

INDUSTRIAL YEAR REPORT

IBM Level 3 CICS Service Engineer

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Chapter 1

Organisational Environment

International Business Machines Corporation (IBM) is an American multinational technology and consulting corporation, with its headquarters in New York, America. IBM sell a wide range of technical products, both hardware and software, in areas ranging from mainframe computing to nanotechnology. As well as technical products IBM also offer a range of consulting, hosting and infrastructure services.

IBM are also known for innovation; holding the largest number of United States of America (US) patents, building new technologies such as IBM Watson and pushing corporate initiatives like Smart Planet.

IBM is split into several different business areas which are listed below:

- Global Business Services (GBS)
- Global Technology Services (GTS)
- Software Group (SWG)
- Systems and Technologies Group (STG)
- Sales & Distribution
- Integrated Technology Delivery (ITD)
- Integrated Managed Business Process Services
- IBM Global Financing

I was employed under the Industrial Trainee (IT) scheme in SWG United Kingdom. Based at the Hursley site in Hampshire, the main SWG site in the United Kingdom (UK).

SWG¹ is split into five brands: DB2, Lotus, Tivoli, WebSphere and Rational. SWG in Hursley is largely WebSphere-based.

Customer Information Control System (CICS) Transaction Server² is a part of the WebSphere brand. Like many products in SWG CICS has several different departments: development, test (Functional Verification (FV) test, system test, etc.) and service.

All service departments in IBM are split into three distinct levels:

¹IBM is such a large company, it would take over 5,000 words to explain the whole structure, so I shall focus on my specific working areas.

²CICS Transaction Server is typically shortened to CICS internally

Level 1 Service Are the first point of contact for customers. They deal with basic problems with the product and have a general understanding of the product. If the problem can't be solved by Level 1, it is elevated to Level 2. All problems reported to Level 1 are raised as a Problem Management Request (PMR) and are tracked by Remoth Technical Assistance Information Network (RETAIN).

Level 2 Service Have a good working knowledge of the product and are typically able to diagnose and solve customer problems. If Level 2 are unable to diagnose the problem the PMR is elevated to Level 3 or, if the diagnosis reveals a problem with the product an Authorized Program Analysis Report (APAR) is raised against Level 3.

Level 3 Service Have a very good knowledge of diagnosing problems with the product and of the internals of the product and are authorised to make changes to the source code of the product to fix problems raised by APARs. The majority of Level 3 work involves handling APARs, however some specialist members of the team handle PMRs.

Due to the specialist knowledge required to work in the CICS Level 3 Service team I was not expected to deal with either APARs or PMRs³. My main role in the team was to maintain existing tooling and to develop new tooling which would benefit the team.

At the start of the year my main responsibilities were to maintain a tool which would gather statistics on PMRs and APARs in RETAIN and a system named "SPA", a z/OS based working environment specific to CICS Level 3 service. However, due to a process change about a year before I joined IBM, a new working environment; Rational Team Concert (RTC) was being used for all new releases of CICS.

I was initially tasked with integrating this environment into the statistics tooling, or vice versa as RTC could potentially provide management and statistics gathering by default.

After some changes to the team I was asked to change my focus to maintaining a large tool which pulled APARs from RETAIN into RTC. This tool was also designed to perform other functionality such as delivering fixes for the Eclipse-based suite of tools for CICS to update sites and IBM's central fix management site - Fix Central.

Due to consistent issues and a lack of knowledge with this tooling, it was eventually decided to switch from this tooling to APAR Polling Tool (APT) a tool built and maintained by the IBM WebSphere MQ (MQ) Level 3 Service team and which was being considered being supported by the lab-wide build team.

This left a hole for the automation of delivering fixes for the suite of Eclipse-based tools CICS has. I was asked to develop a solution, Explorer Delivery Tool (EDT)⁴, which had to be resilient to the problems which had plagued the old tooling.

Developing this tooling also increased my exposure to the team's RTC environment and lead to me being partly responsible for maintaining the structure of work items (representations of APARs and other associated tasks the team required to follow the service process).

Towards the end of my year I was also picked as part of a small team to plan and run the inductions for the SWG-based ITs for 2012-13. As well as this I was a member of the main team for Smart Cursor, a side project to continue the Extreme Blue project of the same name (BBC News Article).

³It can take graduates up to a year and a half to work without constant supervision.

⁴Explorer is a shortening of CICS Explorer; the main Eclipse-based tool for CICS

Chapter 2

Technical and Application Environments

Most systems I worked with in IBM were either mainframe (z/OS or z/Linux systems), RETAIN and SPA were both being z/OS application¹; or Linux servers, typically Red Hat Enterprise Linux (RHEL).

