# FASUG - Fairfield Application Systems Users Group

## Openi – Exploring Open Source Solutions on IBM i

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RogueWave
S O F T W A R E
Innovate with Confidence

# About Me



**Open Source Software (OSS) Background**
- Test team lead for original enablement of Linux on AS/400 in 2001
- Linux instructor as Adjunct Professor for University of MN in early 2000s
- RHCE certified
- LPIC level 1 & 2 certified
- Mirantis Openstack Professional certification
- Headed up OSS center of competency for the iSeries Technology Center (precursor to IBM Lab Services)
- Lead consultant on OSS team in IBM Lab Services

- 39 Years in the Industry
- Worked with multiple of *NIX variants including AT&T System V Release 3, DGUX, SUN/OS, Linux…
- Worked with many different hardware platforms including PDP 11/70, AT&T 3B2/400, MainFrame, AS/400, PC/XT, PC/AT,…
- Started out in development including Model 204, PL/1, Pascal, C
- Also worked with Database, Quality Assurance, Technical Sales Support, Customer Enablement
- IBM technical advocate for initial roll-out of PHP enablement on IBM i

- Still working on wife 1.0
- Have 3 Children
  - 2 Married Sons
  - 1 Daughter – never getting married!

Newest Edition to the team!!

# Agenda

- OSS Background

- Open Source Programming Languages

- IBM i Open Source Technologies Licensed Program (5733-OPS)

- IBM RPM Pile (beta)

- A Couple Quick Examples

  - bash

  - git

# OSS Background

# Open Source Solutions on IBM i

| Legacy Offerings | 5733OPS | Integration | Community |
|---|---|---|---|
| Apache<br>OpenSSL<br>OpenSSH<br>JTOpen<br>etc | Python<br>Node.JS<br>Git<br>Orion<br>etc. | XMLService<br>Language Toolkits<br>IBM I Services (SQL)<br>etc. | Many I OSS projects<br>Active collaboration<br>Blogs, articles<br>etc. |
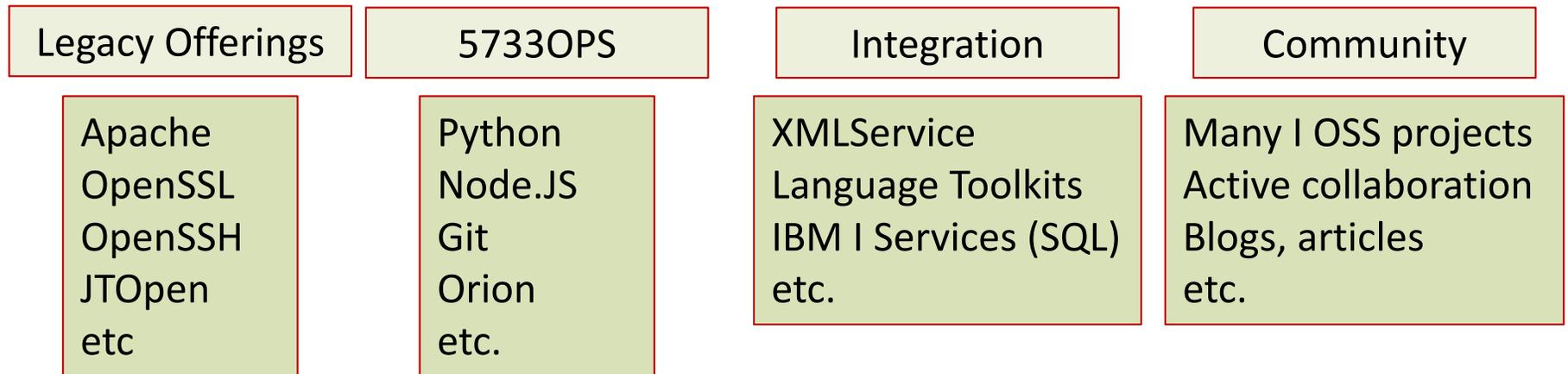
# Is Open Source Strategic

"…the real story is in the adoption of additional development languages, especially open source tools. Nearly 75% of survey respondents are using open source development tools on IBM i."

https://www.helpsystems.com/resources/guides/ibm-i-marketplace-survey-results

**What open source development tools are you using for IBM i apps? Check all that apply.**

| Tool | Percentage |
| --- | --- |
| Apache | 36.8% |
| PHP | 31.0% |
| Node.js | 11.9% |
| Git | 11.7% |
| Python | 11.0% |
| Ruby | 4.3% |
| Samba | 3.8% |
| Orion | 3.0% |
| Pearl | 2.9% |
| GLC (OpenGL for 3D Applications) | 0.8% |
| None | 26.2% |
| Other (Write-in) | 12.8% |

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SOFTWARE

# Open Source Solutions address many of the top concerns of IBM i shops



| Security | High Availability/ Disaster Recovery | Modernizing Applications | IBM i Skills | Reduce IT Spending | Data Growth |
|----------|------|------|------|------|------|
| 72.0% | 56.8% | 54.4% | 44.3% | 33.2% | 32.7% |
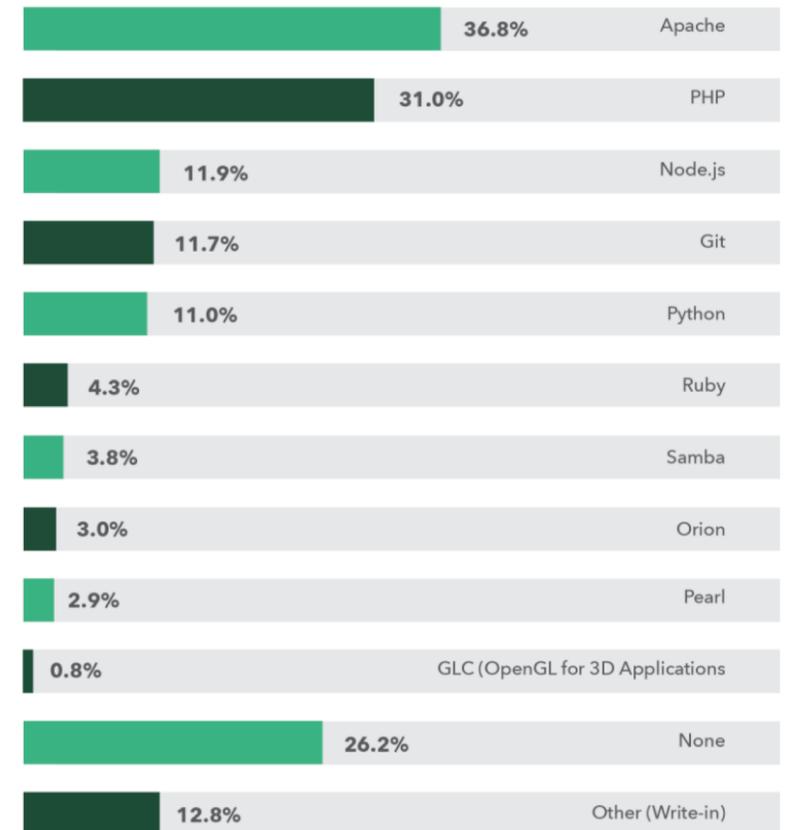
https://www.helpsystems.com/resources/guides/ibm-i-marketplace-survey-results
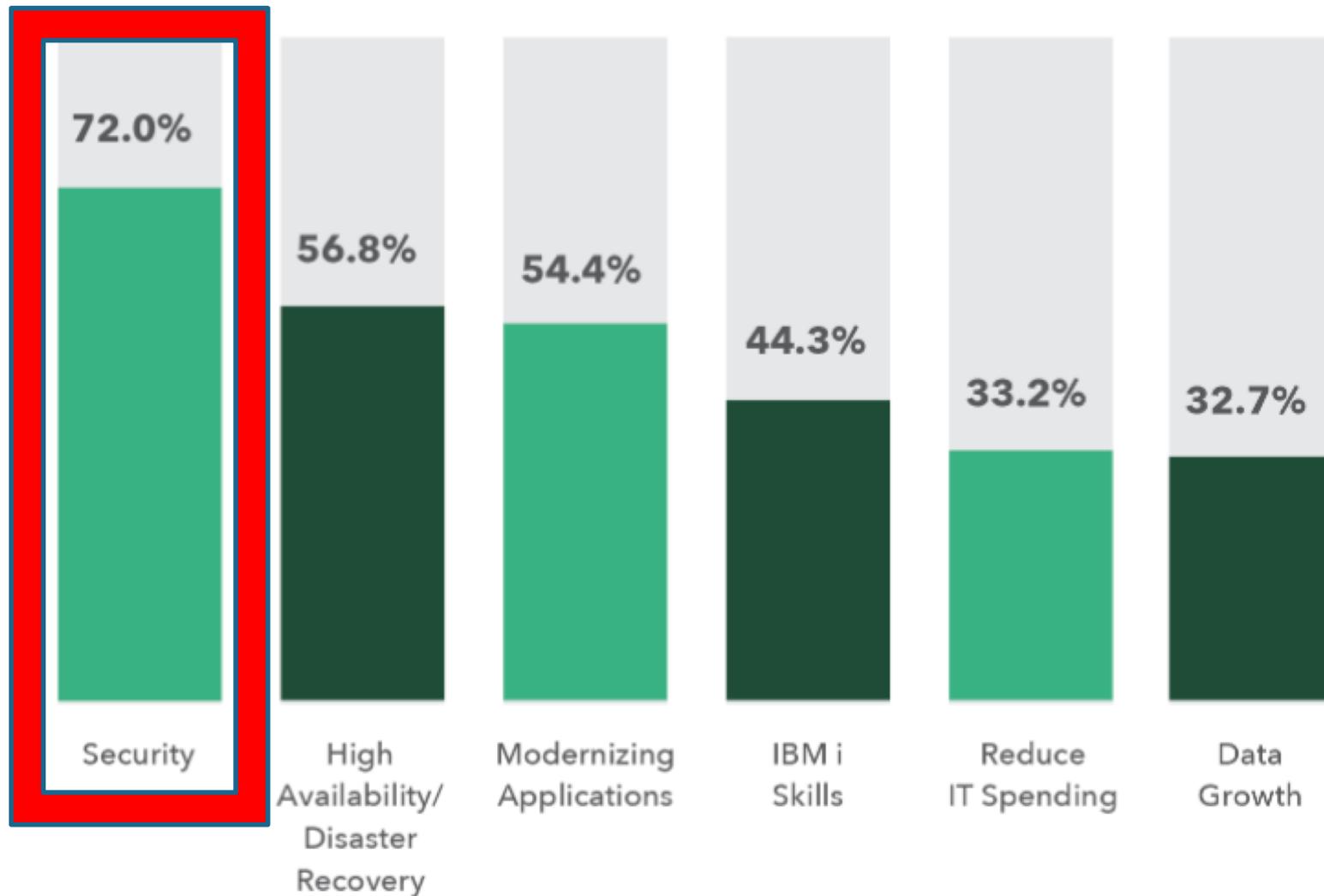
# Core Infrastructure Initiative (CII)

A project managed by The Linux Foundation whose intent is to enable technology companies, stake holders, and developers to collaboratively identify, fund and improve the security of critical open source project.

