How China was Connected to the International Computer Networks

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"Computer interconnection between Germany and China was realised on the basis of the following protocol architecture: X.25 was used for the lower three OSI layers, CSNET/PMDF protocol for the layer four transport protocol, and application-oriented protocols for the e-mail service of CSNET for the higher layers. In the implementation use was made of …." Though technically far more exact, of course, the majority of specialist articles about projects in the field of computer communications take this form – and there is certainly some justification for this. Nevertheless, much is missing from such publications as regards project implementation. Important details, basically even what is most crucial: people, ideas, motivation, linkup problems, wrong paths, chance, luck, misfortune, despondency, tension and finally pleasure once the goal is achieved. Perhaps the interconnection of computers between Germany and China is, not least because of the out-of-the-ordinary boundary constraints, a suitable case study to give an account for once of the other side of project reality, and this now follows.

The idea of setting up a computer link with China basically had its origins in 1983. At that time, the first WASCO symposium took place in Beijing at the invitation of Chinese users of Siemens equipment. Eighteen speakers from various German universities, major research institutes, and industry gave outline lectures that summarised current and future trends in the most important areas of IT in the "far-off countries of the west." In parallel sessions they then got down to details, with the speakers answering questions even down to the bits-and-bytes level.

With the subject of my main talk, "DFN – German Research Network," I had set the main focus in the communications sphere. The accompanying tutorial lectures were largely devoted to the OSI architectural model, which was still unknown in that region at that time.

The period after returning to Germany from China was devoted to implementing the network projects presented. One was a milestone, the first connection to the American computer science network, CSNET, in mid 1984 from Karlsruhe. With this connection, which for the most part was implemented by Michael Rotert, we had made electronic mail service available for the first time, and were quickly convinced of its advantages.

With provision of the CSNET service both within and outside Karlsruhe University, there began a lively "mission activity," whose reputation also gave impulse to our colleagues in the direction of China. Anyone ever making contact or working in collaboration with China is aware of the long route and time delay for replies. A turnaround time of 14 days is even considered fast if one does not want to resort to the extortionately expensive telephone or telex, which are not available everywhere. When preparing for the second WASCO/ CASCO symposium for autumn 1985 the difficult communication often became a test of nerves on which the enterprise seemed to almost fail. Hence from a mixture of frustration, belief in progress and staying power, the obvious desire became ever stronger to have a computer connection with China.

This idea was set forth in the form of a letter on 16 July 1985 directed to "father of the people," Lothar Späth, former prime minister of Baden-Wurttemberg, whose involvements with

China and zeal for decision making in the high-tech sphere are well known. A sum of money for a separate node computer of our own was mentioned – so that our link to America would not be affected – and a small amount for running costs. As partner, we had selected the Institute for Computer Applications (ICA) at the Technical University of Peking (today, University of Science and Technology, Beijing, www.ustb.edu.cn). I had in the meantime established a personal friendship with its former head, Prof. Y. Fung Wang (75 years old and still very active professionally). Its then current head, Director C. C. Li, was a guarantor for proficient and committed implementation.

Despite all the hectic preparations, the second WASCO/CASCO symposium ran according to program, with the subject of my main lecture "International Scientific Computer Networks" arousing even further interest in a computer linkup on the part of the Chinese delegates. Further lectures jointly with Hans Lackner about "Experience gained in building the Karlsruhe local informatics network - LlNK," and also LAN technologies in general, propagated knowledge about the connection between WAN und LAN services.

Up until then, really nothing had yet happened except for the awakening of desires on the part of the Chinese, when suddenly, in autumn 1985, money for a project to link computers with China was delivered to the University of Karlsruhe, and the suspicion fell on me. In his farsightedness and kindness, Lothar Späth had actually responded to my letter and granted the money. Strictly speaking, he delegated the problem of procuring the money to the Ministry for Science and Art, which no doubt had to take it away from some other area. Regardless of how, the go-ahead had been given and it was our turn once more.

To start with, reservations were voiced by various parties as to whether we were perhaps doing something illegal in linking-up to China, which might damage our linkup to America. We calmed things down with our plan for a physically separate point-to-point connection. As a result, reservations were initially put-aside and we were able to continue untroubled.

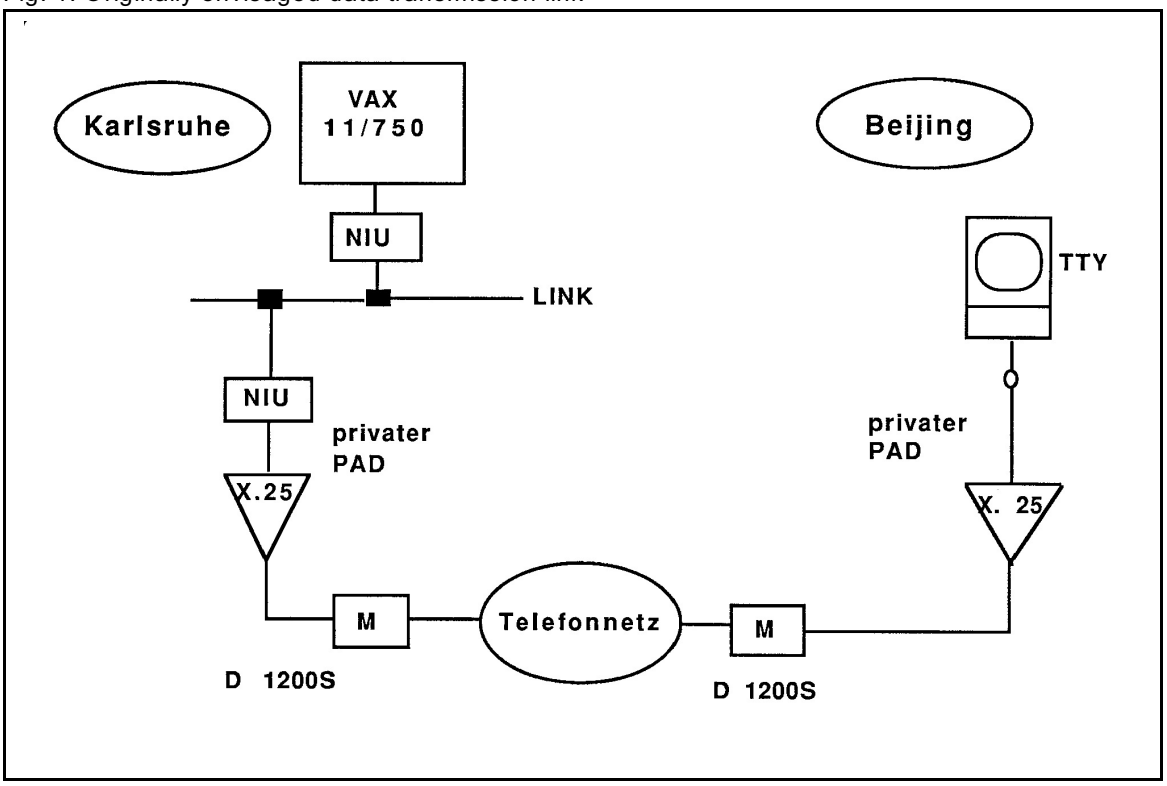
What was then needed though was to resolve the following points quite specifically:

1. Procurement of a German node computer
2. Procurement of a Chinese node computer, suited to this
3. Implementation of a secure data transmission link

Point one was quickly resolved: with the money obtained through Dr. Späth we bought a µVAX II, which was soon up and running under UNIX 4.2. The decision in favour of UNIX was taken because this was also available in China, and it allowed a linkup via UUCP without otherwise needing somebody's approval. Point two proved to be somewhat more difficult. Of course one also wanted to procure a VAX at the institute (ICA) but the procedure to apply for the necessary foreign currency (fec = foreign exchange currency instead of Yuans) is incredibly complicated, comparable perhaps to the law for funding university buildings in Germany, when circumstances are difficult. Moreover, a Chinese clone that would also run under UNIX was soon to be ready.

Once we could see no possibility of influencing point two from outside, we turned our attention to point three, the secure data transmission link. Since we knew of no data networks in China comparable to those of the DBP (German PTT), we resorted to the simplest method of implementation for us, i.e., a telephone dial-up connection with overlying separate X.25 PADs for security (see fig. 1).

Fig. 1. Originally envisaged data transmission link



No sooner said than done. The necessary equipment:

- . X.25 PAD (for China)
- . Line monitor
- . 1200 baud modem including a telephone

was procured and tested locally, with Mr. Wenzel providing us with friendly support on behalf of the Karlsruhe PTT.

In the course of a combined project and lecturing trip to Beijing and Shanghai from 15-27 May 1986 the connection was to be set up and tested. The procurement including dealing with all formalities for time-limited export (which are not without tricky variants) was completed in the minimal time of one week. I had barely one $^{3}/_{4}$ hours for the trip from Karlsruhe including check-in, and getting the equipment through customs including payment of excess baggage charges (an additional DM 2100 had to be paid). An overview of the rest of the expedition schedule follows:

14.-15.05.86 Outward flight
16.-19.05.86 ICA, Beijing
20.-23.05.86 Tongji-University, Shanghai
24.-27.05.86 ICA, Beijing
28.05.86 Return flight

To sum up: everything went well with the trip except for the planned linkup. We tested the telephone connection at all possible times of the day and night, finding speech communicability to be even entirely in order, but, on switching over to the modem, the “carrier” was always released again within a few seconds. The testing organisation of the German PTT in Frankfurt was enlisted and surprisingly confirmed sufficiently good quality with a bit error probability of 10^{-8} on the international pathway. However, one should not imagine the testing to be quite that simple because,

firstly, outgoing calls from China at that time were still connected manually with waiting times of up to one hour and, secondly, the time difference of seven hours meant almost no overlap in the normal working hours of Germany and China, not to mention the telephone charges.

We broke off the tests on 19 May, whereby, with the support of the Chinese PTT, it was intended to undertake further trials after my return from Shanghai. A meeting was held on Monday 26 May with a PTT engineer, who proved to be amazingly knowledgeable, with the relevant CCITT standards (V/X) at his finger tips. He indicated that the cause of our problems was the poor line quality in the local area with bit-error probabilities of 10^{-3}. The only option for improvement would be a permanently connected line between ICA and the PTT's international exchange. This sounds much simpler than it is in reality since lines in Beijing were so rare. One indication of this is that usually an entire residential area had access to only a single phone line. Despite this, we decided to pursue this option in the weeks to follow and then set up the X.25 tests again.

Not long before our date of departure the PTT engineer said, "And incidentally – there is already an X.25 connection in Beijing. Several institutes have access to a PAD at the PTT, which is connected to Italy via a satellite link." I almost fell off my chair for, of course, this was exactly what we needed. The enquiry as to which of all the institutes in Beijing these would be, revealed that one happened to be right next door to the ICA. It was the NISTI (North Institute for Scientific & Technical Information) – 100 metres away – and a fortunate owner of a PAD access terminal, even with its own dedicated line. NISTI and ICA were not only neighbours but even belonged to the same department in the ministry, so it was plain sailing from there on.

An appointment was made to visit NISTI on the next day, Tuesday the 27 May, one day before departure. Unfortunately, the electricity was always turned off in this part of the city every Tuesday due to a shortage of energy, i.e., all computers are shut down and even the sockets no longer have any "juice." Fortunately though, to counter this injustice, the people at NISTI had constructed a small battery-based emergency supply for their PAD terminal, to be independent of the main supply. This then allowed the demonstration to take place. It worked trouble free as can be seen from the following excerpt from the dialogue script.

PAD Session Log

```
SIST - 10 MULTIPAD
 PKTELCOMB BEIJING, CHINA

* 3

* C 2222620021 ditchi0005es
com 2222620021/

network: password:
000000000000000

Please enter your ESA-QUEST password
rbc @@@@@

if you having difficulty logging on
Please contact IRS or your national centre
clr
*
```

Moreover, the entire operation ran quite fast. The connection setup times to Italy were around three seconds and most important of all the entire link setup including the satellite line was within the scope of an European Science Agency (ESA) project, which for the time being also covered the cost. I flew back reassured, with the remaining matters to be taken care of from Germany. IRA

computing center business, lectures and other projects allowed China to slip somewhat into the background again, but after the holidays we got back down to it again.

The following needed to be done or ensured:

1. Discover the person responsible for the Italian project or the X.25 operating company
2. Support through the German PTT
3. Support through the Chinese PTT
4. Through connection and test in ICA/NISTI

It took three telephone calls to find out who was responsible for the Italian project. This was done via ESOC in Darmstadt, Germany, and on 20 August 1986 we were put through to the relevant specialist, Signore Buenoventura (in English: Good Future), at the firm of ITALCABLE. I explained what we wanted to do and he said that, in a quiet hour, he would like to try extending the X.25 administration for Germany, so that one would be able to be put through to DATEX-P via the country code 026245. Telephone calls to the Ministry of Telecoms in Bonn revealed that the latter were very interested in an X.25 link to China, although letters on this subject to the PTT in China had so far remained unanswered. I offered to set up informal contacts via ICA and enlisted Prof. Wang for this. Meanwhile, colleague Signore Buenoventura had registered the extension for DATEX-P in Italy and thought that we should try it out.

