

History of fault-tolerant computing in Europe

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In the beginning I want to thank the program committee for the honor to have been selected as a dinner speaker. In fact, I was impressed by the expectation of the place selected which I knew well from an earlier visit of the Old City of Prague. It is one of the historic sites telling us a lot on former times handed over to our generation by tradition and worth to be reflected again at an occasion like this one.

My talk will consist of two parts after this short introduction: a description of the history of this building and the people to whom it is related, and finally a reference to the title of the presentation which I shall keep short due to the lack of visual support.

Bethlehem Chapel

A few facts about Bethlehem chapel. It was built in 1391 by a rich Prague business man, Johann von Mühlheim, certainly a German sounding name, but presented with the condition, that sermons should be held only in Czech language such that the less educated population could understand the meaning and the goal of the service. This was new, since the Roman Church used Latin as a basic language for all the liturgy until just recently.

It is not the original building which we see around us, but rather a reconstruction of 1950 to 1952 which however preserves quite a lot of its original shape and spirit. Therefore, we can congratulate the Prague Technical University to have acquired it for occasions like today. The original building had been handed over to the Jesuites after the catholic restitution in the 17th century and was completely demolished in 1786 when Emperor Joseph II. had abandoned the monasteries and church property as part of his reforms.

Those of you who have visited Golden Prague and have a certain interest into the background of what everybody can see as a tourist will know that it was in the 14th century when this city experienced a first climax in general importance: Charles IV. of the princes and dukes of Luxemburg had succeeded his father as king of Bohemia and had also been elected as the German King and the Holy Roman Emperor, the most important and highest rank which could be obtained politically at those late medieval times. He chose the name as a political program after he had been baptized as Vaclav in honor of his grandfather: as his famous predecessor Charles the Great almost 6 centuries before he wanted to modernize the empire picking up ideas of antiquity again which should become famous and well accepted by all the leading personalities in the years to follow

which we subsume today by the renaissance period. He founded here in Prague in 1348 the first central European university which turned out immediately as an illustrious example of how to improve science and literacy, arts and religion and was copied almost everywhere. Vienna, Heidelberg, Cologne, Erfurt, Krakau were to follow within one generation.

As I mentioned before, there was still only one common language used in the spiritual world, namely Latin, and the pope with the common (catholic) church was accepted everywhere as the authority to decree privileges, namely the one to found a university. But dispute and quarrel were soon to come: humans were and are never content with the state of living and fortune they have achieved. In particular if government is weak, corruption and struggle for influence and power are pursued everywhere, hence the younger generation creates and supports their own leading personalities. They express new ideas and goals, highlight the faults of those in power, preach new aims and concepts of life, blame developments which must be changed. This very situation which is also characteristic for our imminent turn of the century happened during the reign of Vaclav IV, emperor Charles's successor who was in charge of the Bohemian state for more than 40 years after 1378, but lacked the royal necessities to impress by his personality: he was rather weak, changing goals and attitudes frequently making quite contradictory decisions. In those traditional times he was nevertheless elected as the German King but instead to prepare for the coronation voyage to Rome to be crowned as emperor he hesitated, postponed the plan again and again. Finally the prince electors in Germany complained about his immobility and laziness and drove him off the throne in 1400. Of course he refused this decision, declared it illegal, but he had lost the power and his brother Sigismund was to follow him later long before he died.

It was in Vaclav's time this chapel was built as a place incorporating the new spirit of religious reform, where young people could preach to the city public in their own Czech language, no more in Latin which was reserved to the educated, or German which was spoken by the rich city merchants, who had been invited to come to Prague and do their business here, mostly trade and skilled craftsmanship, privileged by low taxation and chances to obtain soil property, conceived to trigger and improve economy and give opportunities for everybody. This was the medieval colonisation of western Europeans toward the east, extending their territories by the development of newly founded cities and cultivating the country-side more economically, assimilating at the same time the local illiterate mostly Slavic population, teaching to them western knowledge and religion. But the Czech speaking population was too numerous or resistant to be assimilated like the other people around: Austria, Saxonia, Silesia, the Czechs preserved their national character because the priests of this chapel had a vision: do away with the miserable life of the poor who will not be able to share the part of the rich because of their birth, strive for a new goal of life, try to erect a new Jerusalem, a new responsible Christian life different from the one the church is offering, looking for the simple life Jesus has experienced, commemorate his suffering for all of us by changing the

cult, offering the Lord's supper in both forms: not only bread but also wine for body and blood as well to everybody in the congregation during divine services. This is the form protestants are used to still today and we all know that it was Martin Luther who reformed the church which split over these ideas after 1517 because the conservative clergy did not want to accept reforms. However, it was Jan Hus about a century before who tried for the first time to give ideas on how to change the bad habits which had become popular, mostly the corruption by money and property which the church should not possess if it is really implementing the ideals of Jesus. Hus was appointed chapel preacher in 1402, but he also belonged to the university faculty.