**Members of CII include** →



https://www.coreinfrastructure.org/

# Open Source vs. Closed Source (proprietary)

| Open Source | Closed Source/Proprietary |
|---|---|
| Malicious people have easy/ready access to source code | Malicious people can't see source code but can still reverse engineer |
| Funded by a community, coalition, or foundation | Funded by the owner |
| Zero to many developers | Traditional development team |
| Code quality can be verified – peer review | Code quality assured by owner – typically internal review |
| Anyone can fix defects | Owner fixes defects |
| Community maintains update schedule | Owner maintains update |
| Testing community driven including "bounty hunters" | Owner-staffed test team |
| Generally quick to adopt new protocols. [OpenSSL support for TLSv1.3 since April 5] [NSS support since before then] | Requirements submitted to product owner for new protocols. |

# Open Source Solutions address many of the top concerns of IBM i shops



**Security** — 72.0%
**High Availability/ Disaster Recovery** — 56.8%
**Modernizing Applications** — 54.4%
**IBM i Skills** — 44.3%
**Reduce IT Spending** — 33.2%
**Data Growth** — 32.7%

https://www.helpsystems.com/resources/guides/ibm-i-marketplace-survey-results
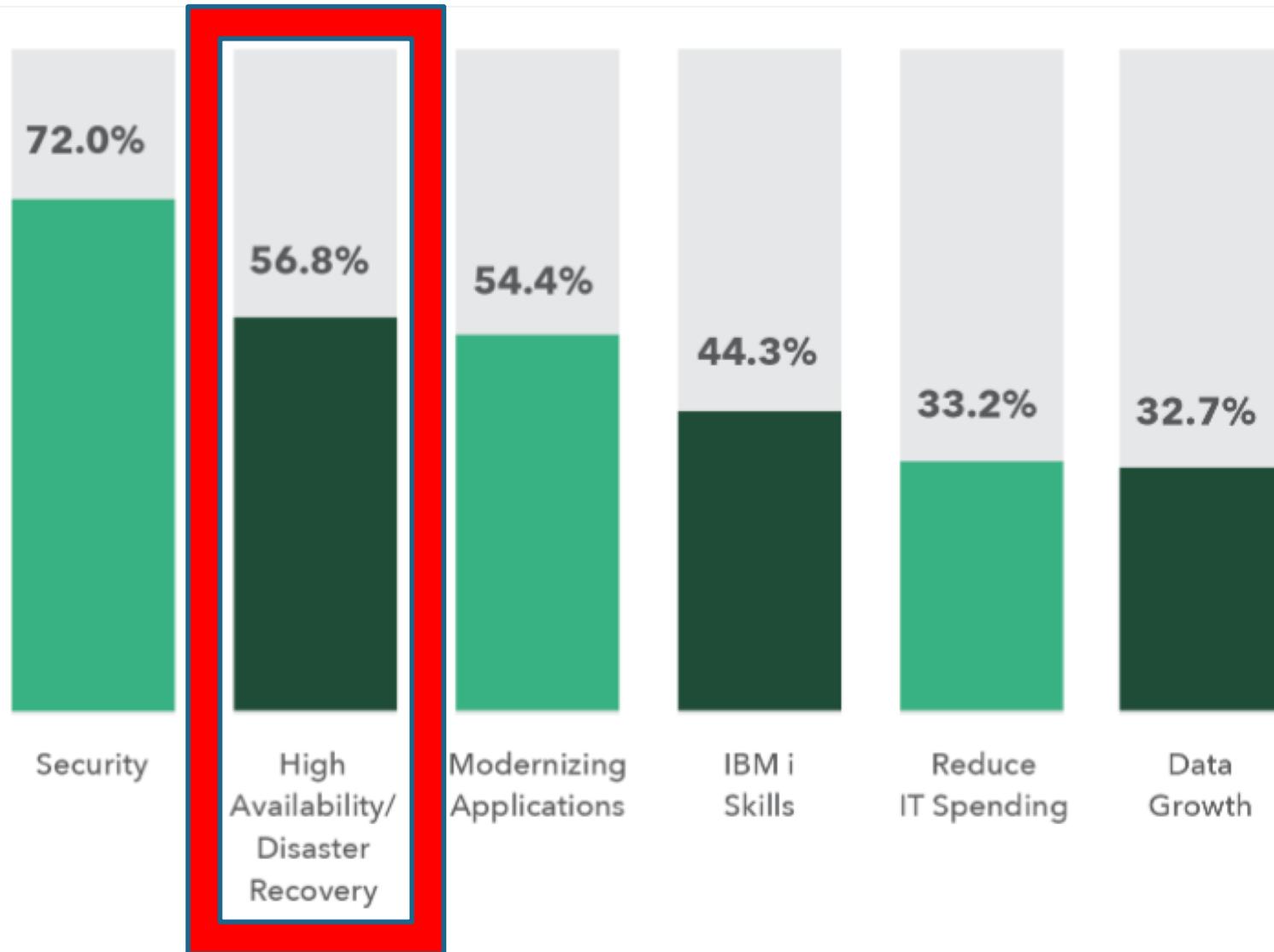
# Better availability through load balancing
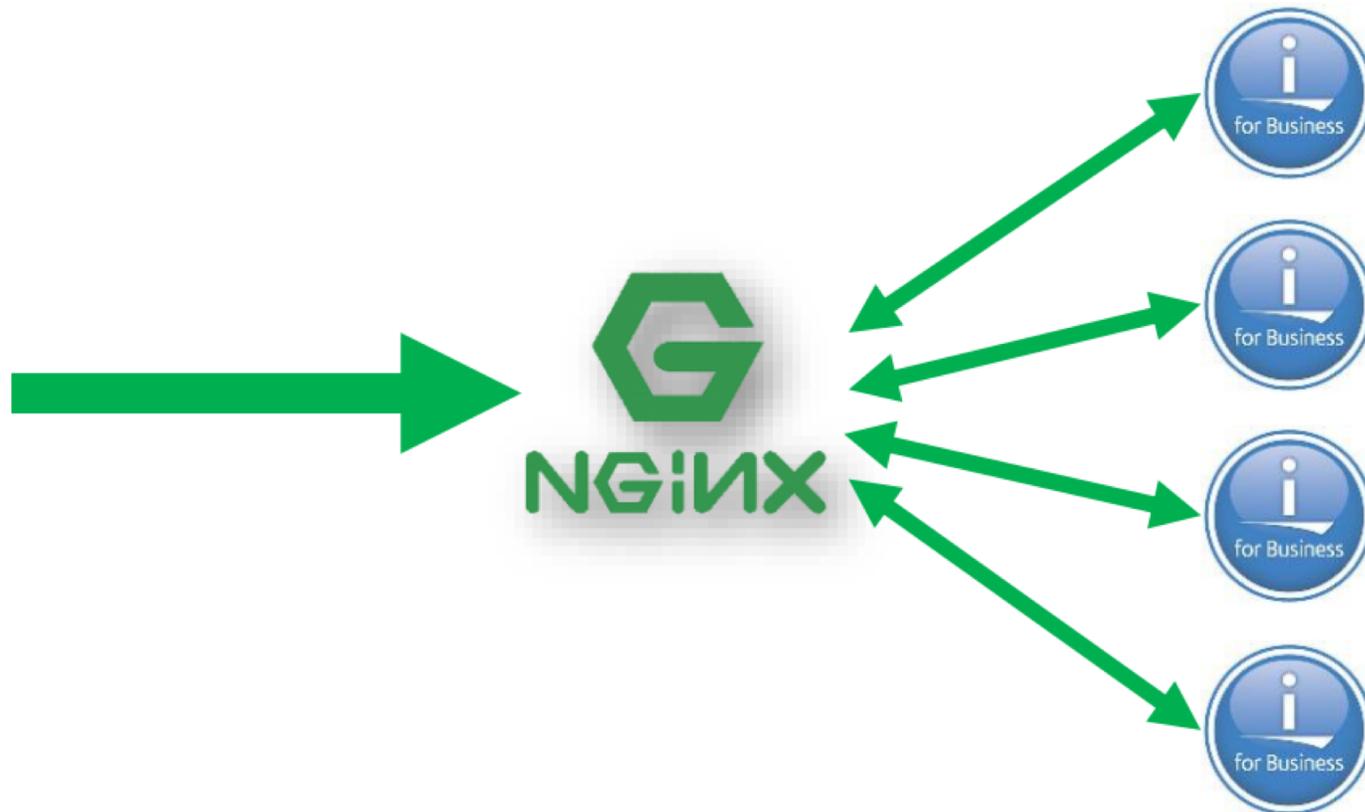


NGINX is an open source package that supports functions such as web serving, reverse proxy, caching, load balancing, media streaming and more.

And YES, NGINX runs on IBM i!

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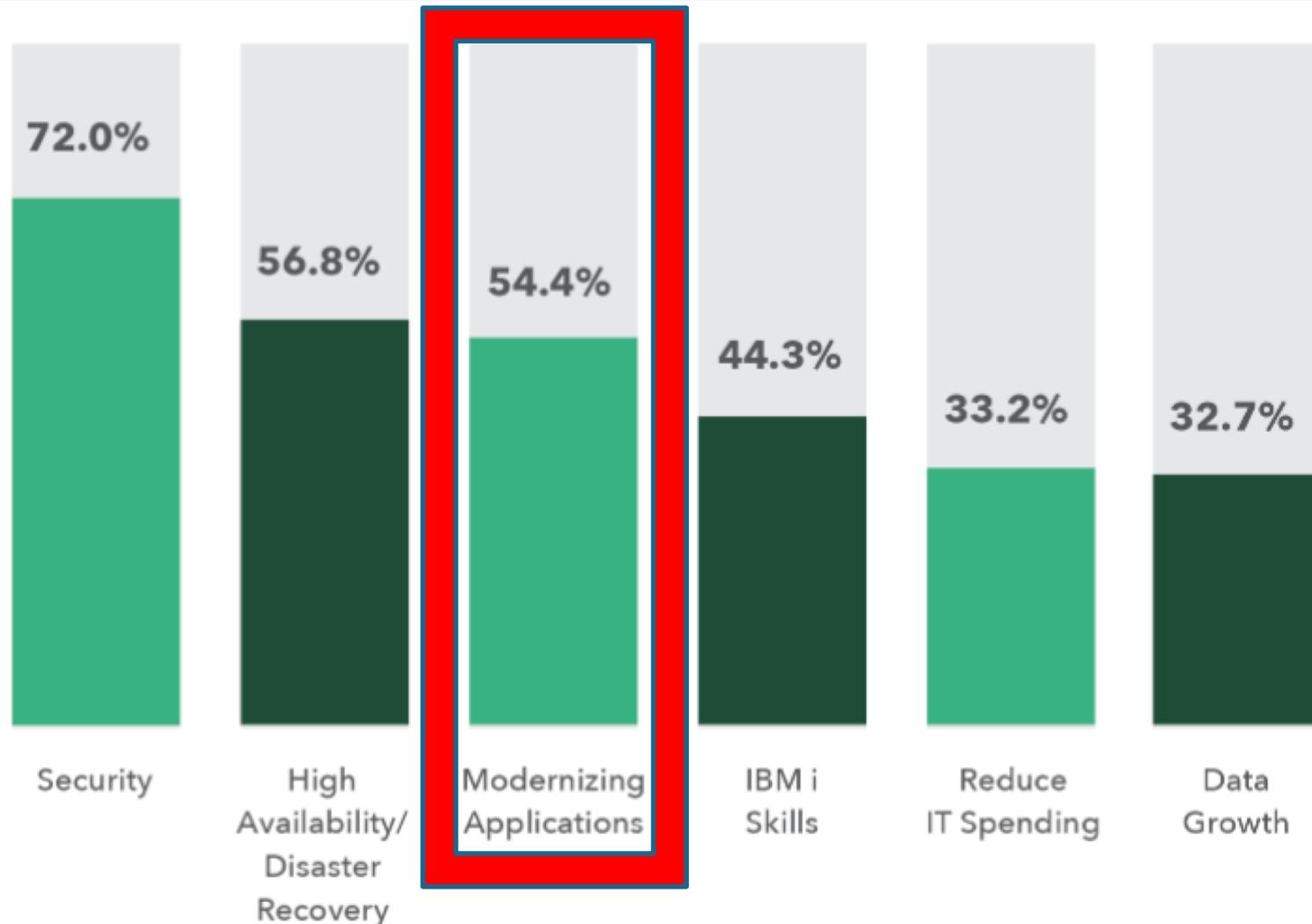
# IBM addresses modernization with every new version

- <u>FastCGI</u>

  – Allows fast connection from HTTP server to backend PASE environment

  – Instrumental in PHP performance

- <u>ILE Object Toolkit</u>

  – Allows connects from various languages (PHP, Python, perl, ruby, etc) to ILE objects and IBM I native artifacts

- <u>SQL Connector</u>

  – Easily integrated way to transfer data to and from DBF2 for i leveraging SQL.
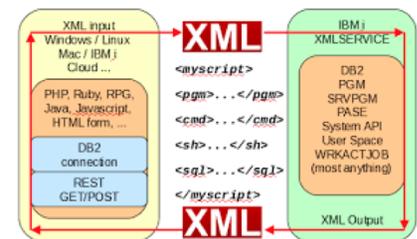
# The Web is driven by Open Source

- Languages
  - PHP
  - Python
  - Ruby
  - Javascript
- Packages
  - JSON / XML
  - Swagger API framework
  - SOAP libraries
  - Web frameworks

- Application Framework/Servers
  - Apache Tomcat / TomEE
  - Jboss EAP
  - Greenfish
  - Rails
  - Epxress.js
  - Salis.js
  - Django
  - Bottle
  - Flask
- HTTP Servers
  - Apache HTTP Server
  - nginx
  - Eclipse Jetty

# DB2 Storage Engine for MySQL and MariaDB

- Supports open source applications (i.e., LAMP-based) while simplifying data management

  - Applications written to MySQL or MariaDB can store their data in DB2 without any code change

  - One database to manage, backup, and protect

  - RPG applications, DB2 Web Query have access to MySQL/MariaDB generated data.

