Christian Rovsing A/S from 1970 to 1984

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Abstract. A personal narrative about how Christian Rovsing A/S succeeded in a number of large and technically demanding projects. The paper describes the precursor events that lead to the closure and subsequent development of a range of turnkey computer and network project contracts for Christian Rovsing A/S during the period 1970 to 1984. A few such projects and the events that preceded the closure of contracts are discussed.

1 Introduction

The program committee for this Conference asked me to describe the precursor events that lead to the closure and subsequent development of a range of turnkey computer and network project contracts for Christian Rovsing A/S during the period 1970 to 1984. I will describe some such projects and the events that preceded the closure of contracts.

The company Christian Rovsing A/S was founded in 1963 by Christian Rovsing and worked the first years mainly as consulting engineers. The transition changes from punched cards to computer systems lead to a requirement for skilled engineers and programmers to work with this new technology. This group of personnel was in high demand. The company hired and subsequently contracted out the staff as consultants to the European Space Agency and to various airlines. During the first 7-8 years the company in this way built up a cadre of very skilled computer engineers ready to take on more demanding tasks, and over the next 15 years the company carried out very large projects for space agencies, airlines, and both military and civilian authorities. I will discuss how the contracts were obtained and how we succeeded with projects like:

- Satellite communication
- Military communication networks
- Airline reservation systems
- Terminals and network for the Danish debit card “Dankort”

2 Applications

By 1970 there were many so called minicomputers on the market. Very few potential customers knew how to use the computers and no one wanted to start a software department for the development of the application. HP, DEC, SAAB, Norsk Data and many other manufacturers tried to sell their hardware, but the costumers had to do the programming themselves. (For acronyms please refer the enclosed list). We had the skilled engineers and started therefore to contract for the delivery of turnkey systems, where we took responsibility for hardware and software and a

system answering the costumer's functional requirement. This included a fixed delivery date and a fixed price. If the costumer wanted a particular minicomputer we bought that and made that part of our turnkey delivery.

This was a new approach at the time and half the sales work was already done by the computer vendor. We had an unwritten arrangement with several computer vendors that when they met a requirement they could not handle themselves they referred to Christian Rovsing A/S.

We could of course not finance such projects which often lasted many months. We therefore introduced advance payments, usually one 3rd of the project sum with stage payments under way. The last payment fell when the project was completed. This method was good for the customer but also for ourselves, because this meant that we had to complete a project. We also included a point in the contract which was called systems engineering, i.e. the number of engineering hours which were required to complete the project. Often a project was extended over and above what was agreed in the original contract, but in that case it was newer disputed that these extra services also could be invoiced.

Sometimes the costumer's wishes were very vague. In that case we initiated a project with a paid definition study which lead to a functional specification report. The costumer was now free to place the system for implementation into international public bidding and thereby making the formalities all right in relation to public institutions.

During the following years we contracted and delivered 12 widely different turnkey systems through using bought in minicomputer equipment. The company was now no longer "consulting engineers" who advised others what to do. Now we had become computer systems contractors with the focus on delivering total systems. This lead to many engineers and technicians becoming deeply involved in the solution of practical computer systems for customers, who were willing to pay for it. This released a closely knit togetherness in the company because everybody was keenly interested in solving the application within the given framework. We did not need a large sales department because the same engineers, who were to implement a system, were also those, who wrote the proposal documents. This gave our engineers a greater insight into and understanding of the customer's wishes and problems and guaranteed that the project could actually be implemented. This was an important success factor. In some cases our engineers became personal friends with our customers.

