

BRIAN EDWARD BUSHELL

Curriculum Vitae

HIGHLIGHTS

- 50 years in IT, working in senior positions on several major projects – and still going strong!
- Senior Manager on design and commissioning of Britain's first, and the world's first nationwide, commercial computer network, using packet switching and TCP/IP – forerunner of the internet.
- Specialist in technical support, particularly of computer operating systems, network software and electronic point of sale (EPOS) systems including ticketing systems
- Creation, design, programming and support for reputedly the world's biggest and most complex DOS-based PC system (until 2012, still running under a DOS emulator within Windows)
- Professionally trained in most computer system programming and design disciplines and fundamentals of accountancy. Also professionally trained in training and presentation techniques.
- Every project for which I have been responsible has been delivered on time.

EMPLOYMENT HISTORY

Please note – being unconventional, this is in chronological order. It makes more sense from the viewpoint of following something in my private life which had had an important influence of my career.

June 1962 to April 1968 - Lever Brothers, Port Sunlight (a Unilever company)

(see accompanying service record provided by Lever Brothers in 1999)

I initially spent three years in Production Planning, scheduling soap manufacturing machines. In 1965, I was entered for a computer aptitude test which I passed with the highest marks recorded (at that time) by IBM in north-west England. Transferred to computer department, where I initially programmed stock control, payroll and accountancy systems for IBM 1401 computers (Ferrite core memory, no operating system, programming in Autocoder and machine code. How they worked without an operating system is an interesting story!) In 1967 I was appointed Senior Systems Programmer, providing technical support for new IBM 360s and writing in-house utilities, macros etc in Assembler Language. Initially with IBM DOS, then MFT operating systems.

April 1968 to October 1971 - British Railways Board (BRB) Crewe

(see accompanying service record provided by BRB Records Office in 2000)

Initially Assistant Technical Manager, providing technical support to BRB's Crewe and Peterborough centres, both using ICL 1900-series computers, running Executive operating system. I was appointed Technical Manager of both centres in August 1970. Crewe, where I was based, was one of the largest centres in Britain, and was ICL's national showpiece. I spent much of the time (when not trouble-shooting!) developing in-house utilities (including the decimal currency conversion subroutines, delivered on time) and commissioning new operating systems (including GEORGE – GEneral ORGanisational Environment) etc. Programming mostly in PLAN (ICL's assembler language), sometimes COBOL (COMmon Business-Orientated Language) and occasionally in machine code. We were also ICL's 'guinea pigs' for testing pre-release versions of their latest operating systems and utility software.

October 1971 to November 1974 - British Railways Board (BRB) HQ, London

(see accompanying supplementary notes on TOPS project, and testimonial from D F Howes)

Promoted from Crewe to London to work on the TOPS project, at the time the biggest computer project ever attempted in Britain (£23m budget at 1970 costs). I was initially responsible for adaptation and enhancement of the new operating system which controlled the system (initially developed as a joint project between IBM and the Southern Pacific Railroad in the USA). Then appointed Computer Systems Controller, responsible for co-ordinating the computer side of commissioning the system throughout the UK. Under my guidance the system went 'live' on time and £2m under budget. (see supplementary TOPS notes for hardware, language and operating system details). Note: As anyone familiar with the BR internal recruitment procedure in the seventies will tell you, it was incredibly cumbersome and slow! In order to get me into the System Control post as quickly as possible, I was asked if I would take it on as an extension of my previous job title and grade, in return for a good pay rise. This I agreed to, hence it does not appear as a separate role on my service record!

November 1974 to April 1976 – Higson’s Brewery, Liverpool

(the Grapes Inn Managers’ son from this time is still alive and well – contact details available on request)

Forced to return to Merseyside due to parental divorce and paternal death, I spent a very enjoyable ‘sabbatical’ working at the Grapes Inn, Mathew Street, Liverpool City Centre. Initially a barman, I was soon promoted to Head Barman and subsequently Relief Manager. Regular stock checks by the brewery verified not only my own integrity, but my ability to ensure that other staff were behaving, too!

April 1976 to June 1977 – Control Data Corporation of America, East Barnet and Haydock, Lancs.

Senior Database Analyst based at East Barnet, developing database applications to meet various end-user requests. With mother approaching 70, I was transferred to the Haydock office to be nearer home. Here, I was mainly involved with Plessey’s, working on TXE4 telephone exchange rack wiring diagrams. All work was remotely processed in Cincinnati or Rijswijk on Cray computers running an operating system called KRONOS and System 2000 DBMS.