- PHP, Apache, and MySQL/MariaDB enable 1000s of applications on IBM I including:

  - CRM, ecommerce, Portals, Wikis, blogs, etc



| PHP Application | RPG Application |
|---|---|
| Writes to | Accesses Data |
| MySQL/MariaDB | |
| Data stored in | |
| DB2 for i | |

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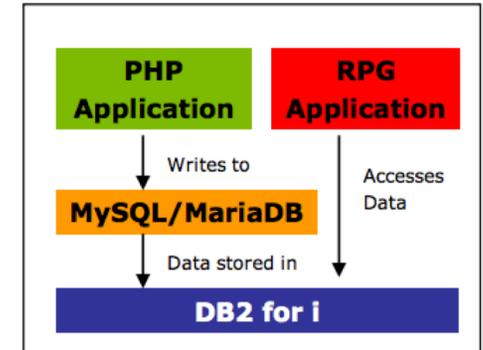
# IBM i – enabled for Open Source Solutions

- IBM i runs many of the industry standard technologies, such as PHP, Apache, and MySQL/MariaDB that enables web solutions like Jenkins and Wordpress to be run natively on the platform

- These applications can be easily deployed and leveraged

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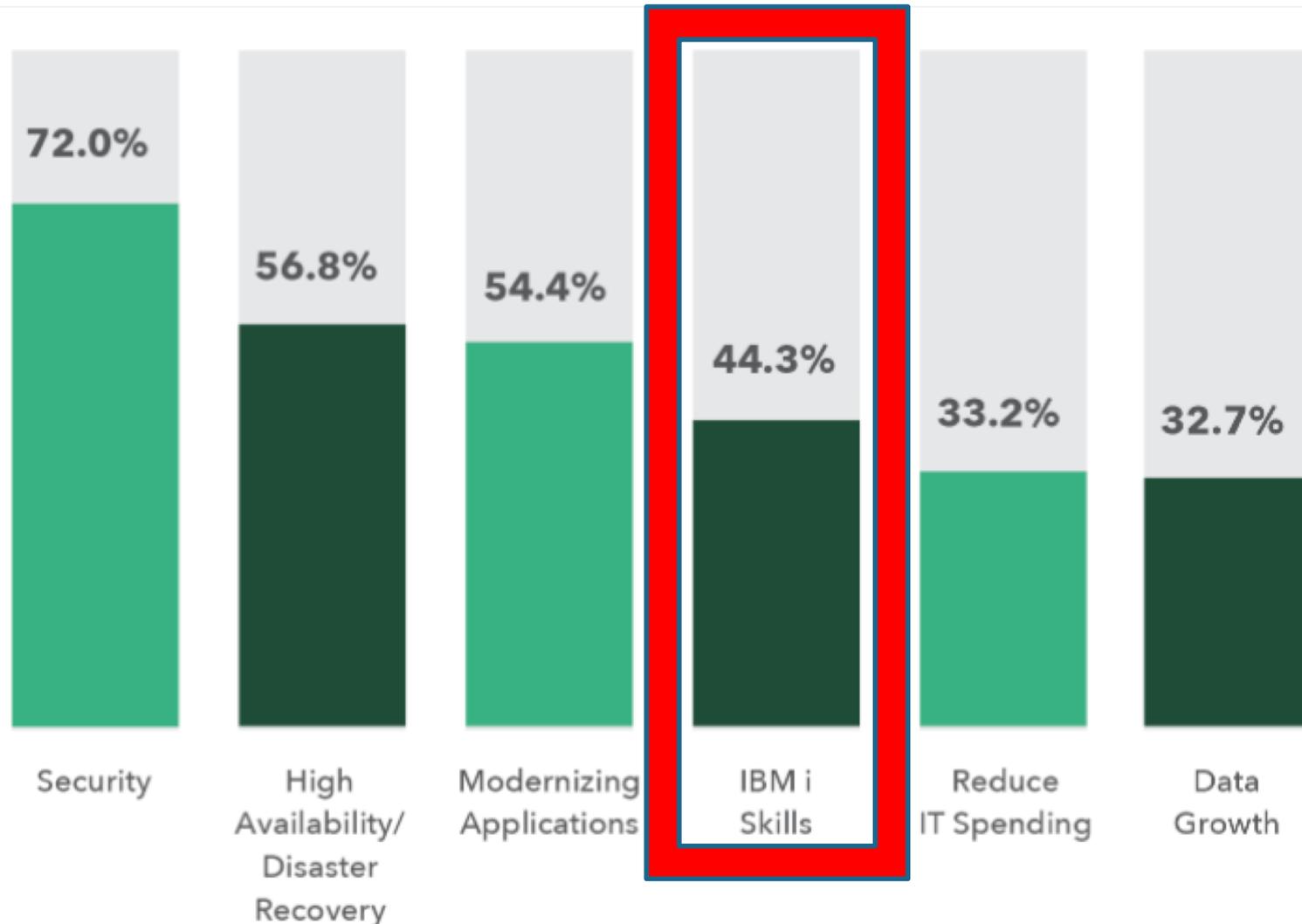
# Open Source Skills in High Demand

- The Open Source skills are the skills being sought after
  - Universities and trade schools offer wide-range of open-source related courses

| Mar 2018 | Mar 2017 | Change | Programming Language | Ratings | Change |
|----------|----------|--------|----------------------|---------|--------|
| 1 | 1 | | Java | 14.941% | -1.44% |
| 2 | 2 | | C | 12.760% | +5.02% |
| 3 | 3 | | C++ | 6.452% | +1.27% |
| 4 | 5 | ^ | Python | 5.869% | +1.95% |
| 5 | 4 | v | C# | 5.067% | +0.66% |
| 6 | 6 | | Visual Basic .NET | 4.085% | +0.91% |
| 7 | 7 | | PHP | 4.010% | +1.00% |
| 8 | 8 | | JavaScript | 3.916% | +1.25% |
| 9 | 12 | ^ | Ruby | 2.744% | +0.49% |
| 10 | - | ^^ | SQL | 2.686% | +2.69% |
| 11 | 11 | | Perl | 2.233% | -0.03% |

https://www.tiobe.com/tiobe-index/

# Skills

- Acquisition
  - Easy to find developers to write applications on your IBM I

- Utilization
  - Open Source technologies/languages provide opportunity for current staff to learn new skills

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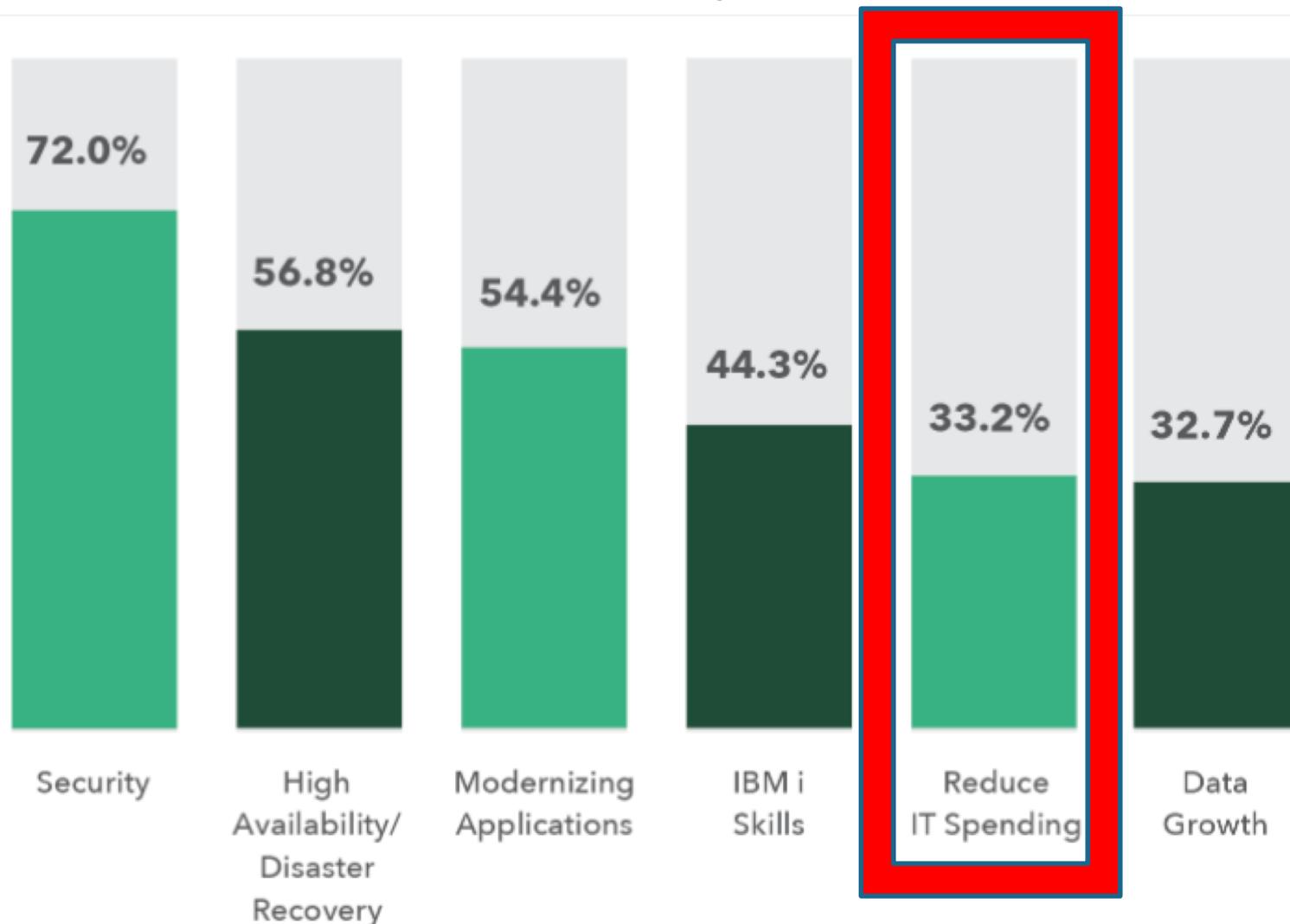
# Open Source Free?

- Sort of, but... consider

    – The "glue" required to integrate various technologies together

    – OSS licensing – not all are created equal

    – Staying current

    – Getting support

# Leverage the Community!

- Node Package Manager (npm) – package manager for Javascript (considered the world's largest repository of packages

  650,000 packages

- Preferred Installer for Python (pip/pip3) – package management system to install and manage software packages written in Python

  125,000 packages

- Yellowdog Updater, Modified (yum) – package management system to install/manage RPM packages

```
$ npm install jshint
jshint@2.5.11 node_modules/jshint
├── strip-json-comments@1.0.2
├── underscore@1.6.0
├── exit@0.1.2
├── console-browserify@1.1.0 (date-now@0.1.4)
├── minimatch@1.0.0 (sigmund@1.0.0, lru-cache@2.5.0)
├── shelljs@0.3.0
├── cli@0.6.5 (glob@3.2.11)
└── htmlparser2@3.8.2 (domelementtype@1.1.3, domutils@1.5.0, entities@1.0.0,
domhandler@2.3.0, readable-stream@1.1.13)
$ ls node_modules/
jshint
$ ls node_modules/jshint/
README.md  bin  data  dist  node_modules  package.json  src
$ ls node_modules/jshint/node_modules/
cli  exit  minimatch  strip-json-comments  console-browserify  htmlparser2
shelljs  underscore
```

```
$ pip install xlswriter
Downloading/unpacking xlswriter
  Downloading Xlswriter-0.7.3-py2..
Installing collected pacakges:
xlswriter
Successfully installed xlswriter
Cleanup up…
$
```

```
# yum list packages
ibm
                | 1.5 kB  00:00
ibm/primary
                | 86 kB  00:00
ibm
                        223/223
Error: No matching Packages to list
bash-4.4# yum list available
Available Packages
autoconf.noarch
2.69-1                    ibm
automake.noarch
1.15-1                    ibm
bison.ppc64
3.0.4-1                   ibm
bzip2.ppc64
1.0.6-5                   ibm
```

# Language toolkits (all open source)

- Node.JS itoolkit
    - https://bitbucket.org/litmis/nodejs-itoolkit
- Python itoolkit-lite
    - http://yips.idevcloud.com/wiki/index.php/XMLSERVICE/Python
    - https://bitbucket.org/litmis/python-itoolkit
- PHP Toolkit for IBM i
    - http://files.zend.com/help/Zend-Server-IBMi/content/php_toolkit_xml_service_functions.htm
    - http://www.seidengroup.com/toolkit/
- Ruby itoolkit
    - https://bitbucket.org/litmis/ruby-itoolkit
- Swift
    - https://bitbucket.org/litmis/swift-itoolkit

