Application Development for z/OS
Not your Father's Green Screen

Mike Fulton, IBM Distinguished Engineer
CTO DevOps for Enterprise Systems

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3:15pm to 4:15pm Dolphin, Oceanic 7
Abstract

Ask most people how they write and maintain applications on z/OS and you hear "oh, you use this thing called a green screen" followed by a chuckle.

In reality, application development for zEnterprise applications has been transformed over the past several years to the point where application developers enjoy the same or better features from integrated development environments as programmers who work on other platforms.

Advances in remote system communication and interaction, syntax-highlighting, parsing, and code understanding for Assembler, PL/I, C/C++, and COBOL source code, as well as programming assists such as code snippets and templates are all available to application programmers.

Interactive debug of applications, written in multiple programming languages and running in various runtime environments is also possible and can greatly boost programmer productivity.

Come and learn about how these features can enable application developers who are new to the mainframe to interact with, update, and efficiently enhance mainframe applications.
IBM DevOps point of view
Enterprise capability for continuous software delivery that enables organizations to seize market opportunities and reduce time to customer feedback

Accelerate software delivery – for faster time to value

Reduce time to customer feedback – for improved customer experience

Balance speed, cost, quality and risk – for increased capacity to innovate

Clients are achieving measurable business outcomes with DevOps

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Collaborative Development

Accelerate **time to delivery** with real-time planning
Improve **quality** with lifecycle traceability
Maximize **time to value** with in-context collaboration
Refine **predictability** with development intelligence
Reduce **costs** with continuous improvement

- Manage many sources - JavaScript to COBOL
- Single work item can span technologies & solutions
- Quickeens agile adoption on the mainframe
- Integrates existing SCMs and deployment tools

IBM Rational Collaborative Lifecycle Management (CLM)
- IBM Rational Team Concert
- IBM Rational Doors Next Generation
- IBM Rational Quality Manager

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Rational Team Concert: One tool, many capabilities

Work Items

Planning

Source Control

Builds – Continuous

Dashboards & Reporting

Enforcement and Automation

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Rational Developer for System z:
An Integrated Development Environment for System z

Integration with Team Concert for Lifecycle and Source Management

Integration with Asset Analyzer for Application Understanding and Impact Analysis

Integration with Fault Analyzer for Dump Analysis

A modern IDE for productive development of cross-platform applications written in COBOL, PL/I, ASM, Java, EGL or C/C++ in System z CICS, IMS, DB2, Batch applications

Integration with RD&T for flexible access to System z environment

Access to typical System z sub-system functionality in z/OS, CICS, IMS, DB2, WAS

Out of the Box debugger and code coverage capabilities

Integration with File Manager for file and test data handling

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RDz: stay focused: work concurrently not sequentially

Access Datasets + Dataset Management

Edit a program

File Compare

Submit a Compile | File Search

Dataset Statistics

Access Jobs (Outlist facility)

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Rational Development and Test Environment for System z
The ultimate in modern application development for System z

- Increase availability of z/OS testing environment and resources
  - Liberate developers to rapidly prototype new applications
  - Develop and test System z applications anywhere, anytime!
  - Eliminate costly delays by reducing dependencies on operations staff
- Improve quality and lower risk via automation, measurement, and collaboration
- Focus on what is required for the change at hand, then scale

Note: This Program is licensed only for development and test of applications that run on IBM z/OS. The Program may not be used to run production workloads of any kind, nor more robust development workloads including without limitation production module builds, pre-production testing, stress testing, or performance testing.
Any process: Executable and repeatable

Use ONE tool to support both agile and non-agile

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Multiple plan views facilitate continuous planning

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Progress Tracking: live status for everyone

Story Status Current Iteration
Shows the status of all stories planned for the current iteration

<table>
<thead>
<tr>
<th>Status</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>New</td>
<td>5</td>
</tr>
<tr>
<td>Ready to Test</td>
<td>10</td>
</tr>
<tr>
<td>Done</td>
<td>15</td>
</tr>
<tr>
<td>Invid</td>
<td>5</td>
</tr>
<tr>
<td>Implementing</td>
<td>30</td>
</tr>
<tr>
<td>Testing</td>
<td>5</td>
</tr>
</tbody>
</table>

Burndown Current Iteration
Shows the remaining amount of estimated work in hours of work items planned for the current iteration.

