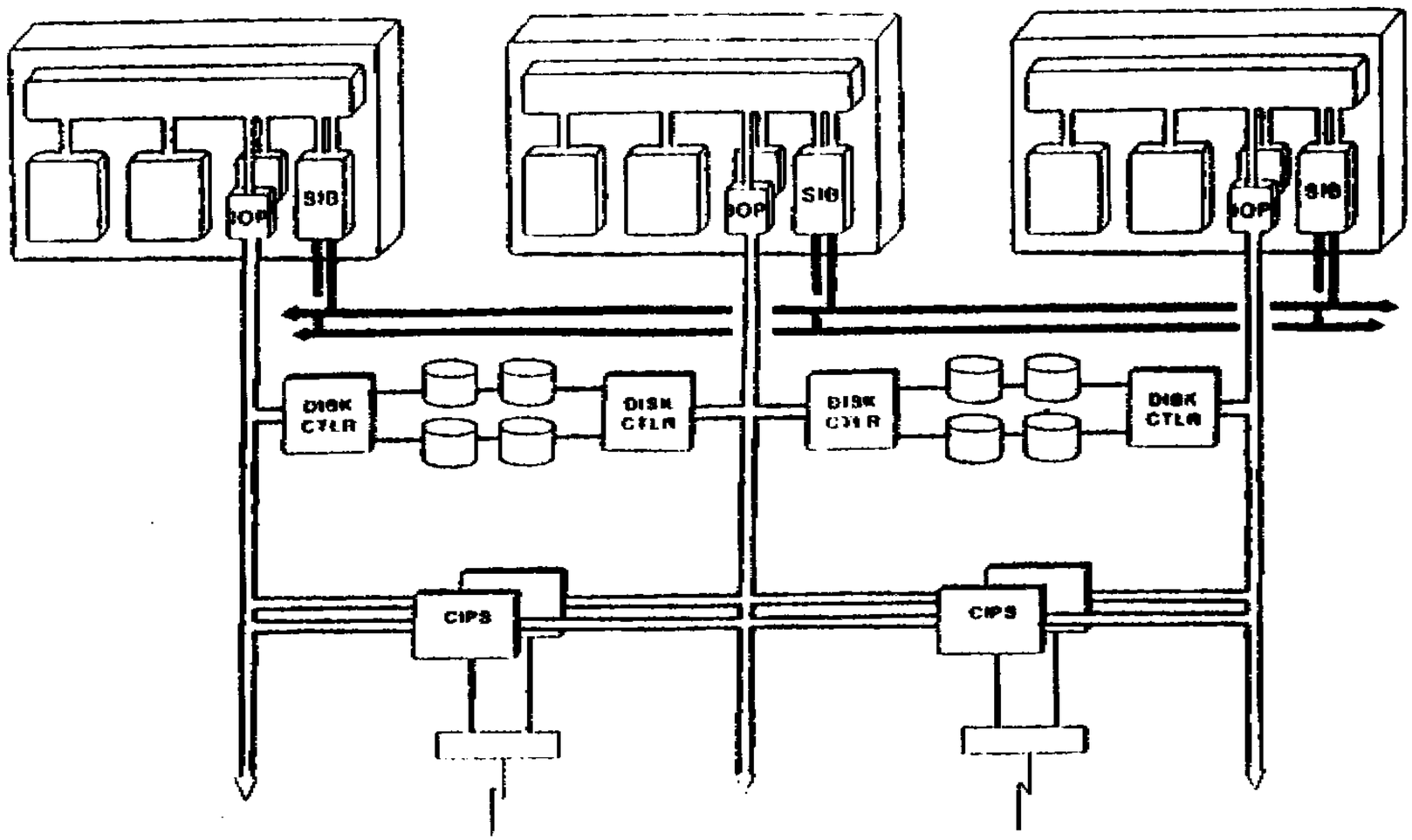
ADDITIONAL FEATURES OF TX

TRANSACTION MANAGEMENT

DATA INTEGRITY

Tolerant systems

DISTRIBUTED CONFIGURATION



LOOSELY COUPLED DISTRIBUTED SYSTEM

- Expansion Without Replacement
- Architectural Foundation for Fault Tolerance

KEY ISSUES

- TECHNICAL EVALUATION OF TOLERANT: STATUS OF ETERNITY SOFTWARE R 5.0?
- DEVELOPMENT COOPERATION BETWEEN CR AND RC: COMMON HARDWARE ARCHITECTURE?
- SYSTEM COST : IS A COMMON ARCHITECTURE COST EFFICIENT?
- DEVELOPMENT SCHEDULE: WILL A COMMON ARCHITECTURE INCREASE THE RELEASE OF RC9000, CR90 UNACCEPTABLE?
- MARKET EVALUATION: MARKET SIZE FOR RC OR FOR CR + RC?