Of course at that time communication with ICA still went via telex and telephone, and we once again passed on the necessary commands to China in order to select on our PAD the local LINK network and ultimately our VAX. Meanwhile, we had set up a "Wang" mailbox, via which in the future all e-mail communication with the ICA was to be routed.

Using a line monitor in front of the PAD we traced the attempts to set up a connection from China and gave support. After several attempts the time had finally come on 26 August 1986; the first login on our VAX from China had been achieved and it wasn't long until the first e-mail was also sent. As chance would have it, shortly thereafter a delegation of our university's vice-chancellor was visiting Beijing, to whom we were able to send the first electronic message of greeting from Germany. Strictly speaking, of course, the message lay in a mailbox on our VAX computer, and was fetched from there by remote dialogue from China and printed out via a terminal printer at ICA.

Nevertheless, our mail arrived at the optimum point in time and generated much pleasure at both ends. With that, both the first X.25 link between Germany and China and a simple e-mail communication had worked. We announced the result to the public via a press release, which met with an extremely positive response since numerous other institutions such as:

Technical information centres

DIN (German Institute for Standardization)

Patent offices

were very interested in such access from China. By being able to have direct dialogue with Germany, the possibility arose for many projects, e.g., in the DIN area, of considerably simpler alternatives for data management and updating in China than was previously the case.

Whilst we reaped a good deal of publicity from this first partial result, it has to be admitted in all honesty that we alone did not do a great deal technically, rather the helpful colleagues at ITALCABLE set up the through connection. Our contribution actually lay in being fortunate enough to find and pave a way via the different entities involved, which ultimately also then worked. The German PTT acknowledged this in that it officially released this route on 1 December 1986 as a new service, with charges and all the other paraphernalia. It was even planned to replace the ESA project link via Italy with an official satellite link between Germany and China. In the meantime we rested

somewhat on our laurels, had a modest e-mail communication with the ICA and were fully occupied with other matters. Nevertheless it was clear that the true project goal of interconnecting computers had of course not yet been accomplished, but merely a secure means found for data communication. Unclear, in particular, was how the host computer required in China for the linkup could be provided.

At this point a short report must be inserted about a further activity, which initially had nothing to do with the China project, namely the CSNET-MAIL BS2000 project.

Those who are familiar with Siemens DP systems will know that integrating BS2000 systems into national and international computer networks, and participation through this in electronic mail services, is not a simple matter. Siemens own X.400 development had only just been announced. KOMEX was partly very elaborate as a conferencing system. Porta-COM was sometimes not supported for BS2000 and the EARN interfaces exhibited functional limitations. For these reasons we decided in 1985 to start a CSNET/ BS2000 implementation, which shortly thereafter was elevated to a Siemens cooperation project. For the implementation task we had assigned a promising IT student named Michael Finken (21 years old at the time), who was to later play a key role in the China linkup project.

Michael did the implementation independently. Now and again urgent status messages of the form: “Now it has seized it!,” “They are now chatting with one another” or “They are not checking it,” forced their way through to me regarding the progress of the project, which reassured me every time. After working for about one year, the first version ran in autumn 1986 on our Siemens central computer, and the first versions were delivered after a further three-month internal test phase. Karlsruhe University administration, Univ. of Kaiserslautern and Univ. of Saarbrücken were the first CSNET pilot customers, together with whom various data communication links in particular were tested: X.25, dial-up connection, LAN-link and others. From early 1987, the node “unisb” ran stably on the Karlsruhe CSNET node and, in addition to further distribution, Michael devoted his time to improving the user interface as well as the documentation.

In parallel with this, preparations were already underway for the third CASCO symposium of 7-11 Sept. 1987 in Beijing. We were planning for the period from 1 to 25 Sept 1987 including visits to other universities at Chengdu and Wuhan. This time the Chinese side had designated computer networks as the most important topic of the conference, and I had the honour of delivering the opening lecture on the subject of “Computer networks – Current state and development trends.”

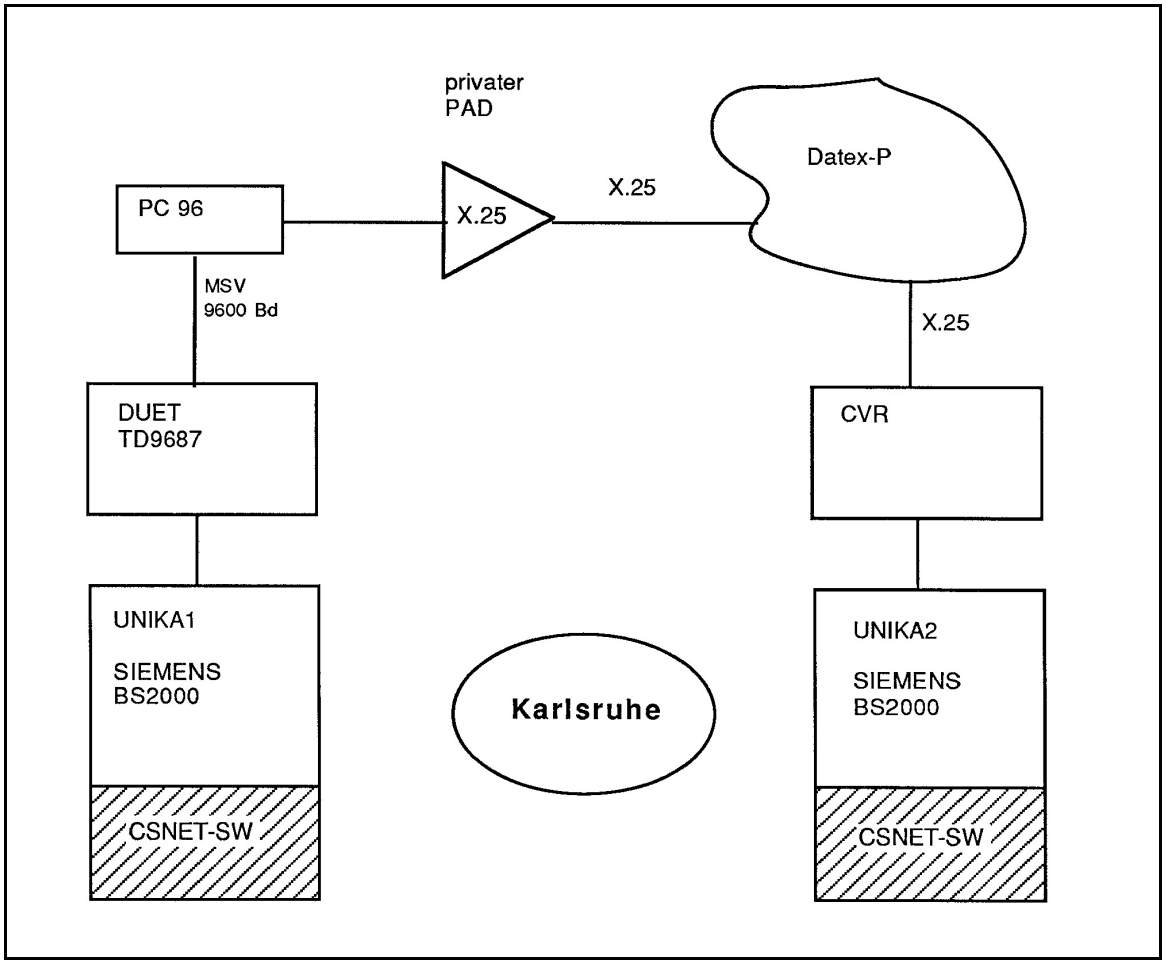
As a replacement for Hans Lackner for support on the subject of networks, this time I had recruited Stephan Paulisch, one of the leading developers of our local area network, LINK. With the hectic pace of preparations for the lecture and conference, the computer interconnection with China project almost sank into oblivion, particularly since there was no news from the Chinese side on the matter of procuring a VAX. With the general count down though, we once again considered what we might still possibly do to advance the project. The idea arose of bringing our BS2000 implementation into play on this trip.