# Open Source Solutions address many of the top concerns of IBM i shops

72.0% — Security

56.8% — High Availability/ Disaster Recovery

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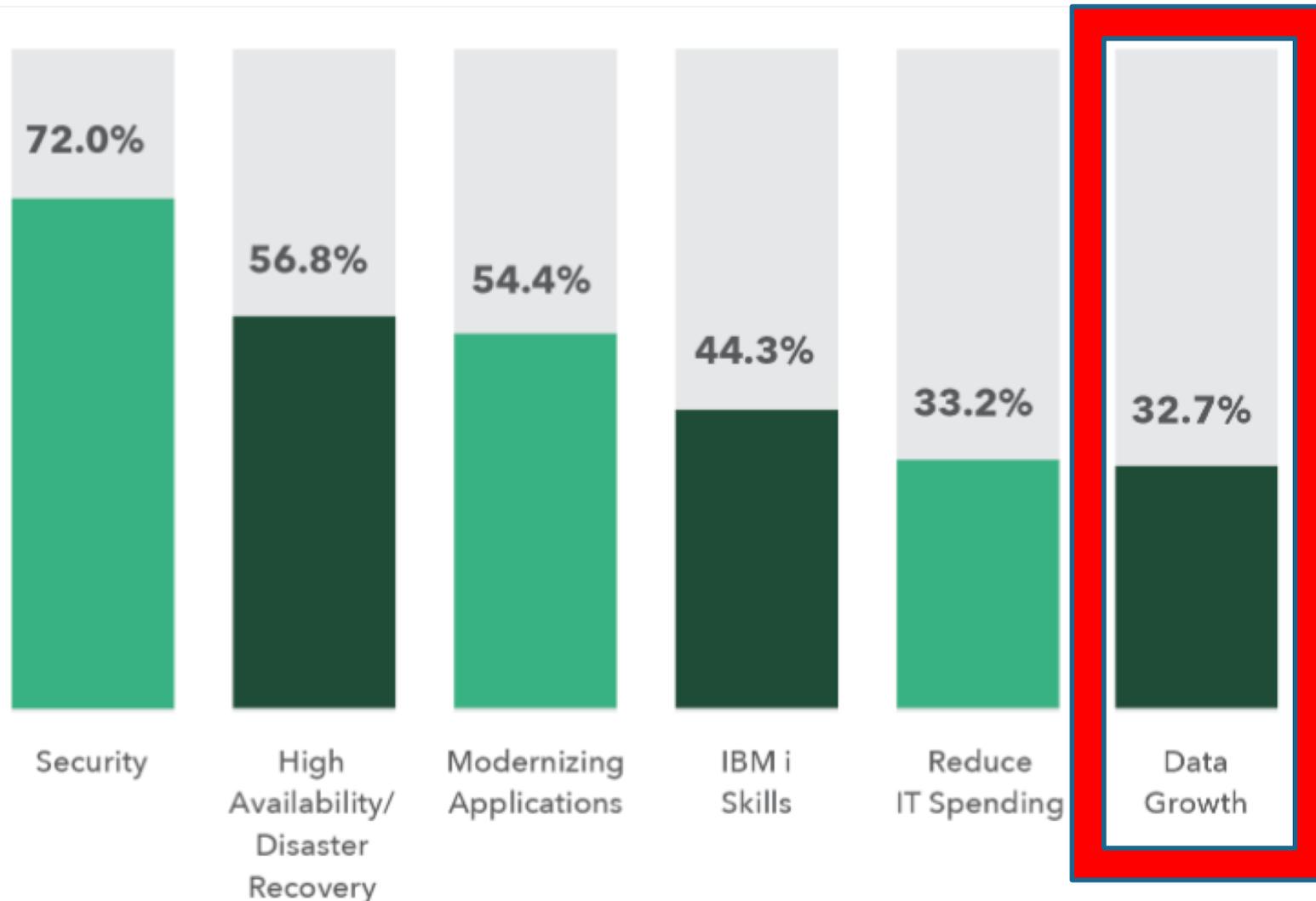
# Analytics/Business Intelligence

- Many packages available in open source communities

- Often these packages can run on the IBM i, or integrate with IBM I with the help of open source technologies

# Integration with other data sources

- Most new/modern languages have OSS packages to interact with social media

- Various OSS packages facilitate the consumption of XML or JSON feeds

- Many databases have open source clients available

# Open Source Programming Languages

# Mobile & web development

**75%**
attacks are on web applications

**87%**
developers experience delays in deployment
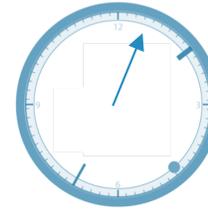
**1 second**
delay reduces conversion by 7%

**40%**
developers spend half their time on problem resolution

## Enterprise PHP demands…

**Fast** resolution time and reduced PHP maintenance

**100% uptime** and accelerated performance

**Seamless** scaling to meet ongoing and peak demands

**Bulletproof**, compliant web applications

# Zend portfolio

**Comprehensive runtime for enterprise PHP**

**Web & Mobile**

Secure access
- Complete stack support
- Website obfuscation
- PCI compliance

Availability
- Performance optimization
- Pinpoint troubleshooting
- Seamless administration & maintenance
- Scale out & up
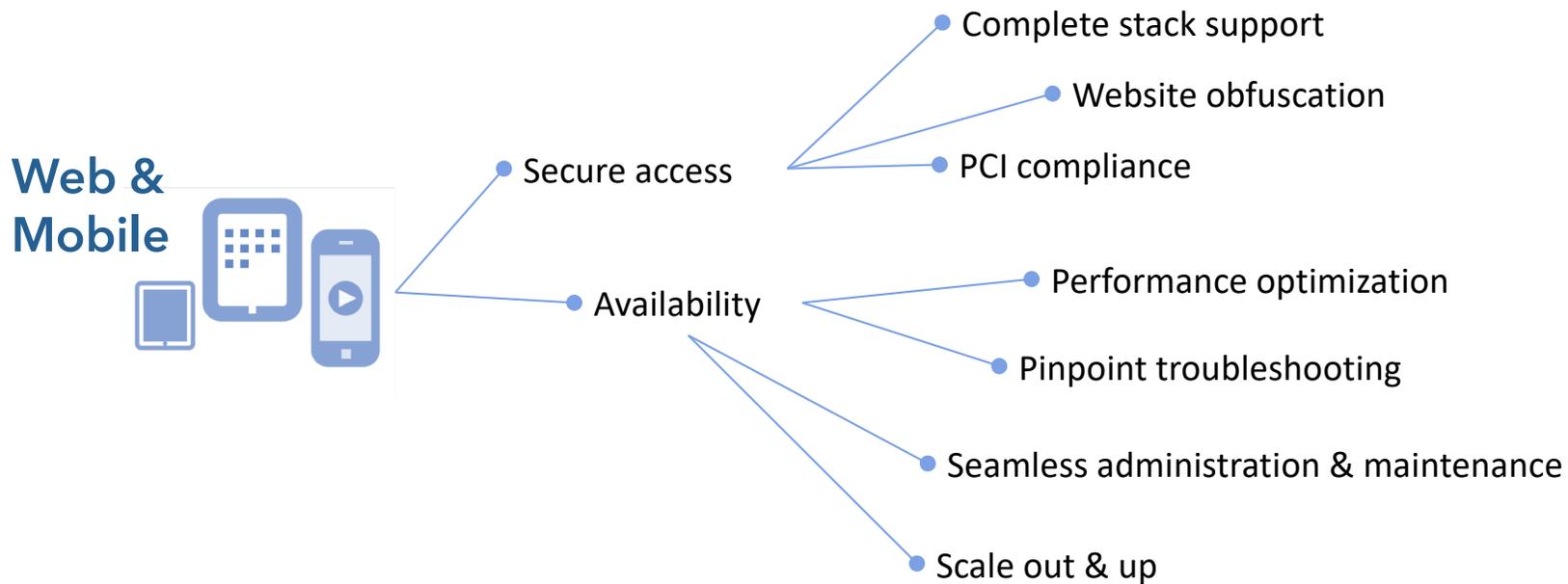
| Secure | Manage | Build | Deploy |
|--------|--------|-------|--------|

# What is PHP

- PHP is an easy to use, open source, platform independent scripting language

  - Designed for web application development

  - 4.5+ Million PHP Developers

- PHP is the leading scripting language deployed on the Internet

- Thousands of PHP applications are available

  - Web applications tied to databases

  - Content management

  - Wikis and Blogs

    Check-Out:

    www.phpjunkyard.com/

    www.phpfreaks.com/

```php
<?php
 echo "Hello World!";
 echo "PHP is so easy!";
?>
```

# Web Development/Deployment Stacks

**L** **A** **M** **P**
Linux Apache MySQL PHP

**W** **A** **M** **P**
Windows Apache MySQL PHP

**i** **A** **D** **P**
BMi Apache DB2 PHP

**i** **A** **M** **P**
BMi Apache MySQL PHP

# Drivers for PHP growth

- The Migration to Web Applications
  - When did you last install a desktop application?
  - Emerging generation of software services (**Web2.0**)
  - PHP is the leading web development platform

- Software buyers favor Open Source Software
  - OSS adoption driven by cost of ownership benefits, freedom from vendor lock in, and superior software quality

- PHP is the perfect Web Integration Platform
  - Best support for browser based rich client applications (Ajax)
  - Strong support for Web Services, XML & legacy systems
  - Powerful **SOA** capabilities enable new IT approaches ("mashable assets") for reducing application backlogs

- PHP is backed by a very active community
  - ~ 1000 committers, ~ 4.5M developers (corporate/community)
  - Thousands of opensource projects and applications
  - Hundreds of thousands of commercial deployments
  - High profile PHP applications like Yahoo!, Flickr and YouTube
  - High profile ISV backing, IBM, Oracle, Microsoft, Adobe, etc.

# What are IBM i Customer's Doing with PHP?

1. **Consolidation:**   Move PHP applications that are running on Windows or Linux that access data in DB2 to run in IBM i to speed up or reduce complexity of the applications.

2. **Modernization:**  Use PHP to web-enable green screen applications.

3. **New application development:**   Create new applications with PHP on IBM i including applications for the intranet, reporting, websites, and extranets.

4. **Leveraging PHP portfolio:** Run commercial or opensource PHP applications on IBM i.

# MySQL + PHP on IBM i Applications

- Examples on IBM i www.zend.com/forums

  - **MySQL** (Open Source DB) on i5/OS - http://www.zend.com/forums/index.php?t=msg&goto=3004

  - **MediaWiki** (Open Source Wiki) on Zend Core for i5/OS - http://www.zend.com/forums/index.php?t=msg&th=3134

  - **SugarCRM** (Open Source Customer Relationship Management (CRM)) on Zend Core for i5/OS - http://www.zend.com/forums/index.php?t=msg&th=3111

  - **Joomla!** (Open Source Content Management System) on Zend Core for i5/OS - http://www.zend.com/forums/index.php?t=msg&th=3068

  - **Zen Cart** (Open Source Online Store) on Zend Core for i5/OS - http://www.zend.com/forums/index.php?t=msg&th=3041

  - **PmWiki** (Open Source Wiki) on Zend Core for i5/OS - http://www.zend.com/forums/index.php?t=msg&goto=8085

  - **PHP-Nuke** (Open Source Content Management System) on Zend Core for i5/OS - http://www.zend.com/forums/index.php?t=msg&goto=3541

Content Management　　　　　　　　Wiki　　　　　　　　E-Commerce



Bug Tracking　　　　　　　　CRM
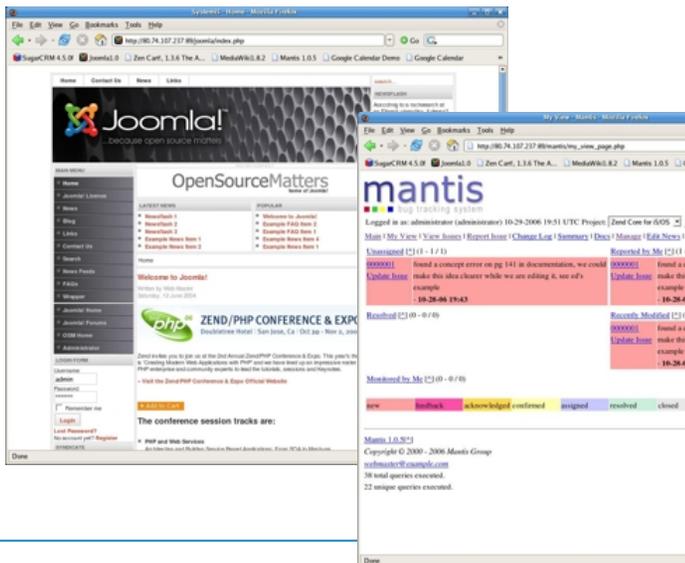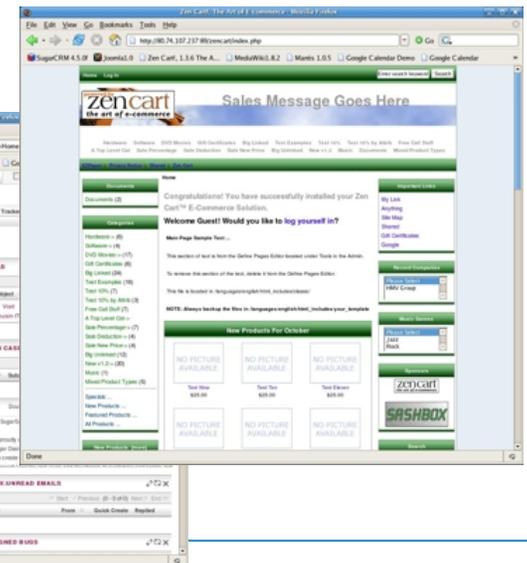
# Accessing DB2/400

- Server/connection
  - db2_bind_param
  - db2_client_info
  - db2_close
  - db2_connect
  - db2_cursor_type
  - db2_exec
  - ✓ db2_execute
  - ✓ db2_prepare
  - db2_pconnect
  - db2_server_info
  - db2_statistics
- Result
  - db2_free_result
  - db2_next_result
  - db2_result
- Commit/Rollback
  - db2_autocommit
  - db2_commit
  - db2_rollback

- Fetch
  - db2_fetch_array
  - db2_fetch_assoc
  - db2_fetch_both
  - db2_fetch_object
  - db2_fetch_row
- Field information
  - db2_field_display_size
  - db2_field_name
  - db2_field_num
  - db2_field_precision
  - db2_field_scale
  - db2_field_type
  - db2_field_width
- Key information
  - db2_foreign_keys
  - db2_primary_keys
- Statement
  - db2_free_stmt

- Errors
  - db2_conn_error
  - db2_conn_errormsg
  - db2_stmt_error
  - db2_stmt_errormsg
- Column/Procedure
  - db2_column_privileges
  - db2_columns
  - db2_procedure_columns
  - db2_procedures
  - db2_special_columns
- Table information
  - db2_num_fields
  - db2_num_rows
  - db2_table_privileges
  - db2_tables

**All of these APIs are documented online at php.net**
- ✓ **- Preferred db2_ SQL statement execution APIs (performance)**
- ▪ **- Non-preferred db2_ SQL statement execution API**

# What is the Toolkit?

- Set of classes that access IBM i native artifacts

  – All program objects

    - RPG, COBOL, CL, etc.