3 TOSCA

In 1971 the Danish Air Material Command had formulated a request for quotation for a Tote System Computer Assisted, TOSCA. This was a system, which on data CRT terminals displayed a whole range of information for the Airforce to carry out their missions. Such as amount of fuel to be loaded, type of weapon, route to fly etc. etc. This data was previously displayed on white boards with pencils and

sent by video link to the adjacent command center. We placed our bid with a SAAB D5 minicomputer. Mainly because the Airforce had bought SAAB fighter aircrafts and I thought that they would offer us a good deal when buying their computer. That they did, but the Air Material Command was still not satisfied that Christian Rovsing A/S, who were consulting engineers at the time, could manufacture the required equipment. I therefore proposed to the managing director of the Maersk owned DISA Electronic to write a letter saying, that if Christian Rovsing A/S could not manufacture DISA would. This is a blank check he said. When the letter was presented to the Air Material Command we won the contract. The system was delivered on time and was for many years a great success. Later on the Royal Airforce in the UK lend a TOSCA site and wanted to copy it. This project was to become the basis for many additional defense projects for the Danish Military and for NATO.

4 Meteosat

In 1971 European Space Agency built a series of meteorological satellites. To process the enormous amount of picture data streaming down from the satellites the Agency built a large computer system, which consisted of British ICL computers. In this connection there was a need for a fast communications front end. We bid with a so called array processor of our own design and won the contract in 1973. We could not call it Christian Rovsing Array Processor short CRAP. There is no need to tell you what that means in English. So a bottle of whiskey was put up as a prize. The winning name was CR80 and this was to become the key element, which we used during the next 10 years for demanding communications applications.

Fig. 1. Meteosat

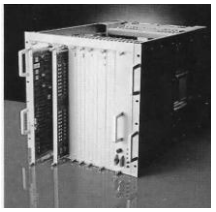

Fig. 2. CR80 Array **Processor**

5 FIKS

The Danish Army, Navy and Airforce had for some time worked on the idea of connecting the three services with a common communications network. In 1973 Christian Rovsing A/S obtained paid definition study contract. A working group was assembled consisting of a Senior Sargent from the Airforce, a Major from the Army and a Navy Commander and myself as the team secretary. The intended system was named Forsvarets Integrerede Kommunikationssystem, FIKS. A series of meetings at the existing communication centers of the three services were conducted. It fell to my lot to write the functional specifications and I took a couple of days

off for the purpose and described a system comprising 12 nodal points connected with a network throughout the country. The architecture was what we today call WEB.

The operational integrity of the network was to be extremely high. System was not to fail even if one nodal point was knocked out. Data were to automatically find new ways through the network through redundant connections. We were to use the existing public telephone infrastructure and the data was therefor to be encrypted. The nodal points were to be protected against an electromagnetic impulse, EMP as a result of a nuclear attack. The Air Material Command sent the specification into international tender with a slightly smaller configuration of 8 nodes. We placed our bid and in 1977 I could sign a 46 million Danish kroner contract for the turnkey delivery of a FIKS system.

In 1978 I participated in a symposium about network security at Washington DC sponsored by US Security Authorities. I came to talk with a person from DARPA the US Defense Research Establishment. He told me that he was writing a doctors thesis on a self-repairing data network for the US Military. I invited him to Denmark to inspect the FIKS system which answered those criteria. We at Christian Rovsing A/S were then at the forefront of technology. Four years later in 1982 DARPA was credited for having invented the Internet we know to today.

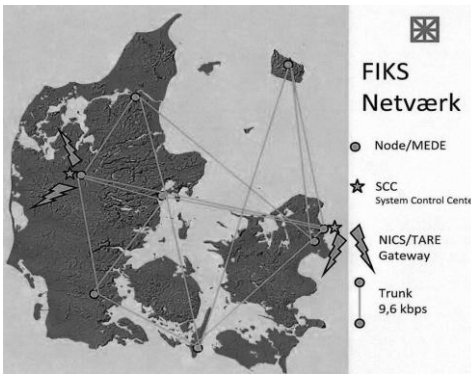

Fig. 3. Typical FIKS Installation

6 CAMELOT

The company's cooperation with ICL developed over the years and we supplied a number of CR80 communication frontend systems for banking and private videotext applications in the UK and in South Africa. For the National Health Service, NHS in the UK the company delivered a *packet switching network* called *CAMELOT*. The system connected 5000 CRT terminals via 15 nodes throughout the UK to ICL computers for the processing the country's health program.