BASIC REQUIREMENTS COMPARISON

	BASIC REQUIREMENT	CR90	RC9000	ETERNITY SPEC.
1	CR80 MX ARCHITECTURE (DATA COMMUNICATION NETWORK COMPUTER)	REQ	NO REQ	- (NO COMMUNICATION SYSTEM)
2	HIGH PERFORMANCE 32 BIT ARCHITECTURE	REQ	REQ	- (NOT HIGH PERFORMANCE)
3	GENERAL PURPOSE MINICOMPUTER	NO REQ	REQ	+
4	UNIX SOFTWARE DEVELOPMENT ENVIRONMENT	REQ	REQ	+ (UNIX AT+T V 5.2, BSD V 4.2 COMPATIBLE)
5	FAULT TOLERANT ON TRANSACTION LEVEL	REQ (NOT SUFFICIENT FOR CR APPLICATIONS)	REQ	+ (DESIGNED FOR THAT MARKET)
6	INCREASED BANDWIDTH ON INTERCONNECTION BUSES	REQ	REQ	- (NO SPARE BANDWIDTH AVAILABLE)
7	SUPPORT FOR EXISTING RC PRODUCTS	NO REQ	REQ	-

CR-RC DEVELOPMENT COOPERATION

KEY QUESTIONS:

- CAN A COMMON SYSTEM/PRODUCT ARCHITECTURE WHICH SUPPORT RC AS WELL AS CR REQUIREMENTS BE DEFINED?

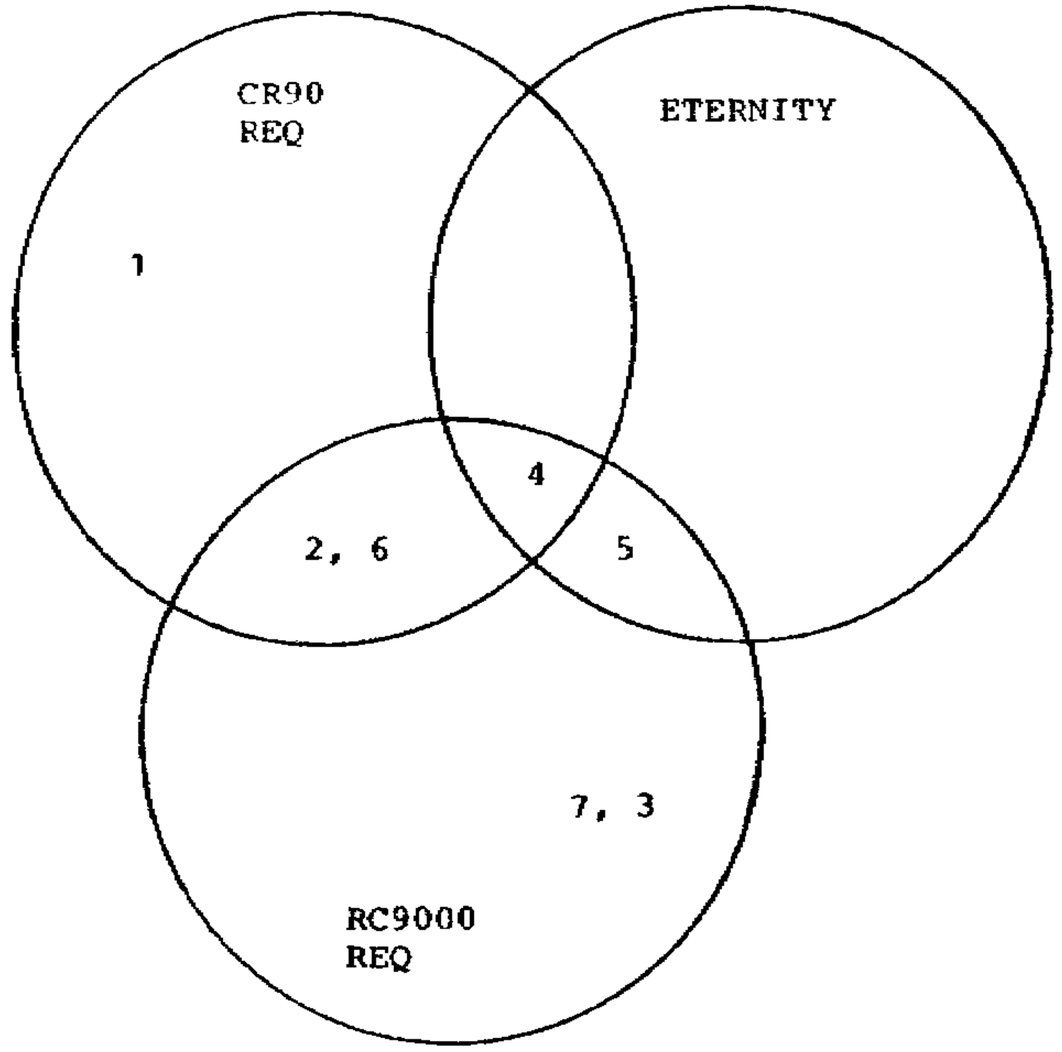
- CAN A COMMON UNIX DEVELOPMENT ENVIRONMENT BE DEFINED?