- Others

  – Command processor
    Data Queues

  – Spooled File

  – More…

- Access naturally from PHP code.

  – No SPs required

- Easy to use
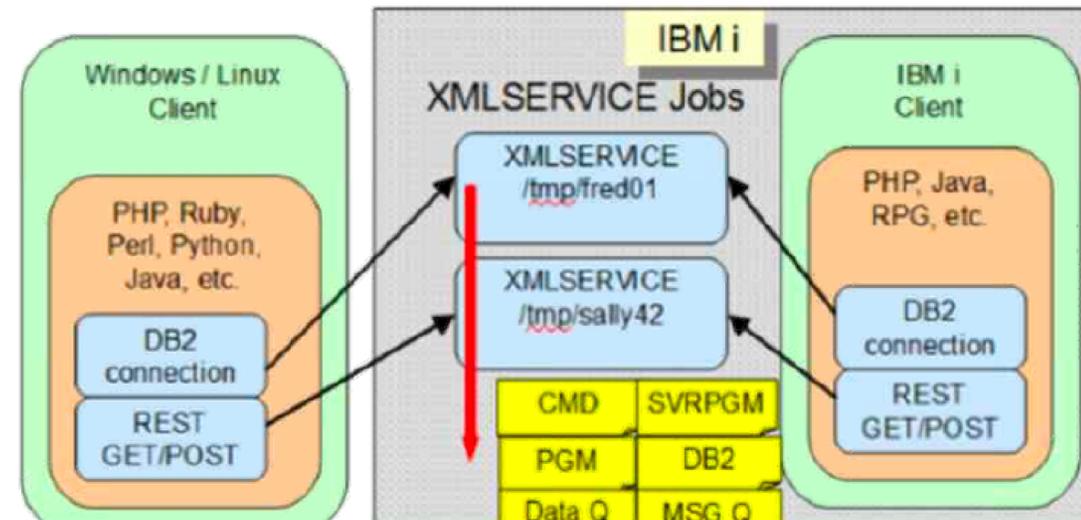
# Ruby on Rails

- Ruby is a dynamic, open source programming language with a focus on simplicity and productivity.

- Ruby is a general-purpose scripting language

- Ruby runs in the PASE environment

- Ruby can be used for web applications, graphing libraries, picture recognition engines, threaded database servers as well as low-level system utilities.

  – Another typical use is for developing database-backed web applications according to the Model-View Control (MVC) pattern

PowerRuby is a commercially supported port of the Ruby programming language and the Ruby on Rails Web application framework for IBM i.

https://powerruby.com



powerruby.

Features    Documentation    More ⌄    Download

## Ruby on Rails can run on IBM i

The combination of the IBM i operating system and the integrated DB2 database is one of the most excellent price/performance options for large-scale business applications. Now you can get the same "Go Big" functionality with Ruby on Rails.

Find out more

# Ruby Overview

- Ruby is the programming language used to manipulate the framework

- Rails is the framework that provides the necessary infrastructure

- Rail is written in Ruby

- Ruby is considered by some to be more powerful than Perl, and more OO than Python

# Ruby Features

- Ruby is an interpreted language (No compile strep)

- Ruby is an Object Oriented Language

- Every is an object (no primitives)

- Ruby draws from Perl, Smalltalk, and Lisp

```
class HelloWorld
 def initialize(name)
     @name = name.capitalize
  end
  def sayHi
     puts "Hello #{@name}!"
  end
end
hello = HelloWorld.new("World")
hello.sayHi
```

# Python

- Popular scripting language

- Started out as a teaching language

- Based on Object Oriented concepts and paradigms

- Supports/encourages rapid development + large systems

- Code is not hard to read, write, and maintain

# Python Uses

- Shell tools

  - System admin tools, command line programs

- Extension-language work

- Rapid prototyping and development

- Language-based modules

  - Instead of special-purpose parsers

- Graphical user interfaces

- Database access

- Distributed programming

- Internet scripting

```
#!/usr/local/bin/python
# import systems module
import sys
marker = ':::::::'
for name in sys.argv[1:]:
  input = open(name, 'r')
        print marker + name
  print input.read()
```

# 5733 OPS

# Open Source for IBM i

- Option 1 — Node.JS 2.x
- Option 2 - Python 3.4
- Option 3 — GCC / chroot
- Option 4 — Python 2.7
- Option 5 — Node.JS 4.x
- Option 6 — Git
- Option 7 — Tools
- Option 8 — Orion
- Option 9 — cloud-init
- Option 10 — Node.JS 6.x

New

# Options delivered with 5733-OPS

| 5733-OPS Option | Solution | Description |
|---|---|---|
| 1 | Node.js v1 | Provides a platform for server-side Javascript applications running without browsers. [deprecated] |
| 2 | Python 3 | Popular high-level programming language. |
| 3 | CHROOT | Allows the root directory to be changed for running a command |
| 4 | Python 2 | Certain libraries don't yet support Python 3 hence the reason v2 is being provided. |
| 5 | Node.js v4 | Newer version of Node.js |
| 6 | Git | Source Control Management (SCM) system. |
| 7 | Tools | Contains many open source tools commonly found on Unix and Linux |
| 8 | Orion | Browser-based editor that supports web development languages |
| 9 | cloud-init | Script that enables virtual machine activation and initialization – used for OpenStack. |
| 10 | Node.js v6 | Newer version of Node.js |
| 11 | Nginx | Web server that can be used as a reverse proxy, load balance, and HTTP cache. |

# IBM i support for Samba

- What it is:  An open-source SMB-based network protocol for providing fast, stable, and secure file access.

- What about NetServer:  A fuller-featured SMB solution that provides functions beyond the open-source SAMBA support

  - Kerberos

  - Automatic CCSID conversion

  - Integration with IBM I auditing exit programs

# Node.js

- Node.js facilitates the running of server-side Javascript

- Node is designed to build scalable network applications

- Node.js supports high-performance web transactions by handling many connections concurrently.

- Along with Nginx, serverless nodes can now be implemented on IBM i

```
┌─────────────────────┐
│       Proxy         │
│      [NGINX]        │
└─────────────────────┘
          │
┌─────────────────────┐
│     Framework       │
│     [Node.JS]       │
└─────────────────────┘
```

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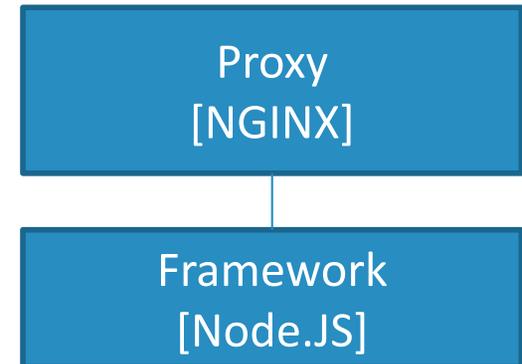
# git

- Git provides Source Code Control / Version Control

- Version control is a system that keeps records of all changes

- Enables collaborative development

- Enables auditing – knowing who did what and when

- Facilitates rolling back changes to a previous state

# Orion

- Some refer to Orion as an IDE on the cloud

- Browser-based open tools integration platform
    - Focused on developing for the web, on the web
    - Focus on web developers working on client-side JavaScript, CSS, and HTML

- Orion is a set of server and client-side components/code that when brought together make up an extensible browser-based development platform.

- Supports integration with Git, as well as shell access, site definition, dealing with various tasks, etc.

# Nginx

- Pronounced at "Engine X"

- Open Source web and reverse proxy server

- High-performance HTTP, HTTPS, SMTP, iMAP, and POP3 server

- Supports load balancing and HTTP caching

- Architecture is asynchronous and event-driven

# Nginx – Why Use It

- Lightweight and small memory footprint

- Uses predictable memory under load

- Provides high level of concurrency

- Servers static content quickly

- Handles connections asynchronously

- Uses single thread

# Open Source RPMs
# RPM Pile (beta)

# RPM Pile Overview

- IBM has released a beta of an RPM pile that provides the packages from 5733-OPS in a RPM-based repository

- This allows for installation of open source packages in a Linux-like fashion with PASE

- Currently the packages are in beta form and can be installed on IBM i 7.2 and newer

- The RPM pile contains many packages including:

  - Node.js version 8

  - Python 3.6

  - The 'less' utility

  - git

  - The 'updated' and 'locate' utilities

  - GCC 6.3.0 and other development tools

  - GNU Nano

  - Others…

The RPMs are not AIX RPMs.  They are IBM i RPMs shipping IBM i Software.  Built on IBM i, for IBM i.

https://www.ibm.com/developerworks/community/wikis/home?lang=en#!/wiki/IBM%20i%20Technology%20Updates/page/Open%20Source%20RPM's

# Installing the RPM/YUM support

- Step 1: Download the bootstrap file to your PC:

  – [ftp://public.dhe.ibm.com/software/ibmi/products/pase/rpms/bootstrap.sql](ftp://public.dhe.ibm.com/software/ibmi/products/pase/rpms/bootstrap.sql)

- Step 2: Run the SQL script against the system you want to install RPMs on
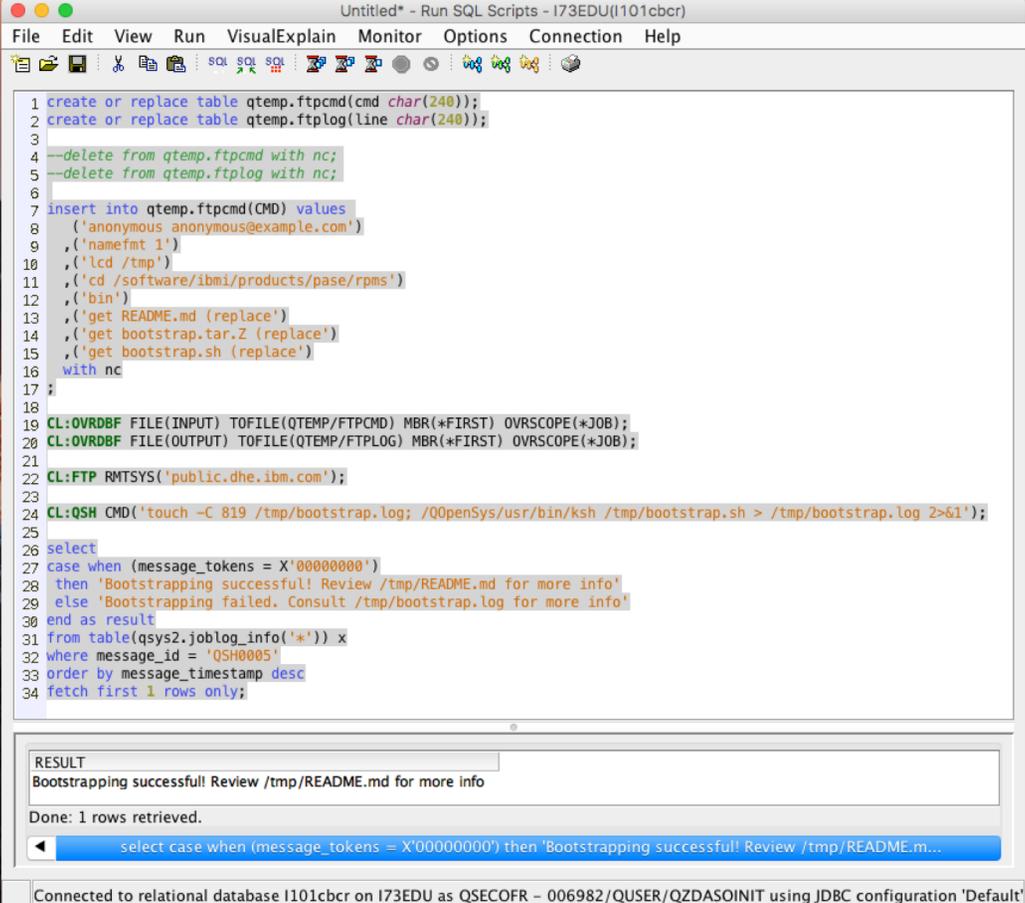
# RPM pile bootstrap

```
create or replace table qtemp.ftpcmd(cmd char(240));
create or replace table qtemp.ftplog(line char(240));
--delete from qtemp.ftpcmd with nc;
--delete from qtemp.ftplog with nc;
insert into qtemp.ftpcmd(CMD) values
    ('anonymous anonymous@example.com')
   ,('namefmt 1')
   ,('lcd /tmp')
   ,('cd /software/ibmi/products/pase/rpms')
   ,('bin')
   ,('get README.md (replace')
   ,('get bootstrap.tar.Z (replace')
   ,('get bootstrap.sh (replace')
   with nc
;
```