Because CICS is almost entirely mainframe-based the department has access to several of the on-site mainframes. However, with the introduction of RTC the department has also required the use of Linux servers to host the RTC server on and to run build engines that hook into RTC and perform useful tasks, such as building CICS or polling APARs into RTC Work Items. Some of these were virtualised machines maintained by the Infrastructure team in Hursley, whilst others were physical machines the department maintained.

The statistics tools I was responsible for were hosted on two different systems; the Java-based tool ran on a RHEL CentOS 5 server running IBM WebSphere Application Server (WAS), MQ and IBM DB2 (DB2). Whilst the other was a Windows XP machine running Lotus Notes 8.5 and IBM Personal Communications (PComm) sessions into RETAIN and SPA.

For RTC build engines, the department had access to several virtualised servers; one RHEL CentOS 4 server (winlnx0u.hursley.ibm.com) which was removed towards the end of my year due to CentOS 4 going out of IBM support and was replaced with two RHEL CentOS 6 servers (cicspoller1.hursley.ibm.com and cicspoller2.hursley.ibm.com). All these servers ran RTC 3.1.0.1 Build Engines which accessed the main departmental RTC servers (jazz104.hursley.ibm.com and jazz114.hursley.ibm.com). Another machine, local to the department (hsm.hursley.ibm.com) was used as a back-up Build Engine machine, in case the server running the virtualised servers should go down. HSM was also used as a testing environment for new releases of RTC.

¹Interesting point: RETAIN is a CICS application

Chapter 3

My role in IBM

3.1 Day Job

3.1.1 Inductions and Joining the CICS Level 3 Service Team

When I first join I started with a two day induction in the North Harbour office in Portsmouth which covered the general environment I would be working, Health and Safety and the Business Conduct Guidelines. As well as some information about what I could do during the year. I received my work laptop and met with my Personal Development Manager (PDM).

On the third day I started properly in the Hursley office and joined the CICS Level 3 Service team. The team was formed of around 20-25 members including several Graduates and a another IT coming to the end of his year at IBM

The current IT, Abul, assisted me with the set-up of my laptop and with settling into the role of maintaining the team's Java-based statistics tool which run on WAS. This tool would poll RETAIN for PMRs and APARs on an hourly basis and also connected to SPA using MQ. This information was collected into a DB2 database.

Every day a report would be generated for the previous day's receipts of PMRs APARs from the data in the database which was sent to the team leaders and the appropriate 1st and 2nd Line Managers. It would also use the database to create a similar report monthly, as well as performing a backup of data.

Finally, using Java Platform, Enterprise Edition (Java EE) the tool provided a JavaSever Pages (JSP) website which could be accessed by any member of the CICS Level 3 Service BlueGroup¹.

I started out fixing some minor issues with this tool and learning the RTC Client Application Programming Interface (API) in the effort to pull APAR data from the DB2 database across to a view in the RTC eclipse client.

Soon after Abul left I was also given charge of a Lotus Notes-based statistics tool which collected similar information as the aforementioned statistics tool. This one, however, was more manual and required the maintainer to run a scan at least once per day. This tool directly interfaced with four PComm sessions, two of which connected to RETAIN and two to UKCPSG.

The RETAIN sessions handled PMR and APAR polling. Collecting full information on PMR data, and basic data on APAR data. One of the UKCPSG sessions connected into SPA and gathered data on the current progress of APARs, whilst the other ran an internal routine called QA which collated APAR information from different SPA sub-sections for a more full

¹Effectively an Lightweight Directory Access Protocol (LDAP) Group

report on the APAR in question.

3.1.2 APAR Poller

A few months into this I was asked to help maintain the team's APAR Poller; a large tool which polled APARs in RETAIN, creating them as a work item in RTC if the APAR didn't already exist in the RTC server or updating the existing work item with any changes which had been made in RETAIN. This was originally designed to be a two-way bridge (changes in the RTC APAR work item could update the RETAIN APAR. However as permissions for the RTC work item were less secure as the ones in RETAIN so this bridge had been disabled).

The APAR Poller ran on a RTC Build Engine; this build engine would connect into a RTC server, which would hand the engine tasks to perform depending on build definitions on the RTC server.

My main role in maintaining this was to keep it working as some of the internal libraries it used updated regularly and, contrary to guidelines, sometimes broke backwards-compatibility. This proved to be difficult with the sheer size of the application and the way in which it was invoked.