June 1977 to May 1980 – Morgan Guaranty Trust Co of New York, London

Programming and Training Manager for the London office of one of the biggest merchant banks in the world (now J P Morgan), working on a major new Loans and Facilities project (the bank’s first serious move into computerisation, using IBM370s running under CICS, son of TOPS!). The ‘Programming’ side of the role mainly involved hiring and firing the contract programmers and analysts for the project, with anything up to one hundred on site at any one time – and dealing with the agencies who hired them out. I left the day to day involvement and enforcement of programming standards to my extremely competent Chief Programmer. The ‘Training’ side of the role involved devising and implementing a training programme for the end users of the system. This covered everything from Computer Appreciation Courses, which all eight hundred bank staff had to attend, through Management Overviews down to detailed terminal training for the staff who would be using the system. For this, I was provided with my own purpose-built Terminal Training Room. With another project up and running on time, a change of management stopped all new system development. With mother getting older and frailer, I headed north again, dividing my time between home in Birkenhead and Wales, where I was volunteering on preserved railways (see accompanying Railway Preservation CV).

May 1980 to Date – Festiniog Railway Company (FR), Porthmadog and Other Railways

(see accompanying recent testimonial, written in 2012, from Iain Fraser, Bsc)

(see also *Railway Magazine*, August 1987)

(see also *Titan is Dead – Long Live ATLAS!* in the ‘Magazine Articles’ section of the website)

Initially, I spent three years working seasonally as guard, signaller, controller, fireman etc, not intending to stay more than three years. My mother, by now 76, had a stroke in 1983, which forced me to put her into a home in Tywyn, where she survived, despite serious Alzheimer’s, until 1998. Thanks to a change of rules by Thatcher, I was forced to sell the family home in Birkenhead (and use up most of my savings) to pay nursing home fees. With the FR deciding to venture into computerisation, I first computerised the payroll (my own program) and the accounts (Pegasus package). I then set about designing and programming a computerised ticketing and seat reservation system (christened TITAN). This went live on time for the start of the season in February 1985, giving the FR the first computerised railway booking office in Britain. I subsequently installed the system for several other railways, but deterioration in my mother’s health forced me to abandon several contracts with other railways and a ferry company, at considerable loss. Her slide into Alzheimer’s forced me to abandon virtually all computer work, but since her death, relieving me of a huge burden, I have again been firing on all cylinders! I returned to the FR to enhance the system (now re-named ATLAS) to take advantage of improvements in computer design and to provide additional facilities for the re-opening of the Welsh Highland railway – the modifications required were again delivered on time. About 2006, I was also made responsible for the railway’s EPOS systems, initially using Sharp UPS 3300, then ICR Touch. ATLAS evolved into what I am told is the biggest and most complex DOS-based system in the world. Until 2012, it was still running within Windows XP under a DOS emulator. Since I retired from the FR (but not computers!), ATLAS has been replaced by a commercial EPOS-based ticketing system with a very limited range of features by comparison. In many respects, this is a relief as it had become something of a millstone around my neck! I am therefore now free to concentrate on other work, and am open to offers!

Technical information – Programmed in good old-fashioned BASIC, TITAN initially ran on British-made Apricot 286 computers, one of the pioneers of using Sony 3.5” ‘floppy’ disks (which weren’t the least bit floppy!) and running MS-DOS. Initially each station had stand-alone computers, but Porthmadog station’s computers were networked in 1987 using

Apricot VX-Net. TITAN was subsequently transferred to fully IBM-compatible PCs, networked under Netware Lite. Data transfer from outstations to Porthmadog was by 'transfer disk', subsequently replaced by automated e-mails using an attachment processor. With the introduction of Windows, TITAN would run without modification under Windows 95, 98, NT and 2000 but nothing later (not even Microsoft Virtual PC running in Windows 98 mode) because they did not incorporate NTVDM (Windows NT Virtual DOS Machine). Fortunately, I found DOSBox, a DOS emulator capable of running under Windows XP onwards. This was specially modified to meet our requirements, by one of its Dutch creators, and ran under Windows XP (but is capable of running under all later versions of Windows). With the enhancements that led to TITAN becoming ATLAS, all stations were networked together using Hamachi VPN, much simpler to set up and easier and more flexible to use than Microsoft VPN (why Microsoft have to make everything so complicated, I do not know!!). The EPOS system with Sharp tills had a 'back office' computer linked to the tills via dial-up modems. Using ICR Touch, the EPOS tills were networked with the 'back office' computer, also using Hamachi VPN.