# RPM pile bootstrap (continued)

```
CL:OVRDBF FILE(INPUT) TOFILE(QTEMP/FTPCMD) MBR(*FIRST) OVRSCOPE(*JOB);
CL:OVRDBF FILE(OUTPUT) TOFILE(QTEMP/FTPLOG) MBR(*FIRST) OVRSCOPE(*JOB);
CL:FTP RMTSYS('public.dhe.ibm.com');
CL:QSH CMD('touch -C 819 /tmp/bootstrap.log;
/QOpenSys/usr/bin/ksh /tmp/bootstrap.sh > /tmp/bootstrap.log 2>&1');

Select
case when (message_tokens = X'00000000')
 then 'Bootstrapping successful! Review /tmp/README.md for more info'
 else 'Bootstrapping failed. Consult /tmp/bootstrap.log for more info'
end as result
from table(qsys2.joblog_info('*')) x
where message_id = 'QSH0005'
order by message_timestamp desc
fetch first 1 rows only;
```

# RPM/YUM installation steps continued

- **Step 3**:  Once the installation of the bootstrap is complete, start a terminal session

    - This can be done via 5250 command `'call qcmd'`

    - Better yet, an SSH session can be established to the system

- **Step 4**:  Modify the PATH to include the bin directory for the packages installed by the bootstrap

    ```
    PATH=/QOpenSys/pkgs/bin:$PATH
    export PATH
    ```

# Useful Commands

| Command | Description |
|---------|-------------|
| bash | A shell typically available on Linux systems.  Features include command/file completion, and command recall. |
| gcc | GNU c Compiler |
| rpm | Used to install/manage packages built using the Redhat Package Manager. |
| yum | Yellowdog Updated, Modified – a wrapper around RPM that uses package repositories to simplify package installation and dependency resolution |

# yum cheat sheet

| Function | yum command |
|---|---|
| Install a package | `yum install <package>` |
| Remove a package | `yum remove <package>` |
| Search for a package | `yum search <package>` |
| List installed packages | `yum list installed` |
| List available packages | `yum list available` |
| List all packages | `yum list all` |

# Available packages

```
# yum list available
ibm                                             | 1.5 kB  00:00
ibm/primary                                     |  86 kB  00:00
ibm                                                       222/222
Available Packages
autoconf.noarch                   2.69-1                      ibm
automake.noarch                   1.15-1                      ibm
bison.ppc64                       3.0.4-1                     ibm
bzip2.ppc64                       1.0.6-5                     ibm
bzip2-devel.ppc64                 1.0.6-5                     ibm
cmake.ppc64                       3.7.2-1                     ibm
coreutils-gnu.ppc64               8.25-1                      ibm
curl.ppc64                        7.58.0-0                    ibm
curl-devel.ppc64                  7.58.0-0                    ibm
diffutils.ppc64                   3.5-0                       ibm
expat.ppc64                       2.2.0-0                     ibm
expat-devel.ppc64                 2.2.0-0                     ibm
file.ppc64                        5.30-0                      ibm
file-devel.ppc64                  5.30-0                      ibm
flex.ppc64                        2.6.3-1                     ibm
flex-devel.ppc64                  2.6.3-1                     ibm
freetype-devel.ppc64              2.7-1                       ibm
gawk.ppc64                        4.1.4-1                     ibm
gcc-aix.fat                       6.3.0-3                     ibm
gcc-cplusplus-aix.fat             6.3.0-0                     ibm
gcc-cpp-aix.fat                   6.3.0-0                     ibm
gcc-gfortran-aix.fat              6.3.0-2                     ibm
gettext-examples.ppc64            0.19.8-0                    ibm
gettext-runtime.ppc64             0.19.8-0                    ibm
```

# Quick Detour
# Using ACS to Work With
# Open Source Packages

# RPM/YUM Installation with Latest Version of ACS

- The latest version of IBM i Access Client Solutions (version 1.1.8.0) includes support for Open Source Package Management

- Selecting `Tools`→`Open Source Package Management` for a given system will check to see if the Open Source Package support has been installed.

  - If it has not been installed an opportunity will be provided to do so:
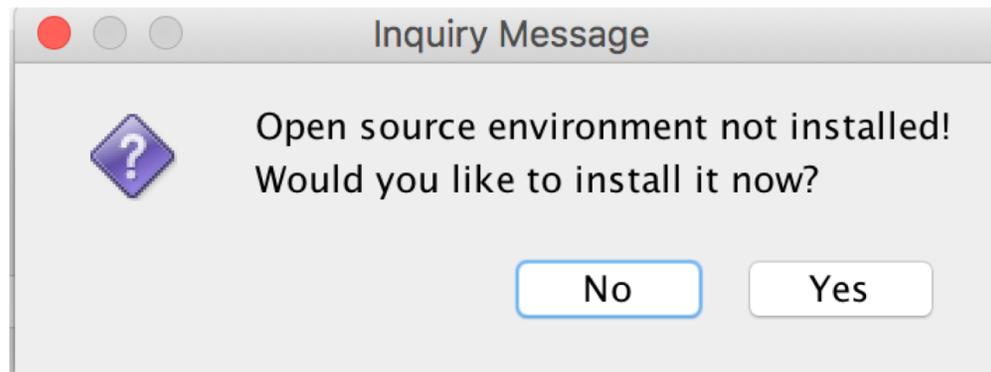
# Initial Setup via ACS

- Selecting <Yes> on the Installation dialog will cause the system to be configured to support Open Source Packages

  - A package repository definition will be created

  - Initial packages, such as `yum` and `rpm` will be installed
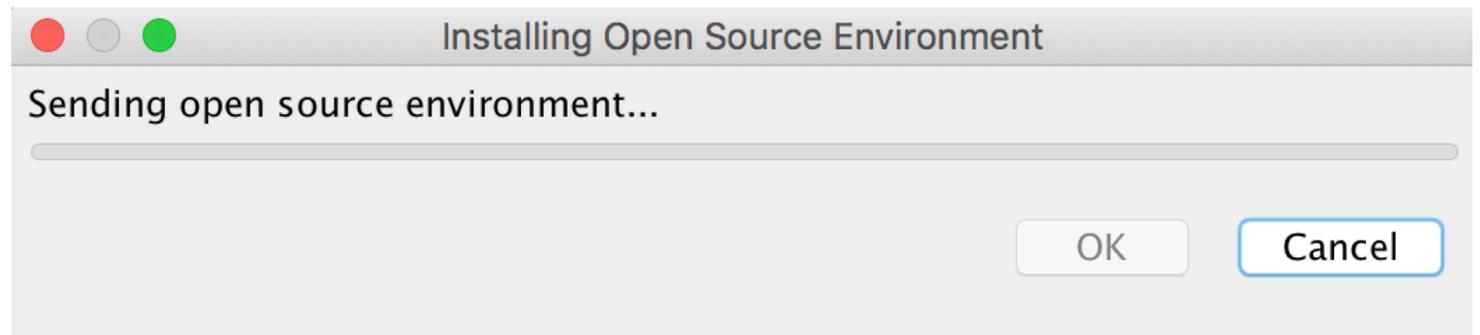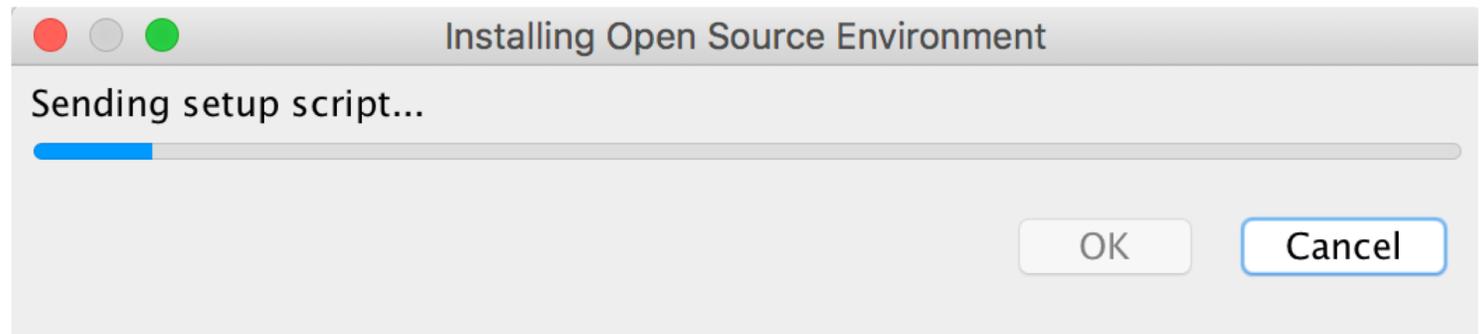
# Installation Progress

- A terminal window will display the progress of installation

- Successful installation will be indicated by the 'Bootstrap succeeded' message

# Installation Completed

- A command completion dialog will be displayed when the terminal window is closed.
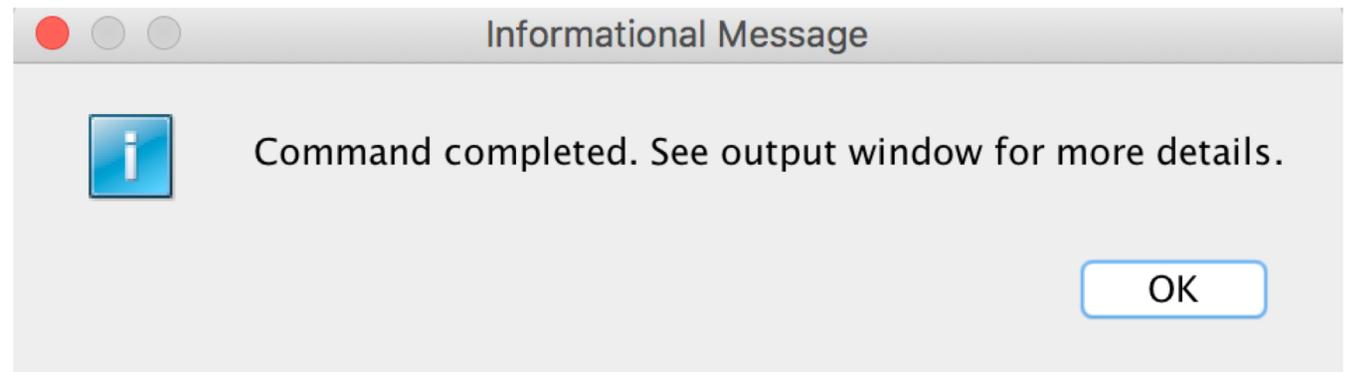
# Package Management – Installed Packages

- Once the Open Source Package Management enablement has been installed a window will be displayed that provides three functions:

  – Work with installed packages

  – Work with updates

  – Work with Available Packages
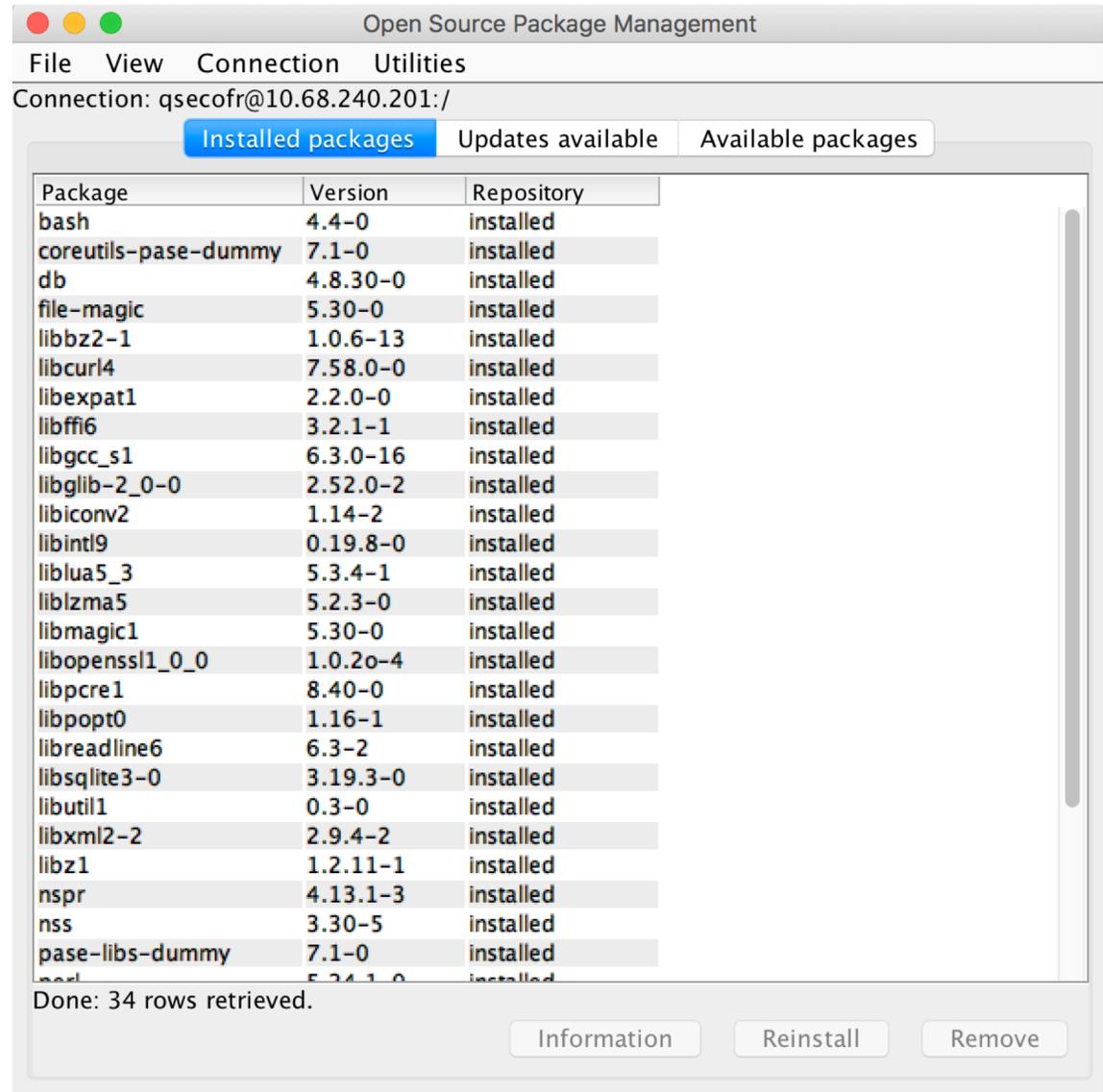


Open Source Package Management

File    View    Connection    Utilities

Connection: qsecofr@10.68.240.201:/

| Installed packages | Updates available | Available packages |

| Package | Version | Repository |
|---|---|---|
| bash | 4.4–0 | installed |
| coreutils–pase–dummy | 7.1–0 | installed |
| db | 4.8.30–0 | installed |
| file–magic | 5.30–0 | installed |
| libbz2–1 | 1.0.6–13 | installed |
| libcurl4 | 7.58.0–0 | installed |
| libexpat1 | 2.2.0–0 | installed |
| libffi6 | 3.2.1–1 | installed |
| libgcc_s1 | 6.3.0–16 | installed |
| libglib–2_0–0 | 2.52.0–2 | installed |
| libiconv2 | 1.14–2 | installed |
| libintl9 | 0.19.8–0 | installed |
| liblua5_3 | 5.3.4–1 | installed |
| liblzma5 | 5.2.3–0 | installed |
| libmagic1 | 5.30–0 | installed |
| libopenssl1_0_0 | 1.0.2o–4 | installed |
| libpcre1 | 8.40–0 | installed |
| libpopt0 | 1.16–1 | installed |
| libreadline6 | 6.3–2 | installed |
| libsqlite3–0 | 3.19.3–0 | installed |
| libutil1 | 0.3–0 | installed |
| libxml2–2 | 2.9.4–2 | installed |
| libz1 | 1.2.11–1 | installed |
| nspr | 4.13.1–3 | installed |
| nss | 3.30–5 | installed |
| pase–libs–dummy | 7.1–0 | installed |
| perl | 5.24.1–0 | installed |

Done: 34 rows retrieved.

Information    Reinstall    Remove

# Package Update

- The 'Updates available' tab will display a list of updates that are available for installed packages

# Package Information

```
# clear;exec /QOpenSys/pkgs/bin/yum  info 'python2'
Installed Packages
Name        : python2
Arch        : ppc64
Version     : 2.7.14
Release     : 0
Size        : 101 M
Repo        : installed
Summary     : Python 2 Programming Language
URL         : https://www.python.org
License     : Python
Description : Python is a programming language that lets you work more quickly
            : and integrate your systems more effectively.
            :
            : You can learn to use Python and see almost immediate gains in
            : productivity and lower maintenance costs.

Available Packages
Name        : python2
Arch        : ppc64
Version     : 2.7.15
Release     : 1
Size        : 26 M
Repo        : ibm
Summary     : Python 2 Programming Language
URL         : https://www.python.org
License     : Python
Description : Python is a programming language that lets you work more quickly
            : and integrate your systems more effectively.
            :
            : You can learn to use Python and see almost immediate gains in
            : productivity and lower maintenance costs.
```

Information

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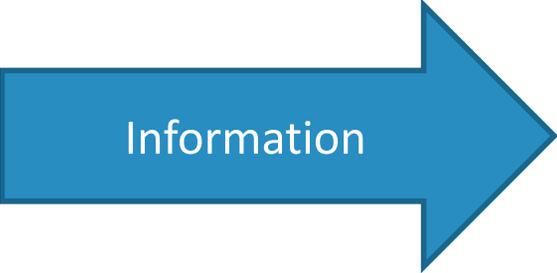
# Package Update

Package Upgrade

```
# clear;exec /QOpenSys/pkgs/bin/yum  upgrade 'python2'
Setting up Upgrade Process
Resolving Dependencies
--> Running transaction check
---> Package python2.ppc64 0:2.7.14-0 will be updated
---> Package python2.ppc64 0:2.7.15-1 will be an update
--> Finished Dependency Resolution

Dependencies Resolved

================================================================================
 Package          Arch            Version          Repository        Size
================================================================================
Updating:
 python2          ppc64           2.7.15-1          ibm              26 M

Transaction Summary
================================================================================
Upgrade        1 Package

Total download size: 26 M
Is this ok [y/N]: y
Downloading Packages:
python2-2.7.15-1.ibmi7.1.ppc64.rpm                      |  26 MB  00:19
Running Transaction Check
Running Transaction Test
Transaction Test Succeeded
Running Transaction
  Updating    : python2-2.7.15-1.ppc64                                    1/2
  Cleanup     : python2-2.7.14-0.ppc64                                    2/2

Updated:
  python2.ppc64 0:2.7.15-1

Complete!
```

# Packages Available for Update

- Select the 'Available packages' tab will display a list of packages that are available for installation

  - This list represents packages from the repository defined during the bootstrap process

  - Additional repositories can be added

# Package Information

```
# clear;exec /QOpenSys/pkgs/bin/yum  info 'nano'
Available Packages
Name        : nano
Arch        : ppc64
Version     : 2.9.0
Release     : 0
Size        : 598 k
Repo        : ibm
Summary     : Small and friendly text editor
URL         : https://www.nano-editor.org
License     : GPLv3
Description : GNU nano is a small and friendly text editor. Besides basic text
            : editing, nano offers many extra features, such as an interactive
            : search-and-replace, undo/redo, syntax coloring, smooth scrolling,
            : auto-indentation, go-to-line-and-column-number, feature toggles,
            : file locking, backup files, and internationalization support.
            :
            : The original goal for nano was to be a complete bug-for-bug
            : emulation of Pico.
```

Package
Information →

# Package Installation

**Package Installation →**

```
# clear;exec /QOpenSys/pkgs/bin/yum  install 'nano'
Setting up Install Process
Resolving Dependencies
--> Running transaction check
---> Package nano.ppc64 0:2.9.0-0 will be installed
--> Processing Dependency: lib:/QOpenSys/pkgs/lib/libncurses.so.6(shr_64.o)(ppc64) for package: nano-2.9.0-0.ppc64
--> Running transaction check
---> Package libncurses6.ppc64 0:6.0-2 will be installed
--> Processing Dependency: ncurses-terminfo for package: libncurses6-6.0-2.ppc64
--> Running transaction check
---> Package ncurses-terminfo.ppc64 0:6.0-2 will be installed
--> Finished Dependency Resolution

Dependencies Resolved

================================================================================
 Package                   Arch          Version          Repository     Size
================================================================================
Installing:
 nano                      ppc64         2.9.0-0          ibm            598 k
Installing for dependencies:
 libncurses6               ppc64         6.0-2            ibm            318 k
 ncurses-terminfo          ppc64         6.0-2            ibm            582 k

Transaction Summary
================================================================================
Install      3 Packages

Total download size: 1.5 M
Installed size: 4.9 M
Is this ok [y/N]:
```

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# Package Installation - Progress

```
Is this ok [y/N]: y
Downloading Packages:
(1/3): libncurses6-6.0-2.ibmi7.1.ppc64.rpm                        | 318 kB  00:00
(2/3): nano-2.9.0-0.ibmi7.1.ppc64.rpm                            | 598 kB  00:00
(3/3): ncurses-terminfo-6.0-2.ibmi7.1.ppc64.rpm                  | 582 kB  00:00
-------------------------------------------------------------------------------
Total                                       381 kB/s | 1.5 MB      00:03
Running Transaction Check
Running Transaction Test
Transaction Test Succeeded
Running Transaction
  Installing : ncurses-terminfo-6.0-2.ppc64                                 1/3
  Installing : libncurses6-6.0-2.ppc64                                      2/3
  Installing : nano-2.9.0-0.ppc64                                           3/3

Installed:
  nano.ppc64 0:2.9.0-0

Dependency Installed:
  libncurses6.ppc64 0:6.0-2              ncurses-terminfo.ppc64 0:6.0-2

Complete!
```

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# Utilities➜Clone Repo for offline use…

- The package repository definition created during the bootstrap process assumes that the system has access to the internet

- For those environments that don't allow outside access a local copy of the repository can be created

Clone Repo for Offline Use

**Source Repository**

- ● IBM default    ftp://public.dhe.ibm.com/software/ibmi/products/pase/rpms/repo
- ○ Specify a location:

**Destination (IFS)**

/QOpenSys/QIBM/UserData/rpm_repos/  ibm

☑ Clear repository before download (recommended)

**Additional Operations**

☑ Create or update repository definition

☑ Disable repositories that require Internet access from the IBM i system

Clone Repository

| File | Progress |
|------|----------|
|      |          |

# Clone Repository

# Clone Repository

**Completion!**

Informational Message

MSGGEN002 – The function completed successfully.