Of course we were once again faced with the tricky problem of deploying American technology in China. Michael reassured me by explaining that in the meantime he had reimplemented the major part of the CSNET software, so that very little remained of the original. But still on the 19 August, in the evening I enquired with Prof. Lawrence Landweber (network name “Larry”) at the University of Wisconsin, who within CSNET was responsible for the international partners as to what his view would be if we were to take our BS2000 version with us to Beijing for a test installation. I pointed out that undoubtedly several months would pass before a computer

linkup could be expected. Larry's view on this was totally positive and already by early morning on 20 August I had his OK both to take along our software and to attempt an experimental trial operation between Beijing and Karlsruhe! It even emerged immediately thereafter that even on the American side a pronounced interest existed in a computer linkup to China.

The matter was now imparted with some drive. Within 24 hours Michael was enlisted to accompany us on the trip to China if he wanted to (which he did). A project plan was drawn up. The Chinese partners were notified. A plane ticket was obtained, his passport sent to the Chinese embassy. A list of the required hardware and software components was drawn up. And the local test field for simulation of the Chinese environment in Karlsruhe was defined (Figure 2).

Fig. 2. Local test configuration to simulate the China link



With the support of Gerd Wacker, who later held a position in Karlsruhe, Michael Finken needed at least half a week to get the test configuration running. After that it seemed clear what it would need to look like but it was unclear what else we would still need locally:

Line monitor
PROM programmer
PASCAL compiler
Run-time system
Latest PDN version

and more besides.

We decided (mindful of the DM 2100, previously paid for excess baggage) to only take the most necessary items with us, i.e., the CSNET- BS2000 software and protocol converter PC96 each with two spare versions, in case something should go wrong during the flight or security checks. Everything was finally ready on the first of September and after a stopover in Bangkok we touched down in Beijing on Thursday 3 September.

On Friday 4 September the first journey after the welcome ceremony led us to the ICA. To begin with, we set up the X.25 link to Karlsruhe and reported our arrival in Beijing. After this Michael loaded the software, whereby it turned out that one of the tapes had in fact suffered damage.

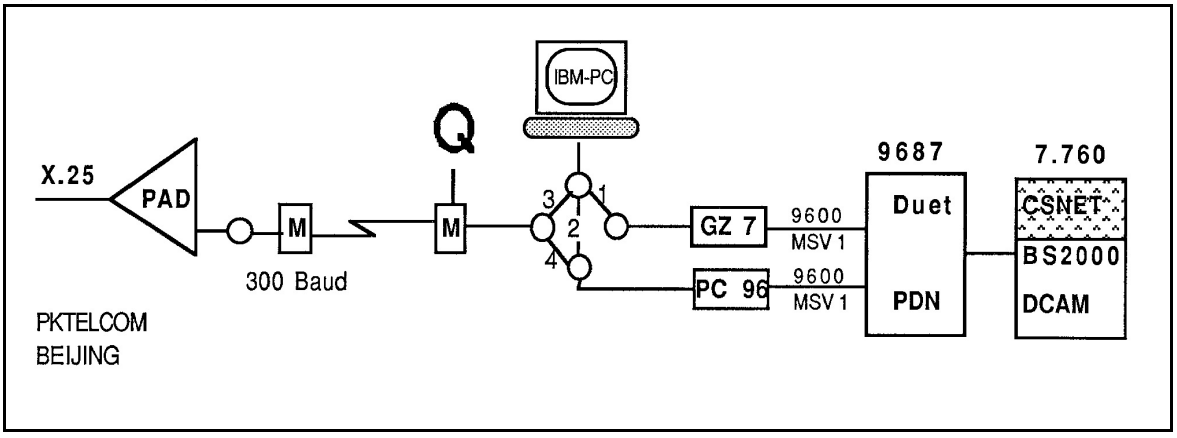
The most important data is listed below in the form of a journal starting on 4 Sept. 1987:

Friday, 4.9.

12.00 Installation CSNET software on
Siemens 7.760 in the ICA.
Local CSNET mail ran!

After this initial success though, it took a further three tough weeks of day and night working (virtually round-the-clock) until the mail also ran via the computer linkup. For a better understanding of the subsequent trials please refer to Fig. 3 which explains the configuration used.

Fig: 3. Test configuration at the ICA



The four switch positions in the connecting field have the following meaning:

1. IBM PC is connected as a local terminal via the protocol converter PC96 (brought over from Germany) to a 9600-baud MSV1 line on the DUET (planned).
2. As under 1, but here the connection is via a Chinese GZ7 protocol converter (an ICA in-house development – worked already).
3. The IBM PC is connected to the PTT PAD and via this, e.g., in REMOTE DIALOGUE to one of the computer systems in the LINK (worked already).
4. The Siemens system is connected via the PC96 to the PTT PAD in Beijing and via this by computer linkup to the Siemens-HOST in Karlsruhe (planned).

We tested the various connection variants and found to our shock that the PTT PAD required a speed transformation from 9600-baud to 300-baud, whilst our PC 96 was generated at both ends with 9600-baud. Although we did ask for the essential technical data by sending a further mail to the ICA before our departure, that message remained laying unread in Karlsruhe.

It now felt like we were wandering in the desert with sufficient food but no can-opener; you see the PC96's software is stored in EPROM but of course we had neither the sources nor a PROM

programmer with us, and unfortunately the PC96 did not have a DIP switch for baud rate settings. What could we do?