The application was invoked using Apache Ant; an open source tool similar to GNU Make, but designed for Java applications. Whilst this in itself was a good design decision, the readability of the Ant scripts was less than desirable. To add to this some of the variables were taken from the Build Engine Definition on the RTC server, some from the Build, some from flat files and some hard coded into the Ant scripts. This made it nearly impossible to debug.

Mark Richards, a fellow member of the CICS Level 3 Service team also charged with maintaining the poller, and I both raised our concerns for the maintainability of the Poller in the long run. With these concerns aboard a number of meetings were set up with the MQ Level 3 Service team to discuss their solution, APT.

APT performed very similar function as the APAR Poller did; however it was a lot more simplistic. Despite this it was being considered by the Hursley Build Team as a lab-wide solution which they could maintain easily. Due to this the CICS Level 3 Service team had a vested interest in this solution and, after a fair few meetings, came up with a list of requirements we would need to be added to APT for us to replace the poller with.

3.1.3 CICS Trace Entries

During this time I was also given another piece of work which regarded the documentation of trace messages in one of the CICS domains. I was set-up with read-only access to the CICS 3.1, 3.2 and 4.1 source code on SPA and tasked with checking the difference between the source code definitions of trace codes and the documented versions on the IBM information centre to check for inconsistencies (i.e. added or removed entries and entries with incorrect parameters) and note down the correct version to be sent to UTD, the department which handles documentation.

3.1.4 UHL Printer Plug-in

Almost immediately after completing this work I was asked to create a small eclipse plug-in to print the team's Unit History Log (UHL) RTC work items in a similar form to the old version done by SPA. The UHL is a report of all the work which goes into diagnosing and fixing

an APAR and are used heavily in the APAR reviews. They are also used if an APAR goes Programming Error (PE), where the fix causes a problem, to identify why the APAR went PE and how the process can be changed to prevent such action happening again.

This UHL Printer Plug-in used the Standard Widget Toolkit (SWT) Printer libraries, along with the RTC Plain-client libraries, to gather information from the currently selected UHL RTC work item, build it into a document tree and finally parse this tree and print it straight to the printer. From this I then generated an Update-Site and associated elements and hosted it on one of the departmental servers for the team to easily access.

3.1.5 Explorer Delivery Tool

With this came another problem. In the CICS Explorer and associated Eclipse-based tools branch of the poller code was a mechanism to deliver APAR fixes to the IBM update-sites and to Fix Central; the centralised location for the majority of fix packs. Due to the nature of CICS this site was only used for the eclipse-based tools².

This functionality was a useful step for the few members of the team who worked with the Eclipse-based tools in the delivery of fixes. Mark Richards was the one to request that I re-write a more maintainable version of this code using Open Services Gateway Initiative framework (OSGi) and following good practices for Java, OSGi and the IBM guidelines. To start with I had a lot of discussions with Mark about the best structure for the application. From there we decided OSGi was the best way forward due to it's focus on modularity; if one section broke due to updating libraries it would remain isolated to that section of the application without affecting any other features.

With this decision in place we then began coming up with a decent structure for the application which would leverage OSGi. We also discussed how we would handle auditing and object serialisation in a readable format. To this end we decided to use Jackson, an Open Source library under the Apache License produced by Codehaus, which serialised Java Objects into JavaScript Object Notation (JSON) files through the use of Java annotations.

EDT Document Generation

The first part of the process was to generate documentation for the fix to be delivered. To do this we turned to another Open Source library; Apache Velocity. This library acts as a templating engine allowing Java values to be passed into a predefined template with relative ease. Again this is licensed under the Apache License.

To do this a set of Plain Old Java Object (POJO)s were also defined, these would be the objects which Jackson would serialises and de-serialise to JSON files.

With this complete I demonstrated the workings to both my Task Manager and Team Leader. With their approval I continued the project and ended up with weekly progress meetings with them.

EDT RTC Interaction

The next part was adding functionality to store files to a Source Code Management (SCM) system. This would allow auditing on all items in the application. Because of the heavy

²A fix for CICS are released as a Program Temporary Fix (PTF); a common mechanism for z/OS applications.

reliance on RTC in the whole department and due to some issues with connectors to other SCM systems, it was decided to use RTC as the SCM system.

At this time I also decided to write the connector to the work item side of RTC. This worked slightly different from the code in the UHL Printer so I chose to write it from scratch to make it cleaner and more maintainable. This work item module read certain types of work item on the server and would populate the correct POJO with information from this work item.