- CAN THE COOPERATION BE SUPPORTED BY THE ORGANIZATION?

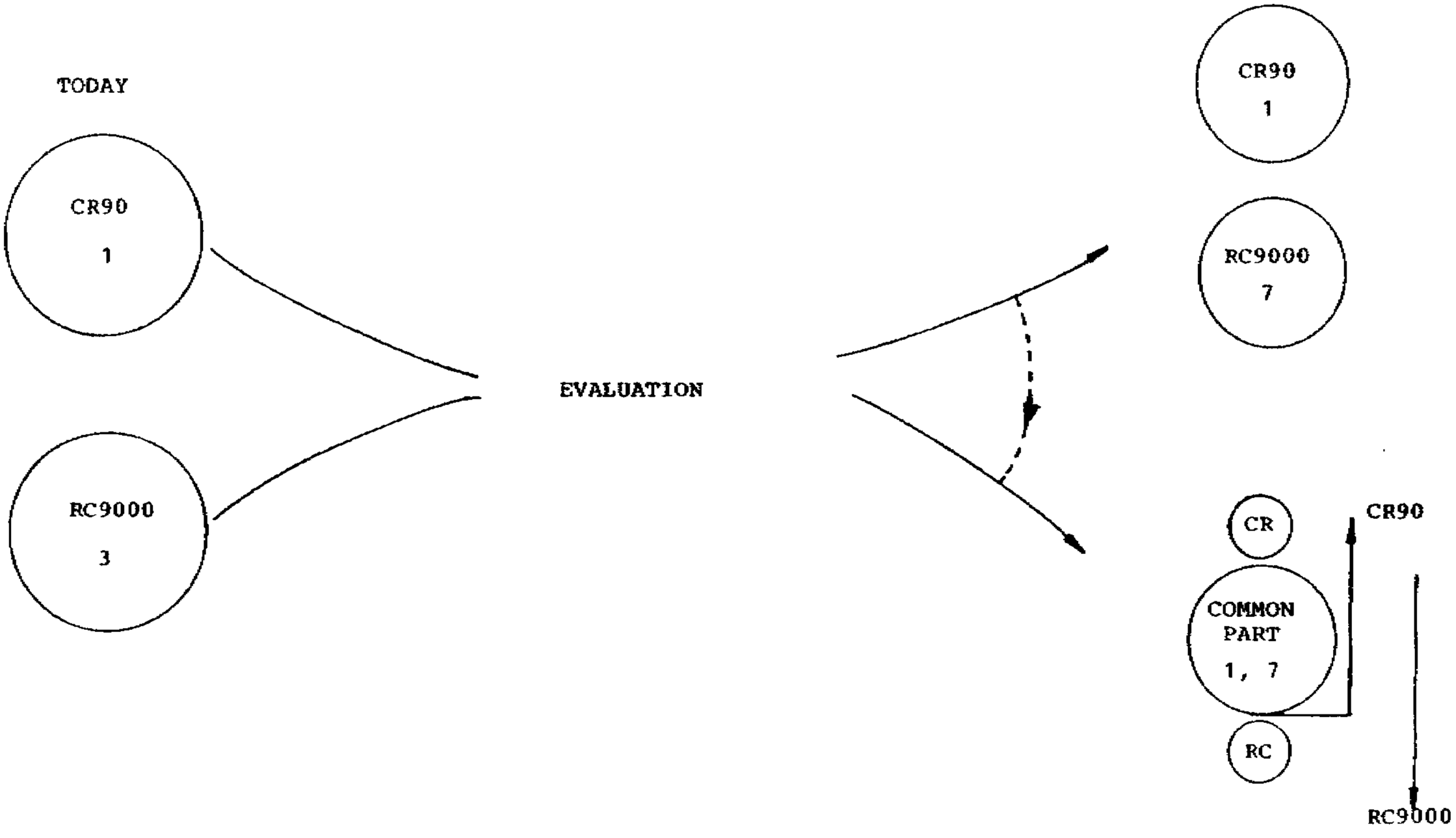
W H Y

- IMPROVED DEVELOPMENT FACILITIES
- REDUCED DEVELOPMENT COST
- REDUCED TRAINING OF NEW MEMBERS OF THE STAFF
- REDUCED MANNING UP PROBLEMS.

REQUIREMENTS OVERLAP



SYSTEM HARDWARE ARCHITECTURE OVERLAP



February 5, 1986

TO: Mr. J.P. Field

FROM: Daniel P.Weadock

SUBJECT: Technical Evaluation of the Tolerant Opportunity

You have already received a copy of the assessment of the Tolerant opportunity prepared by K.Gent/J. Starks of ATC.

Please prepare a consolidated ITTE Technical recommendation using as inputs the technical assessments prepared by :

A. ATC/Test

B. Regnecentralen

C. Christian Rovsing

D. ITT Austria

By copy of this memo I am requesting that the other units forward to you, at the earliest possible date, copies of their technical assessments.

Best regards.

Dan Weadock

cc: Messes. K.Jakobsen
C. Denenberg - ATC
C.F.Smith

SYSTEM CONFIDENTIAL

ITT Corporation

1 Research Drive
Shelton, Connecticut 06484
(203) 929-7341

31 January 1986

To: C. F. Smith

From: E. K. Gent/J. F. Starks

Subject: Assessment of Tolerant Systems, Inc.

As part of its continuing involvement in the evaluation of Tolerant Systems, Inc., TEST visited their San Jose facility on 21 and 22 January.

A copy of the Tolerant presentation is attached.

CONCLUSIONS

* The Tolerant product is not an appropriate engine for the Super Front End Processor (FEP).

* The Tolerant product will not provide a suitable architectural basis for the RC9000.

* No aspect of the Tolerant operation justifies an investment of $5M.

SUMMARY

* The Tolerant product is of reasonable design for its stated purpose -- on-line transaction processing with a limited fault tolerance capability. The Transaction Executive (TX) inter-process communication (IPC) has a bandwidth of 200 KHz which may cause a bottleneck in some applications. No VDE certification is planned.

* Tolerant has a marketing story to tell. However, no coherent user model is present at Tolerant with a resulting lack of product focus. Much of their market projection is based on "unserved available" markets which may not exist.