The problem of not having a PROM programmer was quickly resolved since the ICA (which incidentally is also very well equipped in other things), had one, and furthermore the correct one. First a patch had to be made to modify the speed to 300-baud. We sent the problem by mail to Karlsruhe and in the meantime turned to the working connection 2 to the Chinese protocol converter.

Friday, 4.9.

16.00 Attempt to output an e-mail on the IBM PC
Result: DCAM-ERROR!!

The cause was quickly isolated: the ICA is still running BS2000 version 7.1 and a corresponding old version of DCM, whereas our software runs on 7.5 and was developed under DCM version 8. Therefore, recompile! For this though, the source modules for the assembler routines, which implement the access to DCAM, need to be fetched from a library, which in turn was created with FMS (BS2000 File Management System).

But the ICA does not have FMS. Where in Beijing could FMS be got hold of? Idea: the Siemens branch office must in fact have it. Phone call to Siemens. Bernd Grüther agreed to provide support, with the technician to bring it along on Monday. That's as far as we can go – for the moment.

Friday, 4.9.

Evening: Welcoming of the delegation in the People's Hall by Minister Zhao Jia Hua, (who even mentioned our project personally).

Saturday, 5.9. Visit to the Great Wall

Sunday, 6.9. Visit to the Mao Mausoleum, meet-up with the interpreters for the purposes of discussing the lectures.

Monday, 7.9.

9.00 Opening of the 3rd CASCO symposium. Main lecture "Computer networks – Current state and development trends."

16.00- 17.00 Attempt to reach Siemens by telephone

17.15 Siemens has FMS

18.00- 19.00 Fetch and load FMS
Message: EDT failed!!
Remedy: Build an EDT dummy and insert underneath.

20.00 Recompilation: CSNET run-time system
OK. Output of text on IBM PC via GZ7.
Text appears on the screen, entries from the IBM-PC though do not arrive!
Recollection: PC96 is generated in the PDN with a different terminal type than GZ7. Mail software is adjusted to the PC96. Consequently, the first 15 characters are discarded when inputting.
Problem: To change this, the CSNET software would need to be recompiled with PASCAL. ICA however does not have a PASCAL compiler!
Idea: Patch the object module by overwriting the "15".
Patching the object code is easier said than done. The CSNET software is several 100-Kbytes long and contains a lot of binary code "15". However this was the only option in this situation. We set about it and after 20 minutes had the correct "15". Using PAM a "3" was overlaid and a new attempt started.

Monday, 7.9.

21.00 Text entered arrives correctly.
Next problem: on outputting, an unwanted "@" is appended as the station-specific message header.

To suppress the @ we again had to delve into the binary code. This time it was more complicated because the Pascal compiler's optimisation had been applied at this point. The length of the message header "@" was exactly ONE, a value that the Pascal run-time system always keeps in a register. Consequently, at this point the content of a register was written to memory instead of the constant 1. Pondering, poring over the machine description … then the idea; search back through the code to see whether a register is loaded with 0, and then swap the register numbers in the corresponding command. We are in luck and find such a register 10 commands further on.

Monday, 7.9.

22.00 New trial: Input works, REP is ok.
New problem: It does not go any further. The mail protocol is stuck!

23.00 Action taken: We insert a LlNE MONITOR in the line and observe an incredible amount of TRAFFIC between GZ7 and DUET.

24.00 Assumption: V.24 problem???
Idea: Check the signals. (A Chinese colleague comments with a glance at the clock: "The Germans are impossible"). We want to continue but somehow the right cable for the tester is missing and we decide to break off and resume again the following morning.

The problem at midnight was simply that once again the ICA is without power on Tuesdays. Although director Li had already got in touch with the municipal works department to obtain special treatment in our case, this was by no means guaranteed.

Tuesday, 8.9.

9.00-17.00 Lectures, separate parallel session on "E-mail and other services in local area networks," demonstration of local mail.

17.30 Testing of V.24 signals with and without a null-modem, V.24 is OK.

20.45 Cause of the incredible TRAFFIC found:
The GZ7 protocol converter's transmission also includes the TRANSDATA HEADER which upsets the NET/ONE in Karlsruhe.

21.30 Message from Karlsruhe: to set a speed of 300-baud, the contents of address hex "349" must be changed from 0C to 5C.
At last!!

22.30 Finish for the day because the change cannot be made until the following Monday.

On Wednesday a project meeting was held with vice-president Yang, where, upon our recommendation, it was at last decided that the Chinese side should for the first time attend the International Academic Networkshop in Princeton, N.J. on 9 and 10 November 1987, and also hold a networking conference in spring 1988 in Beijing. Invitations to this should include Prof. Landweber, University of Wisconsin, Prof. Farber, University of Delaware (both CSNET) and Dr. Dennis Jennings, University College Dublin (EARN). Immediately after the meeting I sent off the appropriate invitations by mail.

Wednesday, 9.9.

Morning: ICA burns-in a new PROM for PC96

Afternoon:	PC96 is connected. Does not run!!! Symptom: PC96 is not polled by DUET, whereas GZ7 operates perfectly. Ideas: Check the PDN generation, V.24 signals synchronous/asynchronous, check buffer 9603 hardware-wise.

By reference to the hardware manuals, the head of the ICA team, Mrs. Qiu, determines that the DUET requires a correction in the WIRE WRAP on pin 83, which supplies the clock pulse for asynchronous buffers. She promises the change will be made by the following morning.

Thursday, 10.9.

8.30- 11.00	PC96 is still not running, although the WIRE WRAP and V.24 are OK. We are being slowly driven to despair. Neither does OSI help things along. We just don't know on which ISO layer the error might be hidden!
11.00	Power failure, ICA switches over to the emergency supply (UPS) with which the 7.760 runs for about a further ten minutes.
13.00	DUET runs STAND ALONE until an UPS alarm emphatically demands a total shutdown. Idea: Have the 9603 buffer checked by Siemens. Call to Siemens. Technicians are there but have a huge workload, we should go there and explain the problem.
17.00	Trip into the CITIC building to Siemens. Messrs. Fleischmann and Schneider are both extremely familiar with the buffers. We persuade Mr. Schneider to come with us to the ICA and take a look immediately thereafter.
18.00	Nobody is in the ICA and the power is off because a reception is taking place in the Friendship Hotel. On top of that, our own one. We give up!

Friday, 11.9.