Stories Open/Closed/In Progress
Shows the number of stories which are open, in progress, done during the iteration.

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Load the source artifacts
RDz and RTC together

RDz Projects View shows Loaded Projects

RDz understands z/OS Development
• Rich, Language Specific Editors
• Enterprise web services
• Service Flow Modeler
• Code review
• Unit testing
• program analysis/control flow
• …

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Navigate datasets and jobs on zOS

- Connect to multiple hosts concurrently
- Respects existing security configurations and user IDs
- Search, filter, browse, edit, compare, migrate, and allocate new MVS datasets and USS files
- Copy source code, members, or datasets between systems with a few mouse clicks.
- Access JES queues submit jobs, view job state, and open output spools
- Submit TSO or USS commands
- Add datasets and members into projects to group applications and work items together logically
- Open an emulator in the IDE to configured hosts
Edit capabilities in RDz

RDz at a high level has 2 types of editors

- COBOL, PLI, and JCL advanced editors
  - Based on the Eclipse editor infrastructure
  - Quick fixes, hyper-linking, hover
  - Easy navigation between edit sessions
  - Real time syntax checking, content assist, key word highlighting

- LPEX Editor
  - COBOL, PLI, HLASM, JCL, C/C++, REXX
  - ISPF-like experience including prefix commands, command line, look and feel
  - Supports advanced edit functions for COBOL, PLI and HLASM like real time syntax checking, content assist

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Quick Outline

• Press Ctrl+O to activate
Keyword syntax proposals

- Press Ctrl+SPACE to activate
Enhanced Application Quality & Structure Analysis

Application Analysis

• Control flow diagrams for COBOL and PL/1 programs,
  - **Graphical representation of the program flow with links to the source**
• Helps identify and highlight potential unreachable code

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Enhanced Structure Analysis – Data Element Table

- A table representation of the user-defined data items and symbols in a program
  - Hyperlinks in the table are integrated with the editor allowing easy access to the declaration of the data items.
- Generated by showing the “symbol table” generated when RDz real-time syntax check parses the program

Image: Data Element Table from WARDRPT.cbl
User build is supported in zComponent projects and remote z/OS projects

- Builds the file selected, supports Error feedback
- Uses RTC Language definitions and Translators to generate the right JCL
Pending Changes

Need fine-grained SCM control?
• Check out the pending changes view

Eclipse Rich Client:
• Check in, deliver, accept changes
• Suspend, resume, discard changes
• Replace, reload out-of-sync
• Resolve conflicts

Web Client:
• Open change sets and work

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A GUI-based multi-platform, multi-language debugger

- Full asynchronous mode
  - Thread-level control of multi-threaded applications
- Automonitor support

RDz v9.0.1 Base Support:

- COBOL V5.1, V4, V3.4
- Batch, Batch IMS, Batch DB2, CICS 5.1, 4.2, 4.1
- Interactive Code coverage – Out of the box

RDz 9.1 new support:

- PLI v4.x, v3.9
- C/C++ V1R13, V2R1
- IMS TM
- DB2 Stored procedures
Use the cross-platform debugger to debug end-to-end systems as they execute in the runtime

- CICS
- Batch
- Java

From the workstation:

- View executing source code
- Step through host code line-by-line
- Set breakpoints
- Alter working storage values
- Alter register values
- Etc...