* The Tolerant product appears to be difficult to manufacture. Both electronic and mechanical assemblies are inordinately complex.

* The service and support aspects of wide distribution are not yet addressed in a market with IBM-like expectations.

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BACKGROUND

Tolerant was founded in 1982 and expanded to 140 staff by early 1985. Product delays, caused by development overruns, culminated in senior management changes during 1985. Tolerant now employs 83 staff.

Tolerant shipped their product for evaluation in 1984, based on TX release level 1 software. They have now built approximately 70 System Building Blocks (SBBs) at various engineering revision levels. Twenty are in the hands of customers (three in Europe) and the rest are used internally. Full product release is targetted for May 1986, with TX release 5 software. Development costs to the end of 1985 totaled $28M.

TECHNICAL

Findings

* The product is based upon loosely-coupled multi-processor units. The primary processor is the NS 32032, although the current model uses the NS 32016.

* The peripheral i/o channel is on a per SBB basis with a bandwidth of 3 MHz. Disk controllers will support up to four drives each; interface is the EMSD standard. Up to 60 gigabytes per SSB is possible.

* The Communications Interface Processor (CIP) supports up to 12 ports (two of which may be synchronous) and one parallel port. This device provides a programmable mini front-end and makes the system particularly adaptable for specialized communications protocols. There is a message level interface between the CIP and SSB.

* The system interconnect bus is a pair of Ethernet-like CSMA/CD bus running at 10 MHz each.

* Fault tolerance is supported in hardware by dual-ported disk drives and CIPs, with a clever communications distribution panel that allows backup switching to several CIP units. It is, however, important to note that the level of fault tolerance is directed at data base integrity, as distinct from "fail-safe" or "non-stop" application requirements. No attempt is made to address these markets.