8.30- 11.00	Concluding lectures, ending of the conference, Mr. Fleischmann from Siemens is meanwhile testing the buffer (with all tricks), repairs the timing, generates the PDN anew. Line is polled. At last!
12.00	Messages from Wisconsin, Delaware and Dublin. Prof. Landweber, Prof. Farber and Dennis Jennings all accept for spring 1988. Great!
13.45	PC96 runs!! Data can be input via the IBM PC and the CSNET script simulated. Wow!
14.00	We plug together the cables between China (DUET) and Germany (PTT PAD) for the first time (connection option no. 4 – see Fig. 3 above) and wait for the PAD message: "WELCOME IN BEIJING." Nothing, instead we get ERROR!
14.00- 18.00	We check out all of the options (see Fig. 3): - IBM PC via PC96 to Siemens runs (1) - IBM PC via PAD with Karlsruhe runs (3) -Siemens with PAD via PC96 returns ERROR (4) LINE MONITOR shows: PC96 generates in direction DUET a string of ??? Mail query in Karlsruhe: when can that happen? Laconic reply: if PC96 receives invalid characters. In the middle of our work we are obliged to break the work off in order to participate at a Siemens reception in the Park Restaurant.
22.00	Return to the ICA. The team in Karlsruhe, comprising Michael Rotert and

Gerd Wacker, is on line, which allows us to hold a direct terminal-to-terminal dialogue.
Back to the ???-Problem: possible reasons are poor signals and PARITY errors.
Idea: PARITY definition between PC96/Siemens and PTT PAD is incorrect.
Test: We alter the PARITY on the IBM PC and the PC96 actually generates the ??? Great!

3.00 Now we want to know from Karlsruhe how one alters the PARITY parameter in PC96; the same problem as with the 300-baud, except that until Sunday afternoon we only have one and ½ days left before our flight leaves. The Karlsruhe team doesn't know either where patching is to be done. Perhaps Hans Lackner, sitting at home unsuspectingly having his tea, will know the answer. We speak imploringly and with all our powers of persuasion that he should be called in, when finally the message arrives; he is on his way and seeking the location.
In the meantime we are trying to find out the PKTELCOM PAD parameter for PARITY. It also answers nicely to the param command with a column of numbers of 15 x 2 values, but who keeps them individually in their head? Fortunately, the ICA still has a copy of the MICOM PAD manual that I brought over the previous year. We check the parameters and set the relevant ones to HOST-HOST communication. We send the lot through to Karlsruhe again, who also believe the parameters must be OK.
Hard luck in this was just that; the critical PAD parameters that define the PARITY bits (7/8 EVEN/ODD/NO) lie from 101 upwards and are not standardised internationally. For that reason we really ought not have been angry with the PKTELCOM PAD since it ignored our 101 parameter entries, which it was fully entitled to do. Nevertheless, we were angry and decided to complain or make enquiries the following morning at the Beijing PTT.

4.00 Message from Karlsruhe: the PATCH is there, we are to alter cell 'X348' from "FA" to "CA" or "EA". Eureka!! Feelings of extreme gratitude emerge. We enquire further as to what the individual bits signify and are sent a partial list of assignments.

4.30 The Karlsruhe team is now applying pres-
sure; we are to insert the patch and test. But now we were slowly beginning to show effect and in doing so made an interesting observation; in the computer centre at 5 o'clock in the morning the skin colour of Europeans and Chinese becomes increasingly similar and meets up in a pale shade of green. All those involved were also of the same frame of mind and we explained to the Karlsruhe team at the other end of the line that we simply could not do anymore and would continue in the morning.

Saturday, 12.9.

11.00 Again in the ICA, Mrs. Qiu and the others had indeed tried again during the night to alter the PROM, but the PROM programmer was faulty.

12.00 Director Li decides to buy a new one and sends an employee to the nearest computer store with a cheque (which incidentally would not be that simple

at a German university)!

13.00 We meanwhile place bets as to the PARITY setting that will make it work. In the ICA we find the INTEL manual, which gives an exact description of the control words for the I/O module in the PC96.

14.00 Patched PROMs ready, installation, tests, result: ??? ... as previously. We are ready to freak out.

18.00 Systematic checking through all combinations of PARITY – nothing! Even now ??? ...

18.00-22.00 Evening meal and discussion of the situation with Prof. Wang. The others think we should break off and quietly give the matter some thought in Germany and then start up again in October or November. I say that we want to find out now and make a final attempt at it this very evening.

22.00 Execution of a series of tests to determine whether the ??? ... problem is determinate or indeterminate. Selection of all possible combinations of PAD and IBM PC parameters.
Result: Problem appears to be deterministic.

2.00 Everything stops working, even the local connection of the IBM PC to the Siemens no longer works.

2.30 An absolute low point!
Recollection of yin and yang (see Fig. 4).

Yü Hiung spoke: "The cycle is never ending. Who though notices the hidden changes of the heaven and earth? For when things get less on one side they increase on the other, when they become full here they reduce there."

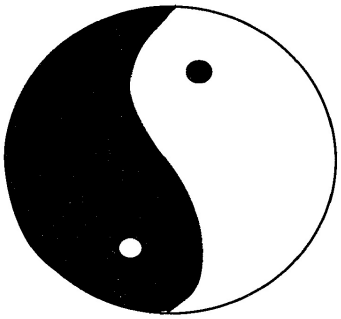


Fig. 4. Yin and Yang

"Decrease and increase, completion and reduction are constantly being generated and ceasing, their arrival and departure are linked to one another by invisible transitions. Who indeed notices? Everywhere a force does not suddenly increase, a shape does not suddenly reduce, which is why one does not notice their completion or decline. It is the same as with people, who from birth until old age change daily in external appearance and in the level of their knowledge; skin, nails and hair are continuously being generated and fall off. Nothing remains stationary at the level of childhood without change. The transitions are imperceptible; one only notices them afterwards. Yin and yang gave us the certainty that, after a low point, things could only get better and this was the case."

2.35 Stephan Paulisch had the idea of trying to set up the connection to Karlsruhe manually, i.e., using the IBM PC to set up the connection to the Siemens in Karlsruhe and to then manually replug to the Siemens in the ICA. We decide to make this last attempt and, in fact:

2.45 The first correct characters arrive from Karlsruhe!!! Hooray!!
The reason: both Siemens systems work with the same character

representation, whereby the PAD parameters are set such from the Karlsruhe side that the characters pass through correctly.

3.00 Discussion of the situation and assessment; with the improvised solution of manual connection setup via the IBM PC it is possible to test the CSNET link as regards software.

5.00 Individual discussion in the Friendship Hotel

I take Michael Finken to one side to ask him whether he could not stay on in Beijing alone to complete the work, for the rest concerned primarily his software. Good-natured and motivated as he was, he also agreed straight away! To be fair, it should be said that in Germany I had already prepared him for this possibility. Nevertheless, I think highly of him for his spontaneous agreement because, after all, he had let himself in for a solo adventure and sacrificed the no doubt delightful Yangtze river trip, which had already been booked for him and paid for.