Debug z/OS and distributed code

- in the same interface even stepping between runtimes and platforms!
Enhanced Application Quality – Code Coverage

Measure and report test coverage of an application
- Supports multiple languages including COBOL and Java
- Leverages the Integrated Debugger technology
- Indicates what source code was tested and remains to be tested
- View Coverage at module / source / procedure level

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Predefined rules and templates

- for COBOL and PL/I applications
- Ensure corporate standard adherence
- Custom rules for COBOL and PL/I
A Framework for developers to write:

- repeatable, self-checking unit tests, based on xUnit.
- **xUnit** a light-weight architecture to implement unit test frameworks.
  - JUnit, for example, is a very popular instance of the xUnit architecture.
- **zUnit** is an xUnit instance for System z
- zUnit encourages **continuous integration and continuous testing**
  - for System z Application development and maintenance

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**zUnit** tested framework for z/OS

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**Language-specific details:**
- In COBOL, this is the first program appearing in the Test Case source file and it will be invoked by the Test Runner for Test Case initialization.
- In PL/I, the is the procedure declared with option(fetchable) in the Test Case source file and it will be invoked by the Test Runner for Test Case initialization.

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**Language-specific details:**
- In COBOL, these are expected to be subprograms (non-nested and therefore compatible with FUNCTION-POINTER).
- In PL/I, these are expected to be internal procedures that are declared at the package level (non-nested).

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IBM Problem Determination Tools for z/OS (PD Tools)

Application Performance Analyzer for z/OS

Fault Analyzer for z/OS
- Abend analysis at source-level reporting to speed up the problem analysis steps.

Debug Tool for z/OS
- Interactive debugging, understanding execution flow, COBOL modernization, code coverage and much more.

File Manager for z/OS
- Data manipulation on z/OS including data in DB2, IMS, CICS, MQ, data sets and HFS files.

IBM Problem Determination Tools Modernization Solution Pack

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IBM Debug Tool Version 13

Debug Tool can help you increase debugging efficiencies and reduce application development cycle times.

- Proven 3270 and eclipse interfaces
- Improved Code Coverage facilities for COBOL and PL/1
- Automatic start of IMS MPP region with dynamic transaction routing
- Playback support in RD/z
- Support for new instruction set available with z13 hardware
- Support for Enterprise COBOL V5.2 and V5.1 compilers
- Support for Enterprise PL/I V4.5 compiler
- Support for z/OS XL C/C++ V2.1 compilers
- Support for CICS Transaction Server V5.2
- Supporting CICS TS V5.3 Open Beta program
- DB2 V11 for z/OS
- IMS 13 Transaction and Database Servers
- WAS for z/OS V8.5
- MQ for z/OS V8.0

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Debug Tool: Continuous advancements

Technical Preview

Web: Code coverage
- Browser interface for reviewing code coverage report.
- Quickly understand coverage of regression testing effort.
- Drill down to source line level for detailed analysis.
- Code coverage services can be accessed via APIs.

Eclipse: Load Module Analyzer
- Analyzes MVS load modules or program objects to determine the language translator (compiler or assembler) used to generate the object for each CSECT.
- Invoke Load Module Analyzer from Eclipse environment.

ISPF: JCL Wizard
- An ISPF edit macro that can be used to modify a JCL or procedure member, creating the statements to invoke Debug Tool in various environments.
- Creates statements to invoke Debug Tool for z/OS for:
  - Terminal Interface Manager, Mainframe Interface, Remote GUI.

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Enterprise COBOL V5.1 & V5.2 Exploitation

Enterprise COBOL V5.2

• Provides easy migration from COBOL V5.1
• Includes all enhancements delivered in COBOL V5.1 PTFs
  – Restored migration features, performance features, new programing features
• Provides Day 1 support for z13 processor
  – Instruction scheduler tuned to new micro architecture at ARCH 11
  – Expanded use of Decimal Floating Point for PACKED-DECIMAL data
  – Uses new SIMD instructions for INSPECT TALLYING or REPLACING statements
• Improves Application Performance
  – Well-structured, compute intensive batch applications running on z13 (compiled with Enterprise COBOL V5.2) have shown CPU time reduction of up to 14% over the same applications running on zEC12 (compiled with the GA release of Enterprise COBOL V5.1) ¹