* Tolerant has developed a modification of UNIX which they call TX. It provides 4.2 BSD and System V compatibility while adding integrated transaction management, high-availability file system, and an improved inter-process communication (IPC) facility.

* In addition to TX, the system utilizes a real-time executive called RTE which is used in the CIP and in the RPU processor of the SBB.

* While the system has many facilities which support recovery, data file n-plexing, and dynamic load balancing, these are not transparent to the programmer. Some tuning of the parameters for these functions is necessary for efficient and successful multi-SBB operation.

* Plans call for the eventual introduction of communications based software, thereby expanding the terminal connection capabilities. All software development is contracted to third party suppliers.

* Tolerant claims that the equipment meets the requirements for FCC A. They further state that the system will not pass FCC B. Testing for VDE certification is not planned. The system will not pass VDE B since it fails to pass FCC B.

* Latest schedules call for full product release in May 1986, preceded by in-house alpha testing in February and external beta testing during March and April.

Issues

* The throughput of IPC facilities is an historic failing of many UNIX-based systems. The 200 KHz throughput rate of the Tolerant IPC may create a bottleneck if application programmers are not aware of the possible problem and program accordingly.

* There is no VDE certification. VDE B may be a requirement in some European countries.

* Power switches are located at the back of the cabinets. In a multiple SBB configuration, this may be unacceptable to product safety agencies.

* While the Tolerant claim for ease of programming may be true when compared to Tandem and Stratus, the tuning of parameters within application code to optimize fault-tolerant features is not a trivial exercise. It is erroneous to assume that software off the shelf becomes fault tolerant when run on the Tolerant system.

* The implications of relying on outside suppliers for all software exposes long-term support requirements.

* Schedules presented for completion of Release 5 of TX and hence full product release are one quarter later than claimed one month ago.

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MARKETING

Findings

* Tolerant describes their market as on-line transaction processing (OLTP). They claim this market is growing at 20-30% cumulative annual growth rate (CAGR) from $22B in 1985 to $40B in 1988. They further claim that the available market for fault-tolerant OLTP was $7B in 1985 with a served market of $1B.

* The distribution strategy is via a variety of OEM and value-added resellers. No direct end-user sales are contemplated. However, no policy or strategy to protect resellers from competition by Tolerant is evident.

* Tolerant had no description of their user profile. However, when the following construct was presented, they agreed that their target user could be described as:

  - Transaction oriented
  - Highly dependent upon computer system for business operation
  - Between 20 and 5000 users
  - 1 to 80 Gbyte data base

* Competitors are listed (in order) as IBM, DEC, Tandem, and Stratus. They have a story to tell about competitive advantage principally based upon price-performance.

* Software is priced at market. The TX license fee is bundled with the SBB price. There are no plans to unbundle. Communications modules, languages, forms management, etc. are priced separately on a per SBB basis.

Issues

* Tolerant does not understand nor is it prepared to address entry barrier issues such as a retaliatory response by a major vendor, lack of reputation, or immaturity of the distribution channel.

* Large dependence upon "unserved available" market. There are many marketing people who question the existence of such a thing.

* System design and functionality are not based upon a coherent user model. Consequently, it is difficult to assess the appropriateness of the product in its market niche.

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MANUFACTURING

Findings

* Tolerant has built 70 SBBs. They primarily integrate and test major subassemblies built by others. Less than 2000 square feet of manufacturing space with about eight people in evidence.

* All boards are six or eight layer and rather densely populated. There are a large number of cuts and straps. Configuration control at this level seems informal.

* There are four different power supply complements. One each for the SBB, CIP and each CIP board, magnetic tape, and disk drive. All types are of different manufacture.

* The cabinetry is complex with many parts. There are many different cooling fans and power terminations.

Issues

* No FCC compliance labels were evident on any systems (despite a requirement that they be there). No such labels were evident in the manufacturing areas.

* The circuit boards and mechanical and power assemblies seem inordinately complex. This level of complexity would make any adaptation or re-design expensive.

* Labor content averages two man-months per SBB. This compares unfavorably with the approximately 35 man-hours labor content in a DEC VAX 11/780.

SERVICE AND SUPPORT

Findings

* Field service is subcontracted to Grumman for North America only.

* System sizing, based on reliability and traffic, takes a day. No predictability model on fault-tolerance has been done.

* Target MTBF per SBB is 5000 hours. No calculated MTBF is available and field data is too sparse for use.

* MTTR target (excluding travel) is 30 minutes. The stated strategy is to have the customer repair it himself with support from a remote diagnosis center. However, not all boards are easily customer serviceable. In particular, the dual port disk boards require skilled service personnel to remove and replace.