OK

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# Useful Commands

| Command | Description |
|---------|-------------|
| bash | A shell typically available on Linux systems.  Features include command/file completion, and command recall. |
| gcc | GNU c Compiler |
| rpm | Used to install/manage packages built using the Redhat Package Manager. |
| yum | Yellowdog Updated, Modified – a wrapper around RPM that uses package repositories to simplify package installation and dependency resolution |

# yum cheat sheet

| Function | yum command |
|---|---|
| Install a package | `yum install <package>` |
| Remove a package | `yum remove <package>` |
| Search for a package | `yum search <package>` |
| List installed packages | `yum list installed` |
| List available packages | `yum list available` |
| List all packages | `yum list all` |

# Available packages

```
# yum list available
ibm                                                 | 1.5 kB  00:00
ibm/primary                                         |  86 kB  00:00
ibm                                                         222/222
Available Packages
autoconf.noarch                      2.69-1                      ibm
automake.noarch                      1.15-1                      ibm
bison.ppc64                          3.0.4-1                     ibm
bzip2.ppc64                          1.0.6-5                     ibm
bzip2-devel.ppc64                    1.0.6-5                     ibm
cmake.ppc64                          3.7.2-1                     ibm
coreutils-gnu.ppc64                  8.25-1                      ibm
curl.ppc64                           7.58.0-0                    ibm
curl-devel.ppc64                     7.58.0-0                    ibm
diffutils.ppc64                      3.5-0                       ibm
expat.ppc64                          2.2.0-0                     ibm
expat-devel.ppc64                    2.2.0-0                     ibm
file.ppc64                           5.30-0                      ibm
file-devel.ppc64                     5.30-0                      ibm
flex.ppc64                           2.6.3-1                     ibm
flex-devel.ppc64                     2.6.3-1                     ibm
freetype-devel.ppc64                 2.7-1                       ibm
gawk.ppc64                           4.1.4-1                     ibm
gcc-aix.fat                          6.3.0-3                     ibm
gcc-cplusplus-aix.fat                6.3.0-0                     ibm
gcc-cpp-aix.fat                      6.3.0-0                     ibm
gcc-gfortran-aix.fat                 6.3.0-2                     ibm
gettext-examples.ppc64               0.19.8-0                    ibm
gettext-runtime.ppc64                0.19.8-0                    ibm
```

# bash

bash is installed as part of the bootstrap installation

# Creating the User Environment

- A number of steps should be accomplished to create the user environment

- Step 1:  Create the user's home directory

    ```
    mkdir /home/<username>
    ```

- Step 2:  Create a .profile in the user's home directory.  The .profile is used to define the shell environment, including environment variables, scripts to execute, and other commands.  The `.profile` is used to store pre-defined settings when a shell program starts

```
PATH=/QOpenSys/pkgs/bin:$PATH
export PATH

bash
```

  – The first two lines update the path statement to include the location of the programs installed both by the bootstrap as well as subsequent '`yum install`' commands

  – The third line causes the bash shell to be executed

    - NOTE:  by default a PASE terminal session starts the 'ksh' shell

# Text Editor – *Overview*

- While the `'vi'` editor is the common, de facto standard, editor on a Linux system it is recommended that it not be used in the PASE environment
  - The `vi` editor available in PASE comes from the AIX space and it does not behave well in PASE

- One of the packages included in the RPM pile is `nano`
  - `nano` is a text editor for unix-like operating environments that uses a command line interface

# Text editor – *Installation*

- Once the bootstrap has been installed, the `yum` command along with the repository definition are available to be used for installation of additional packages

- The `'yum repolist'` command can be used to validate the availability of the repository:

```
# yum repolist
repo id                                repo name                                status
ibm                                    ibm                                      231
repolist: 231
```

- A check can be made to see if a package with `nano` is available via the `'yum provides'` command:

```
# yum provides nano
nano-2.9.0-0.ppc64 : Small and friendly text editor
Repo          : ibm
```

# Text editor – *Installation (continued)*

- The package can be installed via the '`yum install`' command:

```
# yum install nano
Setting up Install Process
Resolving Dependencies
--> Running transaction check
---> Package nano.ppc64 0:2.9.0-0 will be installed
--> Processing Dependency: lib:/QOpenSys/pkgs/lib/libncurses.so.6(shr_64.o)(ppc64) for package: nano-2.9.0-0.ppc64
--> Running transaction check
---> Package libncurses6.ppc64 0:6.0-2 will be installed
--> Processing Dependency: ncurses-terminfo for package: libncurses6-6.0-2.ppc64
--> Running transaction check
---> Package ncurses-terminfo.ppc64 0:6.0-2 will be installed
→ Finished Dependency Resolution

Dependencies Resolved

===============================================================================
 Package                      Arch           Version          Repository    Size
===============================================================================
Installing:
 nano                         ppc64          2.9.0-0          ibm           598 k
Installing for dependencies:
 libncurses6                  ppc64          6.0-2            ibm           318 k
 ncurses-terminfo             ppc64          6.0-2            ibm           582 k

Transaction Summary
===============================================================================
Install       3 Packages
Total download size: 1.5 M
Installed size: 4.9 M
Is this ok [y/N]:
```

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# Text Editor – Installation (continued)

- The `'yum'` command uses the `rpm` command to determine pre-requisites as well as package dependencies
  - If there are no package dependencies then the command will install the requested package without any further user-prompting/confirmation
  - If there are package dependencies then the dependencies will be displayed and the user will be prompted to accept all of the packages display for installation
- The package installation process will download the packages, install them, and update the RPM database.
- Diagnostic messages will be displayed along the way

# Text Editor – *Installation* (completed)

```
Downloading Packages:
(1/3): libncurses6-6.0-2.ibmi7.1.ppc64.rpm                    | 318 kB  00:00
(2/3): nano-2.9.0-0.ibmi7.1.ppc64.rpm                         | 598 kB  00:00
(3/3): ncurses-terminfo-6.0-2.ibmi7.1.ppc64.rpm              | 582 kB  00:00
-----------------------------------------------------------------------------
Total                                  353 kB/s | 1.5 MB      00:04
Running Transaction Check
Running Transaction Test
Transaction Test Succeeded
Running Transaction
   Installing : ncurses-terminfo-6.0-2.ppc64                               1/3
   Installing : libncurses6-6.0-2.ppc64                                    2/3
   Installing : nano-2.9.0-0.ppc64                                         3/3


Installed:
   nano.ppc64 0:2.9.0-0


Dependency Installed:
   libncurses6.ppc64 0:6.0-2           ncurses-terminfo.ppc64 0:6.0-2


Complete!
```

# Text Editor (nano) – *Brief Introduction*

- The nano editor is started by entering the command `'nano'` optionally followed by a file to be read into the text editor

- Commands to make note of:
    - <CTRL>O – save the file
    - <CTRL>X - exit nano
    - <CTRL>R – read in another file

```
  GNU nano 2.9.0                          .profile

PATH=/QOpenSys/pkgs/bin:$PATH
export PATH

bash




                          [ Read 4 lines ]
^G Get Help  ^O Write Out ^W Where Is  ^K Cut Text  ^J Justify   ^C Cur Pos
^X Exit      ^R Read File ^\ Replace   ^U Uncut Text^T To Spell  ^_ Go To Line
```

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# Git

## "A 'git' is a cranky old man"
### Linus Torvalds – creator of git

# Overview

- Created by Linux Torvalds in 2005

  – Came out of the Linux development community

  – Designed for version control of the Linux kernel

- Goals of git

  – Speed

  – Support for non-linear development (thousands of parallel branches

  – Fully distributed

  – Able to handle large projects efficiently

# Checking for / Installing git

- The which command can be used to
  see if git is installed

  - `which git`


- The yum install command can be used
  to install git

  - `yum install git`

# Centralized vs. Distributed Version Control Systems

## Centralized VCS

- Centralized VCS like Subversion, a central server repository (repo) holds the "official copy" of the code
    - The server maintains the sole version history of the repo
- "checkouts" of the code are made to a local copy
    - Local modifications are made
    - Changes are not versioned
- When complete, the code is "checked in" back to the server
    - The checkin increments the repo's version

## Distributed VCS

- Distributed VCS like git doesn't support "checkout" from a local repo
    - Code is "clone"d and changes are "pull"ed
- The local repo is a complete copy of everything on the remote server
    - Local copy is "just as good" as the remove server copy
- Many options are local
    - Check in/out from local repo
    - Commit changes to local repo
    - Local repo keeps version history
- When ready changes can be "pushed" back to the server

# Local git areas

- In a local copy on git, files can be:

    - In the local repo (committed)

    - Checked out and modified, but not yet committed (working copy)

    - In-between, in a "staging" area

        - Staged files are ready to be committed

        - A commit saves a snapshot of all staged states.



**Local Operations**

working directory | staging area | git directory (repository)

checkout the project

stage files

commit

Unmodified/modified Files | Staged Files | Committed Files
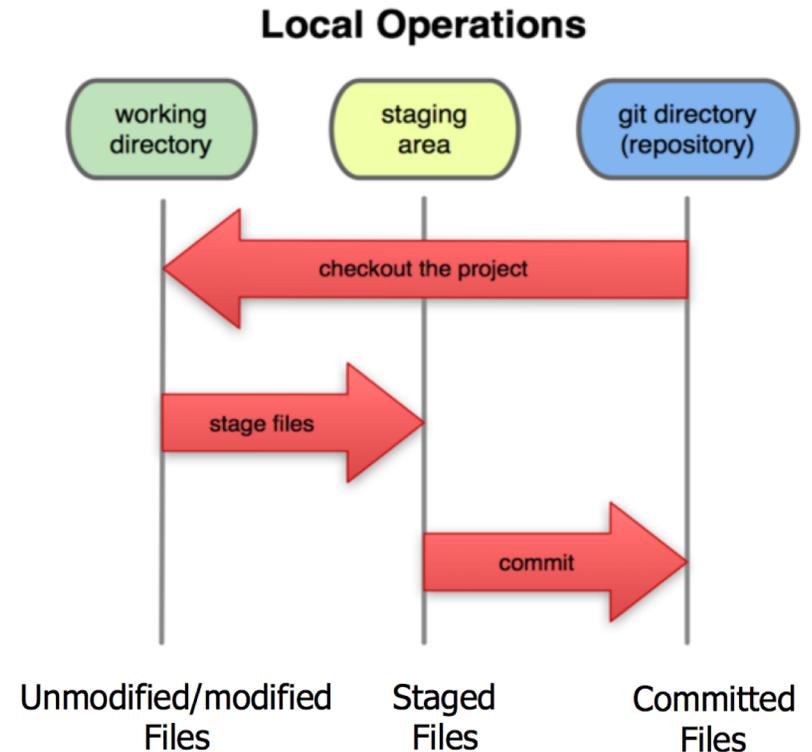
# Initial git configuration

- Set the name and email for git to use when commits are made:
  - `git config --global user.name "Erwin Earley"`
  - `git config --global user.email erwin.earley@roguewave.com`

- Set the editor used for writing commit messages (default is vim)
  - `git config --global core.editor nano`

- Review the settings:
  - `git config --list`

```
# git config --list
user.name=Erwin Earley
user.email=erwin.earley@roguewave.com
core.editor=nano
```

# Cloning a git repo (local git repo)

- Creating a local git repository in the current directory

  - `git init`

    - The above creates a .git directory in your current directory

    - Files can then be committed in that directory into the repo

  - To stage all changes in a file (or directory) for the next commit:

    `git add filename`

  - Commit the staged changes using the –m argument as the commit message

    `git commit –m "commit message"`

```
# cd python-scripts/
bash-4.4# git init
Initialized empty Git repository in
/home/QSECOFR/python-scripts/.git/
bash-4.4# git add *.py
bash-4.4# git commit -m "initial commit"
[master (root-commit) 4263c42] initial
commit
 14 files changed, 167 insertions(+)
 create mode 100644 Ex01hello.py
 create mode 100644 Ex02Indent.py
 create mode 100644 Ex04Strings.py
 create mode 100644 Ex05Lists.py
 create mode 100644 Ex06tuples.py
 create mode 100644 Ex07Dictionary.py
 create mode 100644 Ex10ifs.py
 create mode 100644 Ex11Fors.py
 create mode 100644 Ex12While.py
 create mode 100644 Ex15Functions.py
 create mode 100644 Ex16Functions2.py
 create mode 100644 Ex17Functions3.py
 create mode 100644 datatype.py
 create mode 100644 variables.py
```

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# Cloning a git repo (remote repo)

- To clone a remote repository to the local directory
  - `git clone url localDirectory`
    - **Ex:** `git clone https://github.com/zendtech/ibmiToolkit toolkit`

> The above will create the specified directory (toolkit) that will contain a working copy of the files from the repo (https://github.com/zendtech/ibmiToolkit) as well as a .git directory that will be used to hold the staging area as well as the local repository.

# git commands

| Command | Description |
|---|---|
| `git clone url [dir]` | Copy a git repository so files can be added to it |
| `git add file` | Adds file contents to the staging area |
| `git commit` | Records a snapshot of the staging area |
| `git status` | View the status of files in the working directory and staging area |
| `git diff` | Shows the diff of what is staged and what is modified but unstaged |
| `git pull` | Fetch from a remote repo and try to merge into the current branch |
| `git push` | Push new branches and data to a remote repository |

Good git cheatsheet
https://www.atlassian.com/git/tutorials/atlassian-git-cheatsheet

# Closing Thoughts

- You will get the most out of Open Source by participating in the community

- Many ways to participate

  - Ask Questions

  - Give Advise

  - Share Code

# Useful Links

- IBM developerWorks – Open Source Technologies
  - https://www.ibm.com/developerworks/community/wikis/home?lang=en#!/wiki/IBM%20i%20Technology%20Updates/page/Open%20Source%20Technologies
- Midrange.com mailing list for open source on IBM i
  - http://archive/midrange.com/opensource/
- LinkedIn IBM i OSS group
  - https://www.linkedin.com/groups/8531863
- Ryver IBM i OSS team – Forums, chat, links to social media
  - Invite only
    - https://ibmioss.river.com/applications/signup/members/9tJsXDG7_iSSi1Q
- Club Seiden forums
  - http://club.alanseiden.com/community/
- Twitter
  - #IBMiOSS
- Rogue Wave Open Source Support (OpenLogic)
  - https://www.roguewave.com/capabilities/open-source-support