Other Short-Term Activities

(see also Railway Preservation CV on the website for ongoing, mostly voluntary, activities)

Sept 1961-June 1962. British Railways Port Sunlight goods office. Goods Inward Clerk. As part of the job, had to go into Lever Brothers offices daily to collect and deliver goods traffic-related documents. Liked what I saw, applied on spec, offered production planning job within 48 hours, and started a week later!

1983 Stocktaker – Various pubs and clubs in north-west Wales. Using my own stocktaking program (one of the first), I was if necessary able to do a stocktake and process the results in less than 24 hours, enabling irregularities by staff to be quickly traced.

1995 Regatta Timing – Madoc Yacht Club, Porthmadog. Again using my own program, undertook results timing for several regattas.

Oct 2000-Jan 2001 District Auditors' Office, Welsh town. Year-end audit of grant claims submitted by local county council to the Welsh Assembly Government. I was not very popular! – the council's staff were obviously used to auditors who turned a blind eye and let things through by default. Having an auditor who asked awkward questions did not go down too well!

Various times 1996-2003 Three different taxi firms. Taxi Driver. Lousy pay, great fun!

Continuous, in spare time. 2001-2009. Live-in carer/chauffeur/cook and bottle-washer for elderly lady friend, until her death aged 93. Financially, no great advantage, but spiritually, about the most rewarding thing I've ever done in my life! Damn hard work!

PERSONAL DETAILS

Born	9th December 1943, Birkenhead
IQ	145 (tested by Charterhouse School maths master, 1973)
Educated	Wallasey Grammar School - 7 GCE 'O' Levels, 2 GCE 'A' Levels Liverpool Polytechnic (now John Moores University) - Institute of Cost and Works Accountants (Parts 1 and 2) IBM Training Colleges, London (St John's Wood and Sudbury) - Numerous courses on various aspects of computer system design, development and programming, gaining A or B grades in all exams. Lever Brothers, Personnel Department, Port Sunlight - Training and Presentation Techniques course.
Marital Status	Single
Interests	Good music (mainly classical), the Scottish highlands, photography, writing, good conversation
Personality	Typical mildly eccentric mad professor with zany sense of humour (essential in this work!)
Health	Above average for age, but partially disabled with difficulty walking and on stairs. Apart from mild COPD, X-rays and ECGs not revealing any problems. Blood tests show all organs functioning normally and low cholesterol. Most recent CT scan shows signs of mild stroke in 2013. Vertigo aggravated by fall in 2012, resulting in concussion, short-term amnesia, and eight stitches in head! (It hurt!)

THE TOPS PROJECT

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British Railways first got to hear about TOPS while I was Technical Manager of their Crewe computer centre. The system had been developed in San Francisco, but early versions of it were not suited to BR, for reasons described below. By 1970, though, technical advances had made it feasible for BR, and we joined in – it was going to be a lot cheaper than developing something similar for ourselves! A BR-owned four-storey building in London was dedicated to it – Blandford House, in Harewood Avenue, alongside Marylebone station. The ground floor became the Communications Data Control (CDC) room; the first floor was the computer room; the second floor, individual offices of varying sizes; and the top floor, a large open-plan office. The latter was quite sumptuous by BR standards, with a fitted carpet throughout and lots of potted palms and other flora and fauna to brighten the place up!

I was promoted to the project in 1971. When I first started working on TOPS, long before it had seen a BR train move, about a dozen staff from San Francisco - some from IBM, some from Southern Pacific (SP) - came over to London to train us and help us get it working. The system was developed in 1964 as a joint project between IBM and SP. IBM developed the 'systems software' (operating system, telecommunications programs etc, which were programmed in 'machine code' and IBM360 Assembler Language) and SP developed the 'applications software' (the programs which actually dealt with train and wagon movements, which were programmed in a specially developed language called TOPSTRAN – for the technically minded, that was an Assembler Macro Language). IBM and SP subsequently formed a joint company called TOPS Online Services Inc., set up to market the system to other railways – Burlington Northern and Canadian National adopted it, having seen its success on SP.