Fig. 4. CR80 Front End to ICL Mainframes

7 NICS TARE/CAMPS

NATOs radar air defense system was interconnected via a telex type paper tape system. A network connected the easternmost point of Turkey through all the NATO countries to northern Norway. If a threat was observed in Turkey a message was initiated and relayed through the network to Norway. The scientists at NATO headquarters thought that this process could be speeded up and automated with modern technology. After a couple of years they produced a specification which was sent out for bidding. Christian Rovsing A/S could not undertake this task alone so we teamed with Litton Industries. We had two engineers stationed for a period with Litton in California to help write the proposal. Litton won the bidding and in 1976 I could sign the contract for supplying CR80 front end computers to Litton back end computers. This was the first large scale use of the CR80 for a military application.

With the encrypted network in place the next step was to see if the *contents* of the messages could also be automated. So NATO sent out for international bidding a specification for a Computer Assisted Message Processing System, CAMPS. This time we submitted a proposal alone and won a 305 million Danish kroner contract (fig. 7). The messages were to be processed after a standard military procedure called ACP 125.

Today we do not think twice that the contents of a message can be read and processed electronically by a computer. Today we have the “hyper-text -transfer-protocol”, http, to do the job for us. But in those days the processing of the contents of text messages was new. The unique feature of the CR80 computer was the line termination unit, LTU, which could be programmed to process many different protocols. This feature proved very useful for the large airline projects as we shall see.

Fig. 5. European Nato Countries

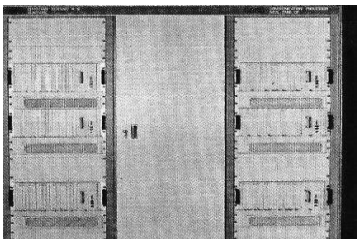

Fig. 6. NICS TARE Installation

Fig. 7. Typical CAMPS Installation

8 Protocols

The reservation systems for the airlines grew in 1970'es increasingly more complex with many different terminals connected to a network. The introduction of CRT terminals also increased the demand on the network. The mainframe manufacturers each had their own proprietary communication protocol. Their marketing strategy was that also the terminals had to be supplied by the same main-frame vendor. In the case of Air Canada they even had two different mainframes, IBM and Univac.

This not easily read diagram in fig. 8 shows a summary of the network protocols our company could handle with the CR80 computer system. From the diagram you may discern, that we also handled the TCP/IP protocols which here at this early stage are labelled ARPANET. The TCP/IP protocols were years later to become the Internet standard protocols. The company developed a unique computer, the CR80, including a line termination unit, LTU, which was capable of handling a wide variety of communication protocols. This printed circuit card performed a whole range of communications functions, which today is included on a single chip.

9 Air Canada / American Airlines

We convinced Air Canada that we could solve their problems with a CR80 front-end communications computer. And they let us have an engineer stationed in their computer center in Toronto for a period to help write the specifications which were sent out for international bidding. About at the same time American Airlines had invited proposals for their network to an IBM mainframe configuration and the bidding was closed. At that time I was visiting Motorola in Boston and they told me that they were