I cannot go into details here. Of course, Jan Hus was not the first to publish such ideas nor was he the revolutionary whose main goal consists in throwing over government and state organisation. But everybody will remember, that he was given safe-conduct to come to Constance to present and defend his ideas at the big church meeting, the concilium, which was in charge of the foundations of religious belief. Unfortunately the clergy did not want to discuss deviations from the main stream. Today it is very difficult for us to understand why: it was then obvious for everybody that reforms are inevitable, because since two generations already the Great Schisma divided Europe. There were two popes banning each other, one in Avignon in France, the other in Rome. But what had the concilium in Pisa done in 1409? It had expelled both and elected a third pope! Of course the other two did not resign, hence there were now three popes in office. How could they treat the issue of spiritual reforms of Wyclif and Hus under these circumstances? There was only one way to end the dispute: set an example and condemn the deviation as heresy. So Hus was asked to declare his ideas as wrong, being erroneous, to renounce his writings which he refused. He knew the consequences, that he had to expect death punishment for his refusal. Did he hope that the emperor will keep his promise of safe-conduct and prevent his execution? Maybe, but in vane: on July 6, 1415, Hus was executed at the stake and Hieronymus of Prague, his friend and colleague as well shortly later.

As we know today, this was a very poor decision of those in power: you never can prevent new ideas from becoming known to everybody, by killing the inventor you only create a martyr thus enlarging the problem. This exactly happened in Hus's case: soon there was uprisal in Prague, for the first time dignitaries were dumped out of the window (of the New City's City Hall in 1419), king Vaclav IV. died just during these days leaving a mess behind. The Hussite wars started soon, not only in Bohemia, but for a decade also in the neighbouring territories like Lausatia and Brandenburg which then belonged to the Luxemburgian dynasty, the second largest next to Habsburg which was to succeed it later. I remember these things from school as a little boy in Berlin, in particular a torture chamber in a historic prison: it was the same Constance concilium by which the princes of Hohenzollern, then only viscounts of the imperial castle at Nuremberg, obtained the fief of a margrave of Brandenburg, thus becoming one of the 7 prince electors and

later the founders of the Prussian state selecting Berlin as its capital already in the 15th century. The Germans will remember these facts because they celebrate currently the retransfer of their government to their original capital.

I shall stop here my remarks on general history, although much more could be said on relations between the Czech developments and their relation to Europe. But I now have to address the announced subject of my talk and a more recent time period which we all still remember, namely the

Roots of fault-tolerant computing in Europe.

Rather than discussing the development in Europe as a whole it will be necessary to describe what has happened in her different countries. This approach is also supported by the fact that 40 years ago we still lived in a completely different environment as far as internationalism is concerned. Yes, there were foreign visitors at large conferences who wanted to learn what is going on in different countries, but certainly at a much lower scale than today. It was possible to obtain the conference proceedings of the events taking place abroad and also a small number of people interested participated, especially at the International Symposium on fault-tolerant computing. This was the yearly event in the field since 1971. Since it was conceived to be international it was soon organized outside the USA namely 1975 in Paris for the first time, followed 1978 in Toulouse, 1983 in Milan, 1986 in Vienna, 1993 again in Toulouse, 1998 in Munich. But were there other activities in Europe?

It will be quite interesting to find out what really happened locally everywhere, but here I can only present a few remarks, mostly determined by a very personal preoccupation: by far I could not know in those days what happened everywhere. It is the field of reliability engineering which was one of the forefathers of fault-tolerance, fault diagnosis being another one. There existed whole conference series in those early ages of computing, not only in USA with reliability and maintainability and also reliability physics as specialized areas, but also in Germany. Here the engineering societies in charge, namely NTG (later ITG), VDE and VDI supported a series of German language conferences on technical reliability since 1961 in Nuremberg, later Munich on a biannual basis. Fault tolerance in those days was just a side track reserved to specialists. The main reason were the high costs for redundancy: a duplication or even triplication of equipment for simple channel checking or majority voting was out of question for most applications. Germany then was lacking the incentives of space exploration or even an aviation program supported by public funding like in USA or France. In Germany there were local events triggered by a demand to enlarge the field of interest. They originated in the professional societies or single industrial companies. I was in charge of one of those early events, a discussion meeting on reliability of computing systems organized in Karlsruhe in 1978. In retrospective it may be questionable to

include this meeting into the scope of fault tolerance, since all the contributions refer to either reliability or to maintainability, but is not still fault tolerance just one (expensive) approach to improve reliability? A similar workshop was organized by M. DalCin in 1981 in Tübingen.

It was shortly later, in 1982, when fault tolerance entered the main floor being now the title of regular conferences on fault-tolerant computing systems in correspondence to the international line of similar events. A total of five conferences were organized up to 1991 in cities like Munich, Bonn, Bremerhaven, Baden-Baden, Nuremberg, three professional societies in Western Germany circulated the organizational responsibility. We consider them to be the forerunners of the actual European Dependable Computing Conferences to which we convened here in Prague after Berlin in 1994 and Taormina in 1996. As you all know by the invitation and the program, it is considered to be the all European successor intended to interconnect the activities of those times when the continent was divided. Therefore, it will be quite interesting to look at the other roots.