* European distributors are expected to provide their own service and support organizations.

* The system has the capability to automatically call and report a failure to the telephone support center.

Issues

* MTTR figures used in reliability calculations are not realistic. Travel time must be included.

* Sparing levels for customer repair will be high. No price for standard spare kit is available.

* The process for system sizing is esoteric and not practical in any large scale marketing effort.

SUITABILITY FOR SUPER FEP

The Tolerant system has no IBM channel interface, nor is one planned. Moreover, Tolerant does not recommend the use of this system for pass-through message switching and related applications.

The Tolerant system is not appropriate as an engine for the Super FEP.

SUITABILITY FOR RC9000

Based upon the Specification of the RC9000 Computer dated 12 December 1985, TEST concludes that the Tolerant architecture is not appropriate for this product:

* The specification calls for the Tolerant UPU/RPU set to be replaced by one or more RC9000 processing units based on a reduced instruction set computer (RISC). This will necessitate a port of the C compiler to this new processor at an estimated cost of $1.5M. Further, this new computer architecture is not supported by Tolerant's TX/RTE software structure.

* The Tolerant software structure precludes the use of multiple independent processors with the same SBB, whereas the specification calls for multiple RC9000 and RC8000 processors.

* The system structure set forth in the specification is substantially different from the Tolerant architecture to the extent that the Tolerant software would be of marginal value.

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SCANDANAVIAN MARKET

Tolerant provided TEST with an estimate of the market size for OLTP in Scandanavia. A copy is attached. Based upon Tolerant's estimate of the served market at 5% of total OLTP and unserved at 28%, the following table can be computed:

	1985	1986	1987	1988	1989	1990
Total OLTP	434	481	534	592	656	730
Low FT/OLTP	22	24	27	30	33	37
High FT/OLTP	122	135	150	166	184	204

All figures in $M.

If one makes the following assumptions:

* FCS in Scandanavia 1 January 1987.
* Investment commences 1 July 1986.
* Cost of capital at 10%.
* Market share of 20%.
* Profit after tax of 10%.

Then, the following table can be constructed:

	Profit			
	1987	1988	1989	1990
Low	.6	.7	.8	.8
Low Cumulative	.6	1.3	2.1	2.9
High	3.7	4.1	4.6	5.1
High Cumulative	3.7	7.8	12.4	17.5

The following additional costs should be considered in light of the RC9000 specification:

* Cost to port C to the RISC	$1.5M
* Cost to develop RISC board	$2M
* Cost to restructure TX/RTX	$2M
* TOTAL	$5.5M

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Costs for support, product preparation, document translation, service logistics, sales training, etc., must be considered. TEST uses the following model to forecast the total product cost of such developments:

* 30% for development
* 30% for manufacturing tooling and startup
* 40% for training (sales, marketing, service), advertising, field service logistics, and related activities

This brings the total cost of this undertaking, including the $5M to Tolerant, to over $23M. No estimate of market size justifies this level of investment.

cc: J. P. Field

ITT Europe Headquarters

0895

Date :

To :

Subject :

Rapidfax

Knud Soerensen
RC Computer
Denmark

Knud Jakobsen

1
/3

SYSTEM CONFIDENTIAL

ITT Corporation

1 Research Drive
Shelton, Connecticut 06484
(203) 929-7341

12 February 1986

To: [redacted]

From: E. K. Gent/J. P. Starks

Subject: Your Memo of 31 January 1986.

We are in receipt of the subject memo and conclude that there is no reason to change the conclusions of our assessment of Tolerant dated 31 January 1986. However, in order to assure clarity, we have recast some of the conclusions of that report in direct response to the items of your memo. The following correspond to the items in the subject memo:

3. The RC9000 specification calls for multiple cpu's to be attached to the bus of the system building block (SBB). SBB is a Tolerant term. The Tolerant architecture, both hardware and software, specifically excludes the use of more than one primary processor within a SBB. Hence, the Tolerant architecture does not support the RC9000 specification.

4. It is not at all clear why UNIX should be a requirement in any commercial end-user marketplace. But, it must be noted that the Tolerant adaptation of UNIX will not support the RC9000 structure without significant alteration. Indeed, it might be easier just to start over.

5. The prospect of Tolerant marketing the RC9000 raises some serious questions:

   - Tolerant has no plans to establish a sales force. Their strategy is to obtain market penetration via OEM and VAR outlets.