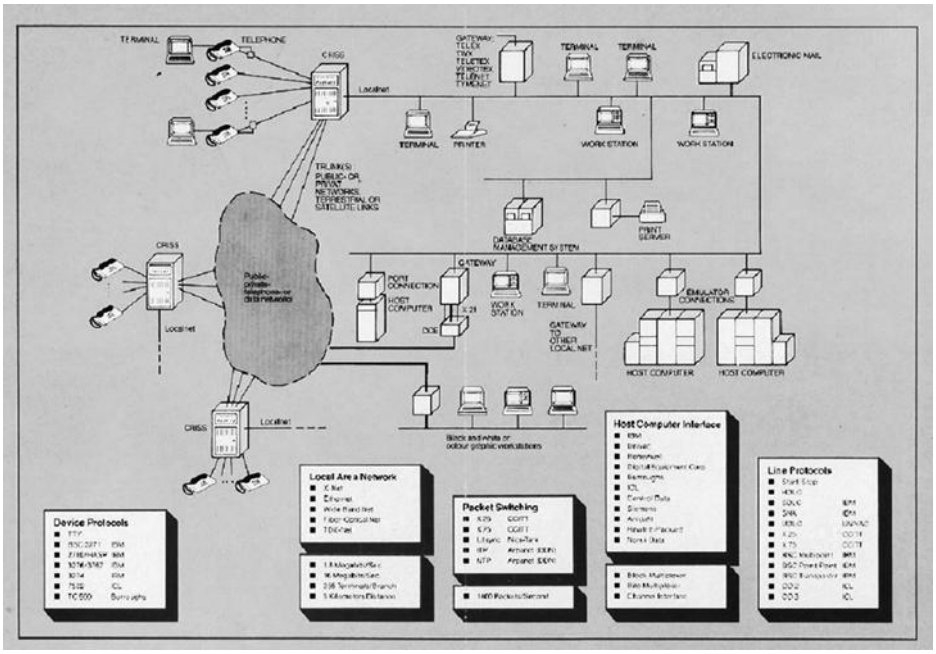

Fig. 8. CR80 could handle several network protocols

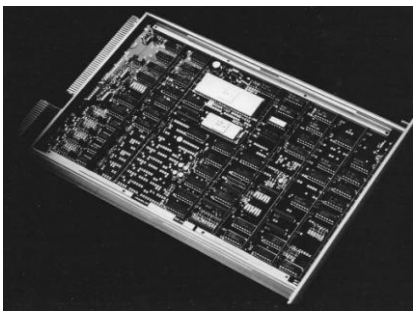

Fig. 9. LTU, Line Termination Unit

to make a presentation on their modems to the American Airlines computer team the following week.

I would of course also like to make a presentation to American Airlines. My friend at Motorola phoned American at Tulsa, Oklahoma and it was agreed that we could make a presentation in the afternoon with Motorola having the forenoon. But American wanted some documentation in advance. I rushed back to Copenhagen and had our engineers compile a stack of documentation 12 cm high. This was sent by courier to American in Tulsa. This was relatively easy for us because we had almost finished our proposal to Air Canada. In the rush we had in the text in a few cases forgot to substitute Air Canada with American Airlines

I assembled a team of four of our engineers and the following week in the afternoon we made our presentation to American at Tulsa. After a short break the American engineers came back and handed over the bidding documents with a smile saying that they were a private organization and therefore could let us bid even though the bidding officially was closed.

It was agreed that we could make a proposal within two weeks and we submitted our proposal. Then followed a period where we conducted clarifications at Tulsa. One day the American evaluation team wanted me to meet their boss William (Bill) Perry. They brushed themselves up and we went to the boss's office, where he greeted me with a "Hallo Axel" and I responded with a "Hallo Bill". It turned out that Bill a few years earlier had shown me around his Californian company, who were interpreting the secrete aerial photos taken from the American U2 spy planes. Bill Perry was also advisor to the US government on communications and we had met in connection with our European NATO networks. So the chemistry between Christian Rovsing A/S and American Airlines was excellent and we were selected to build 320 million Danish kroners worth of network.

Here is a little anecdote that happened in connection with the American Airlines contract. Before signing the contract the Chairman and President of American Airlines Bob Crandall wanted to meet this Christian into whose hands he was placing the fate of his Airline. If the reservation system and the operations system do not work then the Airline is dead. Moreover this Christian Rovsing company was located 60 miles from the Iron Curtain. So a meeting was arranged. That was to take place in an apartment, which American Airlines owned on 5th Avenue in New York. On the day Christian and I turned up at the 2nd floor apartment. Present were Bob Crandall, the chief financial officer of American Airlines, Bill Perry, Christian and myself. The caretaker of the apartment served a cup of coffee. After about 15 minutes of general discussions Bob Crandall suddenly turned to Christian Rovsing and said: "Tell me Christian, what happens to my Airline, if you decide to close your company and go fishing". Christian mumbled something about that he had no intention of doing that. Then Bill Perry cut in and said: "I know Axel, so it is all right". That was the end of discussion!! And we returned to Copenhagen after a cup of coffee in New York.