TOPS (Total Operations Processing System) in the USA initially ran on early IBM360 computers, under what was at the time IBM's most advanced operating system, MFT (Multi-tasking with a Fixed number of Tasks), which permitted up to three tasks to run 'simultaneously' in three memory partitions. (Computers cannot run two or more programs literally simultaneously unless they have a co-processor – they switch from one program to another so quickly that it gives the impression of simultaneous running.) The constituents of TOPS were MCJ (Message Control Job), which was the telecommunications software communicating between the remote terminals and the central computer; MEJ (Message Edit Job) which checked incoming messages for conformity and integrity; and MPJ (Message Processing Job), an operating system in its own right, and which was a true multi-tasking operating system, running as many programs 'simultaneously' as available memory would allow. Each 'job' ran in its own MFT partition. The programs which MPJ ran were the applications programs which processed incoming messages, and generated appropriate responses to be sent either to the originating terminal, or to other terminals around Britain.

The technologies pioneered by the early versions of TOPS were adopted by IBM and made more widely available. MCJ spawned TCAM (TeleCommunications Access Method) and QTAM (Queued TAM); and MPJ spawned MVT (Multi-Programming with a Variable number of Tasks).

The US versions of TOPS ran using a telecommunications technique called circuit switching, which only permitted one remote terminal on one telecommunications line – this was adequate for US purposes, where tracks are few and far between, as are freight yards and trains. Most US railroads run only one or two trains a day on each line – albeit damn long trains with several locos! If you get caught as crossing barriers come down, you might as well switch off your engine and go for a walk – you'll be there for twenty minutes or more! The long, infrequent trains are as much as anything because the lines are single track and passing places are also few and far between – literally hours apart. With circuit switching, if you wanted to communicate with more than one terminal, you physically had to switch the circuit by unplugging it from one terminal and plugging it into another.

One interesting feature adopted by SP was, as far as I am aware, pioneered by BR – namely, bar-coded wagons. The concept was tested on the Blackburn-Hellifield line, using track-side scanners linked to an ICT1302 computer in Salford. Tests were run in a wide range of weather conditions at speeds up to 60mph, with 98% reliability (see *Railway Magazine*, December 1962). The SP network had numerous connections with other railroad companies' lines, and bar coding was an ideal way of keeping track of wagons leaving their own territory. The problem did not arise on a self-contained network like BR.

But for a concentrated and congested network like BR, circuit switching was no use. The breakthrough came in 1970, with the invention of packet switching, pioneered in a system called ARPANET, developed by BBN Technologies in 1969/70 for the Advance Research Project Agency of the US Defence Administration. Along with packet switching came TCP/IP (TeleCommunications Protocol/Internet Protocol) and IP addresses. Without packet switching, the internet would not have

come into being (1979), most modern computer networks would not work, and the all-important Electronic Funds Transfer System, on which the whole world relies, would not work.

Packet switching facilitated numerous terminals on one telecommunications line, which was essential for BR – by completion in 1974, we had 650 terminals on 350 transmission lines. The more remote depots had one terminal per line, but congested conurbations with numerous freight yards and offices in a small area would have several terminals per line. We originally incorporated packet switching into TOPS itself – the London version of TOPS becoming the first version of TOPS to have it, making it unique and a world pioneer. Packet switching was subsequently incorporated into IBM's own telecommunications software as VTAM (Virtual Telecommunications Access Method). Whether or not packet switching was subsequently incorporated into the existing US versions of TOPS, I do not know. With packet switching, the data is 'multiplexed' or interleaved into alternating 'packets' for each terminal; each packet is preceded by the IP address of the terminal to which it is destined. At the remote end of each telecommunications line, a 'hub' or 'router' determines for which terminal incoming data is destined. A similar technique is used for digital television, where one physical channel carries numerous TV and radio stations multiplexed together. Digital phones, mobile phones, satellite communication etc. use the same principle.

BR was lucky insofar as for years, they had had their own nationwide telephone network – in many cases, they had direct dialling (ETD – Exchange Trunk Dialling) between towns which were not even connected by BT direct dialling (STD – Subscriber Trunk Dialling). In most cases, TOPS used the BR lines for data transmission – the data was multiplexed with the voice traffic. Hence very few new lines were needed, simplifying the development process enormously. The TOPS data traffic was controlled from the CDC room on the ground floor of Blandford House. Walking into this, you would be forgiven for thinking that you had walked into a modern signalbox! The main feature was a long panel with a network of black lines on it, and red lights moving along the black lines. In front of this was a panel of switches. But the black lines represented telecommunications lines, the red lights denoted data traffic, and the switches could be used to re-route data in the event of problems. Apart from the more remote terminals, data could reach most terminals by more than one route. But even my security pass would not work the electronic locks to the CDC room!