EDT Fix Central Interaction

Up until this point I hadn't had any problems integrating libraries into the application, both Jackson and Velocity were contained in single jar files. The RTC libraries were large, but due to the Eclipse-based nature of RTC they were already designed to be integrated into OSGi.

However, when it came to integrate Fix Central's libraries into EDT, I started running into dependency problems. The problem had occurred as the Fix Central Library had dependencies on certain external libraries which contained different versions of fairly common libraries. Due to the way OSGi performs class loading it resolved these dependencies in a different order to the way standard Java would.

With Mark's help I was eventually able to resolve this and slowly learn the Fix Central library and finally use it to create the required metadata and upload fixes to a testing server. A further part of this was the ability to upload in preview mode and then to unset the preview flag. This took a lot more time due to the convoluted way Fix Central works.

During this I was constantly testing making sure each module would integrate correctly with other modules. This combined with complex libraries meant the whole project took a lot longer than first anticipated. Eventually I started to do some proper project planning on the request of my team leader.

3.1.6 CICS Eclipse-based Tools Skills Transfer

Around the release of new versions of the CICS Eclipse-based tools I was asked to moderate and record the skills transfer sessions for these new versions. These skills transfer sessions were designed to bring Service teams, both Level 2 and 3, up to speed on the new features of the product and how they are designed to work.

Most of these sessions were delivered by foreign teams so my role could be difficult at times working with due to the language barrier. However all these sessions ran fairly smoothly, where the only problems came from the software we were using to record.

3.2 Giveback

IBM has a scheme known as "giveback" which provides opportunities to help with community events both within IBM and externally. All ITs are pushed by their managers to participate in giveback.

3.2.1 Java Teaching

The first piece of giveback I participated in was teaching Java to my peers. These glsits had a good knowledge of the C programming language so the main focus for this was teaching the

principals of object-orientation and then some of the differences in syntax. To help with this we were given a mentor who had a good knowledge of teaching and lecturing.

This piece of giveback lasted around 3 months with a session a week and by the end of it the ITs in the group knew Java well enough to use it in their own day jobs.

Having heard about these sessions some of my team registered their own interest in learning Java and as such I set up a couple of sessions to teach them too.

3.2.2 Smart Cursor

Having followed Extreme Blue (a summer internship program IBM runs world-wide) with interest due to some friends being in that year's intake I jumped at the chance to get involve with the continuation of one of these projects; the Smart Mouse project.

The Smart Mouse project is a hardware and software project designed to allow disabled users to map mouse movements to gestures from a 9-degrees of freedom sensor they could wear on any part of their body.

The prototype the Extreme Blue students had produced in their 8 week internship was very simplistic and would only work with certain gestures. Our aim was to allow users to use any gesture they wanted (after training the system) along with the ability to attach multiple sensors or other peripherals such as pupil tracking or microphones.

I joined what was known as the "A-Team" (Algorithm Team) and got involved with designing and building the base for this project, including a 3D visualisation program which would be used to debug the actual Artificial Intelligence (AI) sections of the project.

3.2.3 Blue Fusion

Another large piece of giveback both graduates and ITs are pushed to do is an event called "Blue Fusion"; an event which coincides with national science week, with the aim to teach school children concepts of science and technology. I joined a team of 6 to create one of the games for this event which was also going to be used for the grand finale.

Most of my work on this game was the 2D graphics for the front-end of the game. I also spent a lot of time testing the performance of the game to ensure it ran well enough for the low-end hardware we would be given for the event. I also helped to write some of the AI behaviour for the game.

During the project I acted as the team's 2nd in command, standing in for the team leader in the weekly check-up meetings and keeping the team on task while he was away on vacation. On request of my task manager I also gave a quick demo of the game to the rest of the CICS level 3 team, which was a useful experience to get opinions on the game from an impartial audience.

As a developer I had to host a session for the "Bright Sparks" event; a single day ran just before Blue Fusion for a younger audience which acts as a final test where most problems can be caught and fixed. I spent the morning of Bright Sparks hosting the game and the afternoon performing some simple bug fixing in preparation for the finale. All-in-all the day was a little ropery, but all things considered ran well.

During Blue Fusion I spent a lot of time doing minor bug fixes and making sure all the data files were correct for the finale. I also hosted one of the other games for a day due to a shortage of volunteers. For the majority of the event our game was stable and the only issues occurred due to some problems with the Java 2D libraries.