   - It will be difficult to maintain reasonable profit margins with the high probability of the three levels involved (ie, RC, Tolerant, and OEM or VAR) before reaching the end-user. In addition, there would be 4 - 6% import duty burden on a computer of Danish manufacture.

   - If U.S. manufacturing is contemplated, by whom will it be done? Tolerant has no manufacturing capability.

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6. Our Tolerant assessment addressed its appropriateness for use in the Super FEP. With regard to the more basic issue of the use of the Tolerant system, or portions thereof, as part of the CR90:

- The CR90 is conceived as an evolution of the CR80MX and would be required to support the main thrust of the CR business -- high capacity message-switching. To this end, the CR90 will utilize the CR operating system MXAMOS, with the possibility of using a UNIX derivative only as a development environment. It also will support a high degree of fault tolerance based, not only on software, but on such hardware features as redundant power supplies. The CR90 will undoubtedly continue the CR tradition of clean serviceable packaging. The CR90 will include bus interfaces for ICL, IBM, and Univac hosts.

- Both TEST and Tolerant have agreed that the Tolerant system is not appropriate for message-switching. It does not support a migration strategy for applications from the CR80 and CR80MX, using its adaptation of UNIX for an operating as well as a development environment. Its fault-tolerant capacity is limited. The packaging of the Tolerant system has been faulted severely. No bus level interfaces for host computers are provided.

- No advantage is gained from the adaptation of the Tolerant product to conform to CR requirements. Such a course could easily be as costly as continuing the work on the CR90.

7-8. TEST has not received copies of the cited attachments.

cc: C. G. Denenberg
J. P. Field
C. F. Smith
D. P. Weadock

19.2.86

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Fax : 02/640.94.37
Telex : 21.177

RAPIDFAX

February 19, 1986

TO : E.K. Gent/J.P. Starks ATC Shelton

FROM : K. Jakobsen

CC : C.G. Denenberg ATC Shelton
J.P. Field
C.F. Smith
D.P. Weadock

SUBJECT : YOUR MEMO OF 12 FEBRUARY 1986

Having received your memo dated February 12 I must confess that it just added a bit to my previous confusion.

My request to Mr. Weadock was to let ATC perform a technical evaluation of Tolerant in order to see if

1. a possible cooperation Tolerant/RC could save RC time and money in the RC development of the heavily needed RC 9000
2. such a possible cooperation could eventually give a spin-off to CR84 in its development of its FEP or CR90.

RC is used to take its own business decisions based on input from its R&D, marketing and sales functions so the request was for pure technical reasons.

I will so concentrate on item 3 in your memo but add for your information that RC has selected UNIX as a requirement in its marketplace as a result of careful market studies. Your statement on UNIX is thus irrelevant.

I disagree entirely with your conclusions in item 3 and the reason should be clear from the following :

The RC 9000 specifications defines the following products/projects :

B : New HW sytem with a 24 bits "RC 8000" compatible CPU and RC8000 OS adaption.
This product directly replaces the RC 8000, offers 100% SW compatibility with RC 8000, offers a performance increase of approximately 4 and supports the current RC 8000 Multi-CPU architecture.

C : A new 32 bits CPU (RISC based) is added to the system offering the following product :
- High performance single CPU system (10 MIPS)
- UNIX V compatible OS
- On-line transaction processing support (real time kernel, data-integrity etc.)
- Fault-tolerance (N-plexing, transaction roll-back, automatic recovery on dualized hardware).
- Distributed multi-processor system via dualized Ethernet.

A ported version of TX to this architecture fulfills the above mentioned requirements. The porting cost is estimated 15-20 manyears. Note that a natural first step in the portion project would be the development of a dual CPU solution similar to Tolerant's.

D : This phase of the project covers the implementation of tightly-coupled multi-processors within one SBB.

The evaluation team from RC has addressed project D in respect to the applicability of TX and has stated the following :

Quote
The symmetric multiprocessor presents difficult problems which do not arise from TX, but have to do with the combination of cache and virtual memory, as is inherent in the proposed design. To be sure, there will be other problems involved in portion TX to the symmetric multiprocessor environment. The essential requirement will be good hardware support for exclusive access by one processor to shared critical data structures. It should be emphasized that the symmetric multiprocessor is not an essential feature of the RC 9000 from the outset. The requirement for very high performance can be met both by loosely coupled processors and by tightly coupled processors. The former are available immediately from any ported version of TX, i.e. as multi-SBBs systems. It is not clear that tightly coupled high-performance single SBBs will also be needed. For this reason we refrain from estimating the cost of a possible port. Much more experience is required before such a project should be decided.
Unquote

Due to the fact that TX offers nearly transparent multi-processor support in a loosely coupled architecture, the requirement for a tightly coupled architecture becomes less demanding, especially because it seems difficult to embed a transparent multi-CPU architecture in a UNIX OS environment.