For the development of TOPS in the UK, BR were very thoughtful in their choice of staff. For the systems software, they promoted the brightest staff from their existing computer centres. I had previously been Technical Manager of the Crewe and Peterborough centres - or, in wonderful BR language, as per my accompanying service record, I was 'Senior Computer Projects Officer (Technical Support)'!! Crewe and Peterborough used UK computer firm ICL's computers (Peterborough was purely an operations centre – all ICL development was done at Crewe). Crewe, one of the biggest computer centres in the UK and ICL's national showpiece, processed payroll etc. for the Southern and London Midland Regions, and Peterborough for the Eastern Region. But I had previously been Senior Systems Programmer at Lever Brother's, Port Sunlight, using IBM360s, where I was programming in Assembler Language and writing macros. In London, I was initially put in charge of adapting the TOPS operating system (MPJ), before becoming System Controller, in charge of planning, organising, co-ordinating and trouble-shooting the computer side of commissioning the system throughout the UK. Terry Wilcox, my opposite number from Darlington computer centre (IBM computers processing data for the Scottish and North Eastern Regions) joined TOPS and was put in charge of MCJ, the TOPS telecommunications software (and therefore he was fully involved in the incorporation of packet switching). Then John Besant, my opposite number from Reading computer centre (Honeywell computers processing data for the Western Region) joined and was put in charge of adapting the TOPS message editing software, MEJ. He subsequently worked for me on System Control Group (SCG). From outside industry, we gained the brilliant Scott Pollard, who was in charge of the IBM Operating System Support Group (OSSG), and thus became responsible for the conversion to VTAM. The provincial computer centres' use of different manufacturers computers protected BR from the risks of 'putting all your eggs in one basket' – but had the obvious drawback that all applications software had to be written three times over! For instance, all the decimal currency conversion software I had written for the ICL machines at Crewe and Peterborough, John had written for the Honeywell computer at Reading and Terry had written for the IBM computer at Darlington. Nevertheless, they were all written from the same specification produced by technical support head office at BRB HQ, and hence all 'looked' the same from the users viewpoint.

The most thoughtful bit was that for the applications software dealing with train and wagon movements, we didn't do the obvious thing of trying to get computer people to understand railways! Instead, we took all the brightest clerks from freight offices and yards around Britain and put them all through computer aptitude tests. The ones who passed, we then took on and taught them how to program computers! Hence we got a system which worked! (Just in case it didn't, we had a back-up system called BOTTOMS – Back On To The Old Manual System!!). One of the biggest reasons for the failure of many expensive modern computer projects is that the software analysts, designers and programmers do not understand the business function they are trying to computerise – and they have not taken computer aptitude tests, which were pre-requisites for any job in computers in those days. These days, they seem to let anyone have a go, with consequent disastrous results – trying to get someone who has no natural aptitude to do something is a waste of both your own time,

and theirs. We avoided that pitfall by using railwaymen who had proven aptitude. (Aptitude tests were a sort of cross between IQ tests and MENSA admission tests – my IQ is 145, tested by a Charterhouse School maths master).

Other pre-requisites for working with computers at senior level include the memory of an elephant, the patience of a saint, and the ability to work with people who do not understand what you are doing, why you are doing it, and why what, to them, is a simple job is taking you ages! If you have meetings to chair, then the ability to keep your head while everyone around you is losing theirs, is a huge advantage! (Chairing a meeting full of headless chickens, convinced the building is about to collapse, takes tact. Thankfully, TOPS had been moved elsewhere before the building did collapse!). Also essential is the ability to sort out in your head what needs doing 'today' and what can wait until 'tomorrow'!