Sunday, 13.9.

11.00 Closing discussion in the ICA

Announcement: Michael Finken is to stay on until things are running! Our ICA friends are very happy for they were just as committed to success as we were. Optimistic as we were, we set up a greeting message to be sent all over the world in the event that the system worked. "Across the Great Wall we can reach all corners of the world" (see Fig. 6).

Fig. 6. First Electronic Mail from China 20 Sept. 1987 (the messages to Zorn and Finken were sent to provide copies in their German mail boxes).

```
Received: from Peking by unika1; Sun, 20 Sep 87 16:55 (MET dst)
Date: Mon, 14 Sep 87 21:07 China Time
From: Mail Administration for China <MAIL@ze1>
To: Zorn@germany, Rotert@germany, Wacker@germany, Finken@unika1
CC: lhl@parmesan.wisc.edu, farber@udel.edu,
jennings%irlean.bitnet@germany, cic%relay.cs.net@germany, Wang@ze1,
RZLI@ze1
Subject: First Electronic Mail from China to Germany

 "Ueber die Grosse Mauer erreichen wir alle Ecken der Welt "
 "Across the Great Wall we can reach every corner in the world "

Dies ist die erste ELECTRONIC MAIL, die von China aus ueber Rechnerkopplung
in die internationalen Wissenschaft snetze geschickt wird.

This is the first ELECTRONIC MAIL supposed to be sent from China into the
international scientific networks via computer interconnection between
Beijing and Karlsruhe, West Germany (using CSNET/PMDF BS2000 Version).
University of Karlsruhe  Institute for Computer
- Informatik             Application of State
Rechnerabteilung -       Commission of Machine  Industry
      (IRA)                        (ICA)
Prof. Dr. Werner Zorn          Prof. Wang Yuen Fung
Michael Finken                 Dr. Li Cheng Chiung
Stephan Paulisch               Qui Lei Nan
Michael Rotert                 Ruan Ren Cheng
Gerhard Wacker                 Wei Bao Xian
Hans Lackner                   Zhu Jiang
                               Zhao Li Hua
```

Further mail to Michael Rotert and Gerd Wacker in Karlsruhe, who authorised this, to do everything conceivably necessary to give optimum support to Michael Finken in Beijing.

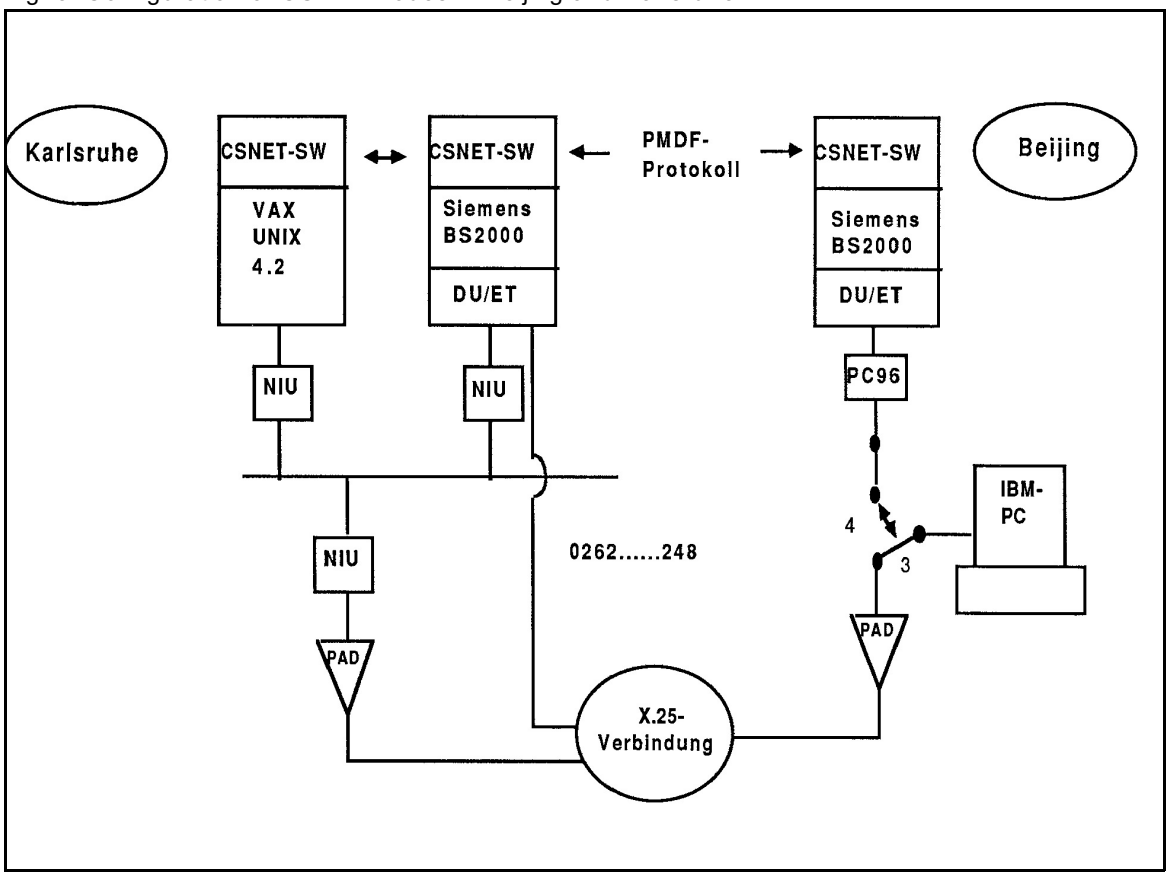
14.00 Departure from the Friendship Hotel

16.00 Departing flight to Chengdu, in Sichuan province

I picked up the further continuation of the work by telephone when traveling (which in some cases was not very easy), which means that I too can now only report by "View from the wall:" – to resolve the tiresome ??? problem called for a further patch in the PC96, which Roland Stoffel quietly discovered and passed on to Beijing.

The solution to a further fundamental problem though was still to come; the CSNET mailers were hung in DEADLOCK!!! The reason: an error in the PMDF standard protocol. This error was later reported to the CIC (CSNET Information Centre) and confirmed by them. Many years previously this problem had occurred when telephone connections were very bad, but had not been rectified at the time, and, because line quality had improved, the problem had cleared itself.

Fig. 5. Configuration of CSNET nodes in Beijing and Karlsruhe



In our case nothing cleared up just by itself, which meant Michael Finken (in Beijing) working together with Gerd Wacker (in Karlsruhe) was obliged to develop and implement a special protocol extension that dealt reliably with further error cases. This called for a further week of hard day-and-night work, with the hindrance of power outages and still the lack of a PASCAL compiler. On top of this, there was the time difference and the fact that the foreign language institute in which Michael was staying, locked up at midnight, which meant he sometimes had to kip down in the ICA (on a bamboo mat). Finally though, the moment had at last arrived.