Bill Perry later became the US Secretary of the Defense under the Clinton administration.

A few weeks later the contract was signed. In the meantime I could also sign a 195 Million Danish kroner contract with Air Canada.

10 Dankort

I will now turn to the events that transpired before the contract for the Dankort system was awarded to Christian Rovsing A/S. In the latter half of the 1970 the Dan-

ish banks and the retail organization formed a joint company, PKK, which was to develop a Danish electronic payment system. That company had representatives from the banks and the retail institutions. The head of the company was a person from the retail institutions. The banks had a few years earlier introduced a credit card of plastic, which could be used with a paper slip. Christian Rovsing A/S obtained a small paid study contract from PKK and that enabled us to look into the production of plastic cards with a magnetic stripe. We also studied the use of cryptographic algorithms for use in the civil sector. Previously we had experience of cryptography for military applications. During the study period the requirement specifications developed:

- The system was to be a Debit Card, i.e. the payment transactions were to be booked on line directly on the customer's bank account immediately. A Credit Card on the other hand works through the transactions being collected off line by the bank that at the end of the month sends an invoice to the customer with interests and charges.
- The existing wired telephone infrastructure was to be used. It was a prerequisite that the telephone infrastructure was well developed. This was the case in Denmark were even the most remote place could be reached with a wired telephone connection.
- The system was to be operationally absolutely safe and no single transaction was to be lost.
- The payment transaction as well as the terminal was to be encrypted.
- A very important prerequisite was that the Danish Government and the Trade Unions same years earlier had agreed that all Danish citizens were to have a bank account.
- The system was to be used by the entire Danish banking community. Therefore banks with a well-developed computer infrastructure were not to be favourized over smaller banks and savings institutions.
- The intended system was to be jointly owned by the Danish banks, so that no single bank could obtain a monopoly.
- The point of sales terminals were to be protected so they could not be compromised by electric radiation.
- The specifications were to be structured so the project could be sent into international bidding by PKK.

After several months of joint specification work the project was sent in for international bidding. On equal terms with other bidders Christian Rovsing A/S submitted our bid.

We bid with a so-called "fault tolerant" CR 80 Computer configuration. Our computer architecture was well suited for "transaction processing" i.e. the fast handling of large amounts of short transactions. This was at the time a new technology that a very few companies in world mastered.

Fig. 10. The Danish Public Wired Telephone

Fig. 11. The Central Dankort CR80 Configuration

The transaction data in our Dankort system were transported through the wired public telephone system by means of an 800 Hertz side channel on the ordinary 3 300 Hertz telephone cannel to the local telephone exchange. By agreement with the telephone companies the transaction data were sifted away and transported by high speed digital link to the central Dankort CR80 computer system located in a building with special physical security which was to be built at Ballerup for the purpose.

The transaction data were encrypted at the point of sale terminal and double encrypted with the terminal number. This meant that the data when travelling on the initial Dankort transport network could not be compromised unless you had physical access to the network in the telephone exchanges and at the same time could crack the crypto keys.

We used a so-called DES (Data Encryption Standard) algorithm. DES applies a 56-bit key to each 64-bit block of data. DES originated at IBM in 1977 and was adopted by the US Department of the Defense as a standard because it at the time was considered unbreakable and was therefore restricted for export. This export ban was later rescinded and the algorithm was placed in the public domain. We knew that the DES crypto algorithm could only become public if the US Security Agencies, now NSA, could crack the code. But we were at the time not unduly worried because our data travelled in a closed network. *This was as we shall see to change later.*

When the encrypted data arrived at the CR80 Dankort computer this was decrypted in a closed hardwired module. This meant that the operators had no access to the transacted contents. They could only see that a transaction had taken place and take corrective action in the data flow. *This was as we shall see also changed later*.