My responsibilities as Systems Controller included ensuring the integrity of the system by imposing strict procedures for development of program modifications, and developing a thorough testing regime before modifications were incorporated into the 'live' system. I also evolved a system through which end users in the freight depots could report back on problems they experienced. At the height of implementation, I was chairing up to seven meetings a week, reviewing and prioritising TOPS Modification Requests (TMRs); identifying the cause of problems reported by end users and progressing their resolution; and assessing the implications of major technical issues which could potentially put the whole project at risk. I was regularly faced with the unenviable task of having to make decisions which, if I got them right, nobody noticed! – but if I got them wrong, it could potentially set the project back a couple of weeks and cost thousands of pounds! Thankfully, I got most of them right! (You are reckoned to be doing well if you get eight out of ten decisions right – the knack is to make sure the ones you get wrong aren't the important ones. Thankfully, I got most of them right. People usually make decisions based on the information available to them at the time, and their own assessment of it. If further information comes to light, or you realise your assessment may have been flawed, own up to it and change course immediately – don't try to fudge and bluff your way out of it!)

Problem reports from end users generally fell into three categories – documentation problems (which were referred to the documentation team); software problems (which usually gave rise to TMRs, which ended up back on my desk!); and training problems (referred to Harry Reed's training team). The training team had their own modified train of four Mk.1 coaches, comprising a sleeping car and a restaurant/dining car for use by the crew; a car fitted out as a lecture theatre; and a car fitted out with IBM1050-series terminals for training purposes. This train toured the country as required, training staff at their home depot. Once stabled in an appropriate siding (or spare station bay platform), the train was connected up to the mains for power, and to the telephone circuits, for communication with Blandford House computer room.

Amongst the staff who came over from San Francisco were a youngish married couple from IBM, who had been working on the TOPS operating system since the beginning. Their job was to train me in every detail of how it worked, so that I could adapt it for British use and subsequently maintain and modify it when they returned to the USA. In turn, I trained the senior computer room staff, working 24/7 in shifts, on a 'need to know' basis so that they could carry out essential maintenance in my absence. TOPS was supplied on an 'open source' basis – you were given the source code to modify as required. Consequently, no two railway's versions of TOPS were identical.

The couple from the USA brought with them an up-to-date TOPS database for us to use for our testing. I had adjacent offices on the second floor of Blandford House set up as Los Angeles and Sacramento. The day I first managed to 'send a train' from one to the other, I dashed out into the corridor shouting 'Eureka!' – only to run straight into a passing Brian Hollingsworth, my boss. He patted me on the shoulder, saying "Calm down, dear boy"! I explained what I'd done – "Oh! Well – erm – eureka, then!" he responded – whereupon I had to take him into Sacramento and repeat the whole test for his benefit!! Fun days!

In the modern context, 'systems software' would include such things as Windows and all its accessories, such as file copying routines, disk defragmentation, etc. Typical 'applications software' would be word processors, payroll, accounts, ticketing and so on. No computer can run anything without systems software, and applications software cannot run unless the systems software is running. But applications software must be written to be compatible with the systems software. So, for instance, programs written to run under an ICL operating system would not run under an IBM operating system. Similarly, today, a program written for an Apple MAC or Linux computer will not run under Windows.

By the same token, the TOPS systems software could just as easily run applications other than railway software. IBM were well aware of this, and wanted to extend the concept to other fields. Although the TOPS operating system had been released to the wider community as MVT in 1967, IBM were still restricted by the limitations of circuit switching. The development of packet switching changed all that, and by 1971, IBM had made VTAM widely available.

When IBM decided to make the TOPS systems software more widely available for other purposes, a legal dispute over rights broke out between IBM and SP. Following a typically bizarre US court case, IBM were forced to modify the software and re-name it – they re-launched it as CICS (Communications Interface Control System). Although CICS had been around in the

late sixties, it was not until the advent of packet switching that it really took off. It became IBM's world-wide flagship networking software, and was (and in some cases still is) widely used by airlines, theatres, banks etc. All subsequent networking software runs on the same fundamental principles – it doesn't have much choice!

Even into the early seventies, TOPS still lived on a diet of punched cards – the IBM 1050-series terminals it used consisted of a printer (golf-ball print head)/keyboard, card reader and card punch. IBM 3270 terminals, consisting of a Visual Display Unit (VDU) and keyboard, were already around on some other CICS-based applications. These had no local intelligence, and merely allowed information from the central computer to be displayed on the screen instead of printed out, and information to the computer to be directly keyed in, instead of first being punched into cards. TOPS was gradually adapted to use these, or the more compact equivalent manufactured by Ventek – commissioning of these was well under way when I left in late 1974. It was not until I joined Control Data Corporation in 1976 that terminals with local intelligence were coming into use – these allowed files to be copied from the central computer, edited locally, and the sent back to the computer for processing. They also allowed the user to view the computer's 'job queue', which gave him a rough idea as to how long he would have to wait for his own work to be processed!