3.2.4 Java Masterclass at Swanmore College of Technology

Having done a lot of Java teaching in the first part of my year, I responded to an advertisement looking for helpers to run Java teaching sessions in a local school. This led to me both running and organising these sessions. Contacting the teacher who'd requested these sessions we organised a taster session just before the Easter holidays to work out the levels of interest so the main sessions could begin after the Easter break.

All the sessions were run in a similar format; a quick presentation for 5-15 minutes followed by a practical worksheet the students could work through with any help from me or one of the other helpers.

For these sessions I spent a fair amount of time beforehand trying to find helpers for the sessions and checking through the content for the session to make sure the practical sessions would work well or shortening the presentations.

3.2.5 2012-13 IT Inductions

Towards the end of my employment at IBM I was asked to organise the IT inductions for the 2012-13 intake of ITs. The team for this consisted of myself and two other ITs, supervised by Sarah Churchard, one of the three Hursley IT managers; and Ed Moffat, the lead manager for the Hursley ITs.

We quickly formulated a timetable for the typical 2 day induction and started finding and booking speakers to run some of the sessions we had planned. These speakers included: the Hursley Laboratory Manager, two Senior Inventors (IBMers with several patents filed), several of the 2011-12 ITs and some graduates from different product areas.

As well as this we also needed to book rooms and food for the event. Alongside this we requested laptops for each new intake which we then set-up to make the first few days easier for the ITs.

Being one of the more technical of the three, I was responsible for this set-up. With some help I added Hard-disk passwords to every laptop; changed the Windows and Lotus Notes passwords to a default so the owner could easily set their own; changed to the regional options to be the UK locale; enabled the replication settings on Lotus Notes; created an internal ID for the owner and linked it to a wireless account.

During the day I was on hand to greet and introduce speakers, answer any questions, guide the ITs around the site and fix any laptop problems which arose during the set-up sessions. The first two inductions ran very successfully and due to limited numbers of people in the final induction I gave a half-day induction to a single new IT, which again ran smoothly.

Due to our efforts on the induction we were thanked by Derek Tregus; the aforementioned Hursley Lab Manager and by Ed and Sarah.

Chapter 4

Critical Evaluation

Having been invited to several reviews as part of the Level 3 CICS Service team I was surprised at the level of detail put into each review no matter how many lines of code had been changed. For example: one of the reviews I attended was for two trivial lines of code and yet every single possibility was run through; how it might affect any other modules, what would happen with other versions, etc. It was even decided that development should also approve the fix before it was released due to some unknowns.

Therefore, it was a little surprising that a lot of the side-products for CICS didn't undergo the same standards in their reviews (possibly due to the fact that they couldn't go PE). It also seemed a lot of these products were coded without following the IBM coding guidelines or the guidelines for the language they were written in. It also seemed like there was a dangerous misconception over the use of Open Source Software, despite there being lawyers to ensure otherwise.

One thing that really impressed me with IBM was that there was never any prejudice based on my position as an IT. The only thing which affected my work was the limited amount of time I had in IBM. Most of the time fellow employees would mistake me for a graduate, even those inside my own team.

Technically I learned a lot over the course of the year. As I have maintained to some of the new ITs; I came in with 2 years knowledge of Java and came out with a single year of solid use of Java. I also spent a lot of time learning the OSGi framework and have come to appreciate being able to produce highly-modular Java applications when necessary.

Having worked with mainframes for a year I have definitely learnt a lot about z/OS and associated operating systems and plan to take the z/OS Mastery Qualification, as well as a Java 7 qualification too.

One of the most important skills I have improved over the course of this year is the ability to learn an external library quickly despite the state of it's documentation. Hand-in-hand with this I have also significantly improved my ability to debug programs, especially with the in-built eclipse graphics debugger.

Presenting is a big part of working in IBM. Over the year I have ended up doing a lot of presenting, from teaching to explaining the technical workings of my projects. I also took the opportunity to attend a presentation workshop with a member of the executive briefing centre and feel a lot more confident giving presentations.

Having spent a lot of time in teams I feel my teamwork has improved and whilst I still don't feel entirely confident leading a team, I am more willing to throw in more opinions regardless of my place within the team.

I also had some great learning opportunities to learn a great deal more about CICS and other IBM products, as well as interesting topics like virtualisation and machine learning. As well as being able to do some of my own teaching and presenting. I actually ended up doing part of a CICS seminar along with some of the other CICS ITs.

All-in-all this year at IBM has boosted my confidence, both with technology and communication. I also have a much greater appreciation for what it's like to work in a large software (and hardware) company.