Thus the original requirement of implementing project D has been postponed to a later stage due to the fact that the functional requirements as outlined in the draft dated 3rd of September 1985 can be fulfilled without this project.

Having finally understood that CR 84 does not have any interest in Tolerant we will within RC now carefully study all the material received from different sources and out from that decide whether to proceed with Tolerant.

Thank you for assistance.

Regards.

9601K

24.3.86

- 1570

ITT Europe Headquarters

'86 MAR 24 16:23

To: Rapidfax Date:

Subject:

Knud Sørensen
Regnecentralen (RC)
Copenhagen

from

K. Jakobsen ITT-E

Knud Jakobsen

Vi skal vælge til kl.

1/4

SYSTEM CONFIDENTIAL

ITT Corporation

1 Research Drive
Shelton, Connecticut 06484
(203) 926-7341

To: J. P. Field

From: E. K. Gent EKGent. 12 March 1986

Subject: Regencentralen/Tolerant Systems Inc.

TEST (E. K. Gent) assisted ITTE (J. P. Field) to consolidate several reviews of Tolerant Systems and to re-assess Tolerant Systems' technical value to ITT Austria, Christian Rovsing and Regencentralen (RC). This report documents the issues addressed during this activity, which was conducted during 3-7 March 1986. In addition, certain aspects of the proposed RC9000 product are reviewed.

SUMMARY

* TEST finds no reason to amend its previous reports that relate to Tolerant Systems Inc.

* Christian Rovsing and ITT Austria have concluded that they have no further interest in Tolerant.

* RC has no plans to use Tolerant hardware components for the RC9000. Interest in Tolerant is limited to Transaction Executive (TX) software components.

* Although the RC evaluation is incomplete, RC engineering plans assume that TX can be ported to be the RC9000 Operating System.

* Development of the RC9000 incorporates a major upgrade to the RC8000 product.

* RC requirements to develop both a RISC based machine and a fault tolerant product capabilty are technically driven, with claims of,

  . high performance (MIPS oriented)

  . competitive edge

* There is no Product Plan or detailed business justification, at this time, that supports the RC9000 development programme.

3/4

RECOMMENDATIONS

* ITT should not invest $4.5M in Tolerant. The technical value has not been proven.

* A detailed Product Plan is required, in order to evaluate the potential RC9000 requirement.

* As a minimum, RC should create an Acceptance Test Specification against which to fully evaluate TX operations. The test and acceptance criteria must be based on RC9000 requirements. Tests should cover,

    1. Performance (e.g. transaction throughput)

    2. Fault handling capability

    3. Functional compliance with UNIX V

* RC should re-evaluate and concisely define the level of "fault tolerance" required.

* RC should re-evaluate the necessity for a RISC based architecture; development of RISC-based products involve non-trivial overheads.

* System performance requirements for the RC9000 are expressed in terms of MIPS. A more subtle and realistic user profile must be constructed for OLTP and other application environments.

* RC should complete a detailed development schedule, listing any assumptions.

GENERAL

It is perhaps appropriate to touch on Reduced Instruction Set Computers (RISC).

* Earlier this year both Hewlett-Packard (HP) and IBM announced machines built around the new and largely unproven approach of RISC. HP introduced two models of "Spectrum" (HP 3000 Series 930 and 950) at an estimated development cost of $200M. Availability is targetted for end of this year for the 930 and 1987 for the 950. IBM introduced the IBM RT/PC, but development costs have not been divulged.

* Development of a RISC based machine demands significant technical expertise and requires a highly integrated development programme in the areas of,

  Hardware and system architecture

  Operating System

  Compiler Suite and associated tools

  Performance Analysis

* RISC machines are considered good for computational intensive applications whereas the RC9000 is aimed at the I/O intensive applications found in most businesses, especially OLTP.

* RISC machine compilers play a more important role in realizing system performance than conventional compilers. Determining the instruction set should result from extensive measurements of execution frequency, across a variety of workloads.

* The compiler development as outlined in the RC development schedule, appears to refer to the 'C' language requirement; the "Specification of the RC9000 Computer" document dated 12/12/85, outlines a 'C', Pascal, Cobol and Fortran 77 Compiler Suite.

cc: C. G. Denenberg