The project I was responsible for when I joined J P Morgan in 1977 relied totally on terminals with local intelligence, for preparation and editing of input data. Morgan's computers ran using CICS. But even then, personal computers (PCs) were not around – the first appeared in 1979, but it was to be another couple of years before they became popular. The TITAN ticketing system I developed for the Ffestiniog Railway, in 1983/84 was one of the first major uses of PCs for business functions in the UK, and, after my article in the August 1987 *Railway Magazine*, it attracted a lot of interest – not just from other railways, but from computer manufacturers, theatres, and even a ferry company, who all came to Porthmadog to look at it! It's a great pity that my mother's stroke in 1983, and subsequent deterioration into Alzheimer's, forced me to abandon so many other contracts for it.

The UK Packet-switching version of TOPS was, at the time, probably some of the most advanced software in the world. IBM had a lot staked on its success. But this period was the height of the Cold War, and the Russians were desperate to get hold of Western computer technology. There were several instances of computer staff being kidnapped and forced to work in Russia (and like many things which happen in this country, they were never reported in the press). Industrial espionage was rife, too (and still is) – that is the practice of companies to spy on each others' developments and upstage or even sabotage them. I and two of my colleagues received occasional 'personal security' briefings from 'men in grey suits' (no prizes for guessing who they were!). The advice included very useful tips on how to tell if your phones, office or home etc. were being bugged – and it doesn't need any fancy technical equipment! (In fact, it's so easy, you'd laugh!). But we figured that the Russians would never suspect that British Railways were working on the most advanced computer project in the world, and basically kept a fairly low guard!!

The London computer centre was one of IBM's ten largest in Europe. It had two large IBM370/168 computers, each with a bank of 36 IBM 3330 disk drives, switchable between the two computers. Everything was duplicated, and if the on-line system went down on one computer, it could be up and running again on the other in about ten minutes. TOPS was, at the time, the biggest computer project ever attempted in Britain (£23m budget at early 1970s costs). Partly under my guidance as Systems Controller in London, it went 'live' by October 1974, only a couple of weeks adrift from the date originally planned three years earlier, and £2m under budget. It had gone live in stages, beginning with Devon and Cornwall in July 1973, and spread to the rest of the Western and Southern regions before heading north, with Harry Reeds training train for company at every stage. On completion, TOPS project manager Bob Arnott (previously General Manager of BR's London Midland region) invited us all to a celebration buffet on the top floor of Blandford House!

With the system up and running on time, many of us left and moved on to other projects, either within BR or in outside industry. My successor as Systems Controller was former Computer Controller, Bill Fretton. He retired in 1995. Another former computer room inmate, Ian Snowdon, decided to try and make Bill's retirement a TOPS 'Class of 74' re-union. It took him ages to trace us all – I was one of the easy ones! One former TOPS colleague, Len Chard from OSSG, stayed with BR on the APTIS project – BR's own ticketing system. By then, I was working on TITAN, the Festiniog Railway's ticketing system – the race was on! Guess who won? (see main CV!)

In my case, I was offered promotion to head a new project, TARDIS, to develop an historical database by bleeding information off the live system. TARDIS officially stood for Tops Ancillary Retrospective Data Interrogation System (!) – or, unofficially, because nobody knew where it was going to end up! Even if I had stayed, I probably would not have taken the promotion – the project did not particularly inspire me or offer enough challenges, and I was then not really qualified to be a project leader (I know my limitations!). But parental divorce problems forced me to return home to Birkenhead, where I had a most enjoyable eighteen month 'sabbatical' working as head barman and relief manager of a Liverpool city centre pub! When word got round that I was leaving TOPS, Ken Green, the Applications Programming Manager, called me into his office. "We'll be very sorry to see you go" he said, adding that "you are the only person round here who can say 'no' even to people senior to you, and have your decision accepted without question". Subsequently, a close friend from the Tallylyn

Railway, Richard Hope, who was at the time editor of *Railway Gazette International*, one of the most respected journals in the railway industry, interviewed my boss, Brian Hollingsworth, for an article about TOPS. Brian H had been Assistant Project Manager on TOPS, and was the manager to whom I reported. Richard told me that Brian H had commented “TOPS wouldn’t be where it is today if it hadn’t been for Brian Bushell”. Suddenly, all the long hours, headaches and sleepless nights seemed to have been worth every minute.

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