The CR80 system was scalable and was designed to operate in both civil and military environments. The Dankort configuration consisted of 10 CR80 computers, which were capable of handling up to 700 transactions per second 24/7/365. The

Dankort system was put into full operation in 1983 and the contract sum was 41 million Danish Kroner

Initially the retail industry boycotted the system because the banks were greedy and imposed a large bank charge per transaction on the retail industry. At the time a payment transaction by cheque or paper slip which was carried by the banks, cost more than 6 Danish kroner, whilst a Dankort payment could be made for less than 25 øre. Fortunately the banks rethought their charging policy because they saved so much by operating the Dankort system.

Fig. 12. Refuse Dankort

Fig. 13. Accept Dankort

After a few years the Dankort system became the most widely used online payment system in the world measured per capita.

During the first 10 years of operation Dankort fraud was negligible and system downtime was almost nonexistent. By 2006 there were 676 million transactions per year and a turnover of 249 billion Danish kroner. This was a considerable part of the Danish economy.

The Dankort system subsequently joined with VISA and this opened up the world market. The data transport net was subsequently changed from the original closed network in Denmark to the Internet. But this meant that the system could now be accessed from any point in the world. If you at the same time you could crack open the encryption code the transaction content could be disclosed to 3rd party. It has now been revealed that this is exactly what US NSA is doing in their hunt for terrorists, but at the expense of law abiding citizen's privacy.

In our original Dankort system encryption and decryption was performed by means of a closely guarded hardwired module. The system operators therefor had little or no access to the contents of the transactions. *This has also changed dramatically by introducing the chip in the card under the pretext that a chip was safer.*

However, the chip enables the bank to compile a personal profile of each cardholder. This profile is for security reasons used to supervise each individual transaction and alert the cardholder if the card is used in an abnormal way. The cardholder's profile can also be used as a marketing tool, which today is known as "Big Data".

The jointly bank owned payment system company PBS subsequently subcontracted the task of data processing to an outside vendor and therefor no longer has full control over the system. As we now know that enabled a Danish subcontractor's operator to obtain and sell information about the card usage of the Danish Royal

Family and other dignitaries.

Lately the control of the system has passed from semipublic ownership (the Danish National Bank was part-owner of Dankort) to a private American investment company, whose only purpose is to make a profit. *As a result it is unclear whether the American laws of privacy can overrule the corresponding Danish laws.*

More than 30 years ago we at Christian Rovsing A/S started a technological development process in Denmark for payment systems, which in the near future will replace cash payments with wireless payments by smartphone.

11 A Lesson to be learnt

It seems that the lifespan for international companies that are based on developing a niche in new technology is about 20 years. There are several examples in the Nordic countries and many such companies have disappeared internationally. Christian Rovsing A/S was no exception. The company based its original success on focusing on a direct relationship with the customers in solving their specific network problems. The success was so big, that the company moved one step away from solving the customer's problems. The company moved to become a computer vendor in competition with many other companies on the market, almost back to where the company started 14 years earlier. Such a change in marketing philosophy requires a completely different organization and above all large capital resources, which were not available at the time.

Christian Rovsing A/S was an engineering company consisting of enthusiastic engineers, who took great pride in solving the customer's problems using technology in the forefront.

Appendix

The table below explains most of the acronyms used in this paper.

ACP 125, *NATO Message Format*
ARPANET, *Initial World Wide Web, WWW*
CAMELOT, *Health Care System for the UK*
CAMPS, *Computer Assisted Message Processing System*
Dankort, *Danish Banks Debitcard System*
DARPA, *Defense Advanced Research Project Agency*
DEC, *Digital Equipment Corporation*
EMP, *Electromagnetic Pulse*
FIKS, *Forsvarets Integrerede Kommunikations System Danish Defense Integrated Communications System*
HP, *Hewlett Packard Corporation*
ICL, *International Computers Limited*
NICS, *NATO Integrated Communication System*
NSA, *National Security Agency*
PKK, *Pengeinstituternes Købe og Kreditkort Selskab (Danish Banks' Debet and Credit Card Company)*
SAAB, *Svenska Aeroplan Aktiebolaget*
TARE, *Tape Automatic Relay Equipment*
TCP/IP, *WWW Protocols*
TOSCA, *Tote System Computer Assisted*