I do not know very much on local activities in the western countries, Great Britain, France, Italy to name a few. I just mention the multifold activities in the field of test conferences, namely the series of semiconductor, later international test conferences originally in Cherry Hill, USA, later at changing locations. In Europe there was a series of design for test workshops since 1982 which resulted in the first European Test Conference 1989 in Paris. Now there is a kind of annual unified event in this field called DATE for design, automation, and test in Europe which was held last in 1999 in Munich. It remains as a task for historians to compile the publications as far as they are available. Of course, if there are no publications the efforts will soon be lost, that is the fate of academic or scientific activity. But I should mention something on the professional remainders in Eastern Europe to which also the eastern part of Germany belonged to. Let me start with the latter and also with the field of technical reliability I have mentioned before.

In 1991 I was in charge to organize the 16th reliability conference in Munich. It was characterized by two outstanding circumstances: it was to celebrate the 30th anniversary of a continuous effort in one important and well-known field and it was the first occasion for those living in Eastern Germany to participate personally. As you all know, this was almost impossible between 1961 and 1989, the more than 10 000 days of the Berlin Wall. To compensate for this deficiency, an eastern series of conferences had been established since 1973. The last event of those was organized in Leipzig in May 1989 under the denomination “9th Reliability Conference – Assuring Quality in Automated Production Processes”. This series was considered as belonging to those open for participation to all Comecon Countries – excluding at the same time participation from the west. This is a funny organizational frame as looked upon from academia and science, but such was politics in the Eastern Block Countries and we have learned whereto this policy was heading... Nevertheless these meetings attracted about 400 people mostly from industry, they were organized

by the (party controlled) chamber of techniques and at least the abstracts of the presentations were properly documented although maybe restricted from export to the west.

Another line to be mentioned, one more international and closer related to the scope of our conference, is the series of well documented conferences having the title FTSD (fault-tolerant systems and diagnostics). It was conceived as a counterpart to the international FTC Symposium series triggered and organised by the IEEE computer society in USA, hence it was organized by being shifted among the Eastern European countries, too. Unfortunately I had only limited access to their organizational background. But my incomplete knowledge on what was going on may be of interest and should be outlined here. They were organized annually, apparently since 1976 in Poland. Was it in Visla and was I among the participants? Yes indeed, I was very surprised by these circumstances which I had almost forgotten during the 23 years interval since then. History is a little obscured by the use of different labels in the beginning: “symposium on fault diagnosis of digital networks and fault-tolerant computing” was the long title of this first conference in Poland. A look into my souvenirs confirm: there were about 45 presentations and 52 international participants who came together in the little resort place at the origin of the Vistula river, within the mountains of southern Poland. The conference proceedings edited by A. Hlawicka contain 43 papers. I attended also the second conference which was organized by Jan Hlavicka and others here in Prague in August 1977 being called “International Conference on Technical Diagnostics”. The preface of the proceedings is purely written in Czech making no reference either to Visla nor to fault tolerance but rather to another earlier event in 1975, on the subject of “nondestructive diagnosis in industry”.

I do not have a complete record of the years to follow. However, FTSD-10 was organized in 1987 in Varna, Bulgaria, and the preface of the proceedings mentions that it marks a decade of annual meetings devoted to reliable computing. Czechoslovakia, Poland and Bulgaria were responsible for the single meetings and in 1987 authors of the papers originated from 10 different countries, not only eastern ones like Soviet Union, but also USA, France, Italy. In 1988 by FTSD-11 the GDR entered the group of organizers and held the conference in Suhl, before Czechoslovakia took over again with FTSD-12 in Prague. FTSD-13 was again in Varna in 1990. Was this the last conference before the political reforms and lack of money stopped so many professional activities? Probably.

What should we conclude from this survey of history of our field? Can we learn something important beyond the respectable number of single efforts which all seem to contribute to a common view, useful for all of us? In my eyes the most important point will be to have now a more humble, united basis for scientific competition, and competition is without doubt the most important fundament of conferences: open a competitive forum to present new ideas thus enlarging our knowledge. But we should be aware of the danger of exponential growth of knowledge: we are

slowly losing the ability to follow and comprehend what is going on, since it is more and more difficult to gain a relevant survey on the whole field. Therefore, I welcome this development of reducing just a little the dissolution of science into narrow fields of specialization: one line of EDCC-conferences shall be sufficient for Europe as a whole, if anything is needed at all next to the FTC Symposia with their world-wide attention. It is more than just a funny coincidence that the same trend can be observed in the United States: FTCS-30 next year is going to merge with DCCA-8 which stands for Dependable Computing for Critical Applications to form an International Conference on Dependable Systems and Networks in New York City. This merger also is intended to unite competing efforts in the field and concentrate their attention. As in our European case future only will show any success on what shall be important enough to form the fundamentals of our scientific work. We only can contribute our limited efforts.

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