PD Tools Exploitation

• The new DWARF format side file of COBOL V5.1 brings a significant advantage for its users especially when performing problem diagnosis using tools like PD Tools:
  – Program information required for problem diagnosis is stored in the same file as the load module.
  – This simplifies the management of side files as it is no longer required to maintain load modules and matching side files separately.
  – Since DWARF information is created and stored while link edit the program, it eliminates the possibility of side file mismatch.
  – No performance penalty for selecting the DWARF option. DWARF information is not loaded into storage while program executes normally. It is only read from the file when it is required by problem diagnosis tools like PD Tools.
• Application Performance Analyzer for z/OS, Debug Tool for z/OS and Fault Analyzer for z/OS fully exploit the new DWARF format COBOL V5.1 side file format.
• All tools supports new z13 hardware instructions exploited by the compiler.
• File Manager for z/OS continues to support COBOL V5.1 level COPYBOOKs.

¹ Results are based on an internal compute-intensive test suite. Performance results from other applications may vary.

developerWorks Article: Prepare to upgrade to Enterprise COBOL for z/OS V5
Enterprise COBOL for z/OS V5.1.1 Migration Guide

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Improved Productivity

Application is abending. What do I do?

Simple S0CB in COBOL program analysis

Steps without FA:
1. Capture CEEDUMP or MVS dump
2. Determine abend offset into program from dump traceback
3. Obtain a matching compiler listing – need to make sure it really matches!
4. Using the listing, identify the matching source line for the abend offset
5. Identify data fields involved and their offsets into working storage
6. Validate the content of each data field in the dump to determine the one(s) in error
7. Fix the problem

Do I really want to do this?
Improved Productivity

Solution provided by Fault Analyzer report

Gives you an explanation of failure and pinpoint erroneous source line #

Displays source information involving in the error

Showing you precisely what data needing the fix

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Fault Analyzer: Continuous advancements
COBOL Explorer: Post-mortem debugger

- Want to understand the execution path which led to a failure from a dump?
- Want to see how a variable changed and contributed to a failure?
- COBOL Explorer is a new feature of Fault Analyzer which lets you interactively navigate through your application from the point of failure, examining variable ref/def

Start

Main program

Statement you need to fix!!!

MOVE 0 AVALUE.
MOVE 100 ATOTAL.
CALL CALC USING AVALUE ATOTAL.

Subroutine CALC

......
LINKAGE SECTION.
01 X PIC 9(4).
01 Y PIC 9(4).
......
DIVIDE Y BY X GIVING Z.
......

Available in Fault Analyzer V13 with PTF UI18641
Watch the video @ http://www.youtube.com/watch?v=ZXwsaBnfk2Q
File Manager: Continuous advancements
Data scrambling – protecting sensitive information

File Manager in conjunction with Optim ODPP APIs provides powerful data scrambling for your enterprise data residing in a variety of locations on z/OS.

• Work with complex data structures such as SMF records and CSC Hogan Systems data.
• Support for most data sources found on z/OS: DB2, IMS, Data Sets, HFS files, WebSphere MQ, and CICS TS.
• Take advantage of powerful File Manager’s copy function.

### COPY types

1. Simple copy (scramble)

   ![Simple copy diagram]

2. Reformat copy

   ![Reformat copy diagram]

3. Selective copy (scramble)

   ![Selective copy diagram]

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APA: Continuous advancements

How to fix performance related problems?

This job is mostly CPU intensive, but also has a lot of wait time. Tuning should focus on CPU but also consider wait time.

Much of the CPU time is in application modules.
APA: Continuous advancements
How to fix performance related problems?

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Summary

Many companies spend >70% on keeping lights on, and that amount is increasing.

IT organizations have problems modifying applications at speed of business.

IBM provides a structured approach to incrementally modernize your portfolio:

- based on business priorities

Change without a plan is chaos.

A Plan without change is stagnation.

Business goals change:

- applications need to change to address goals.

Continual renewal is required:

- tools help to guide, govern, drive, and accomplish change.
Getting started
Next steps to modernize your enterprise applications

www.ibm.com/rational/modernization

- Try latest System z software for free
- Sign up for free web-based training
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