Waiting for correct characters from Karlsruhe.

Sunday, 20.9.
23.55

The prepared first mail is transferred correctly to Karlsruhe and from there to further networks. The good news reached me in Macao, where we drafted a press release the same evening. This was telexed to director Li and from there and disseminated throughout the world via the official Chinese news agency, Xinhua (See Fig. 7).

Fig. 7. Press release in the *China Daily* of 25 Sept. 1987

"Computer links are developed"

"China can now have computer links with more than 10,000 scientific research institutes, universities and computer manufacturers around the world.

The link using two Siemens computers in Beijing and Karlsruhe, Federal Republic of Germany, went into operation recently.

Prof. Wang Yunfeng, advisor on electronics information and technology for the State Science and Technology Commission, described the development as a technical breakthrough concerning the integration of China's universities and research institutes with the worldwide computer network. The link, he said, was successfully established by an expert team under the direction of Professor Werner Zorn of the University of Karlsruhe. The team included scientists from the Beijing Institute for Computer application, the University of Karlsruhe, Siemens, and CSNET of the United States" (Xinhua).

The remaining time, until departure on 25 Sept. for Hong Kong and from there back to Germany with the entire group, was utilised by Michael to stabilise the software, install the administration and set up mail accounts, create the documentation and give instruction to the operating staff at ICA.

Friday, 25.9.

11.00 Arrival of Michael in Hong Kong with the *China Daily* of the same day (which is never available in Hong Kong until the next day) and our press release.

20.00 Return flight to Germany with the delegation

Despite the joy of a successful mission, after our return the worrying question was whether the link would continue to work without our local support. We monitored our X.25 inputs continuously: nothing! Then finally on October 8 the ICA node signed on again, whereby in hindsight there was a simple explanation for the broadcasting silence.

October 1 is a national holiday in China, which many Chinese use to take a well-earned short break and this included our friends at the ICA. After their return the link continued to work without any problems and subsequently rendered useful services, including finding a solution to further problems still quite unresolved:

1. Official American agreement to the linkup with China.
2. Participation of China in the International Academic Networkshop in Princeton (9,10 Nov 1987) with admission into the networking community.
3. Propagation of services inside and outside of China with the goal of building China's own internal computer network.

As is known, we had received merely the OK from CSNET for an experimental test link but not yet the final approval. However, on account of the technical status now achieved, Dave Farber and Larry Landweber immediately put every effort into obtaining official agreement on the part of the American NSF (National Science Foundation) responsible for this.

It was a fine prelude to the Princeton meeting that Prof. Farber (CSNET) was able to hand over the official NSF letter of approval to vice-president Yang, head of the three-man Chinese delegation (see Fig. 8).

Fig. 8. Text of the official NSF letter of approval

NATIONAL SCIENCE FOUNDATION

WASHINGTON, D.C. 20550

Division of Networking and Communications Research and Infrastructure

Professor David Farber,
Chairman
CSNET
Executive Committee

Mr. Ira Fuchs,
Chairman
BITNET
Executive Committee

Gentlemen:
The extension of BITNET and CSNET electronic mail to China is a natural enlargement of the telephone and postal services that will increase the possibilities for collaboration among U.S. and Chinese research scientists. I welcome this move witch your organization has made.

Sincerely,

<signature>
Stephen S. Wolff
Division Director
November 8, 1987

Thus, approval is given not just for our CSNET link but equally for further planned linkups with China within BITNET.

In response to the press release sent right around the world, we learned that other groups were also working intensely to achieve a network link with China.

A project under the overall control of George Kemper and Jaan Laane of the Texas A & M University was running with the working title; **CHINANET - BITNET** to connect 17 Chinese universities to BITNET with a planned start of operation for the Transpacific link of 1 Oct. 1987!

The Chinanet project group immediately started a computer search by e-mail for a professor "Tso-en," who is said to have achieved the linkup using a "Xi men Xi" computer, and soon made a find. Since then there has been increasingly flourishing communication with many interesting and interested partners, which proves once again that computer networks do not alienate the people of the world but bring them closer to one another.

This article is a translation of the original publication:
Zorn, Werner: *"Wie China mit den internationalen Rechnernetzen verbunden wurde"* in "PIK-Praxis der Informationsverarbeitung und Kommunikation." 11 Jahrgang 1988, Heft 1, S. 22–29
http://www-ks.hpi.uni-potsdam.de/index.php?id=36

Annex:

1988 Start of CANET

28.-30.03.1988 CANET- Chinese Academic Network launched at ICA/Beijing in presence of Daniel Karrenberg (RIPE), Dr. Dennis Jennings (EARN) and Prof. Werner Zorn (Karlsruhe University)

1990 Registration of .CN Domain

9.10. Prof. Yunfeng Wang (ICA/Beijing) meets Prof. Zorn at Karlsruhe University in Germany. They discuss further possibilities to support networking in China in general and CANET particularly. (E-mail – Prof. Zorn to Qian Tian Bai)

18.10. Prof. Zorn sends a pre request for “CN” to the Internet NIC (cc E-mail – Prof. Zorn to Qian Tian Bai on Oct. 24).

03.11. CANET/ICA highly welcomes this initiative and asks for technical support during the migration phase toward DNS (E-mail – Qian Tian Bai to Prof. Zorn).

26.11. Prof. Zorn officially applies for registration of the Chinese Top Level Domain CN at the Internet NIC. Primary Domain Name Server for CN is:
IRAUN1.IRA.UKA.DE
International Secondary Domain Servers for CN are:
MCSUN.EU.NET and **UUNET.EE.NET**
(E-mail – Prof. Zorn to Qian Tian Bai on Dec. 02, as well as the E-mail answer from Qian Tian Bai to Prof. Zorn on Dec. 03).

2.12. First usage of the newly registered :
TLD “CN” (E-mail – Arnold Nipper/Xlink to Prof. Zorn on Dec. 03).

1991

03.01. – 19.01.: Prof. Zorn sends an expert team from Karlsruhe University to ICA/ Beijing, consisting of Michael Rotert, Gerd Wacker and Nikolaus von der Lancken. Rotert implements the local DNS service together with the newest CSNET/PMDF-software on the VAX at ICA, Wacker and von der Lancken install LAN-components and the Dial-In Server.

01/1991- 05/1994

Karlsruhe University runs the CN Primary DNS until this service was taken over completely by the Chinese side (CNNIC), thanks to a direct link between China and the USA, which allows the provision of full Internet services.

(The emails are all still available from Prof. Zorn).