



# IBM LinuxONE and Virtualization Technology Advancement



Rui Yang  
System z Virtualization  
IBM China System Lab

# The future has begun...



...and a new 'Era of computing' with IBM Z



Linux is  
**EVERWHERE**

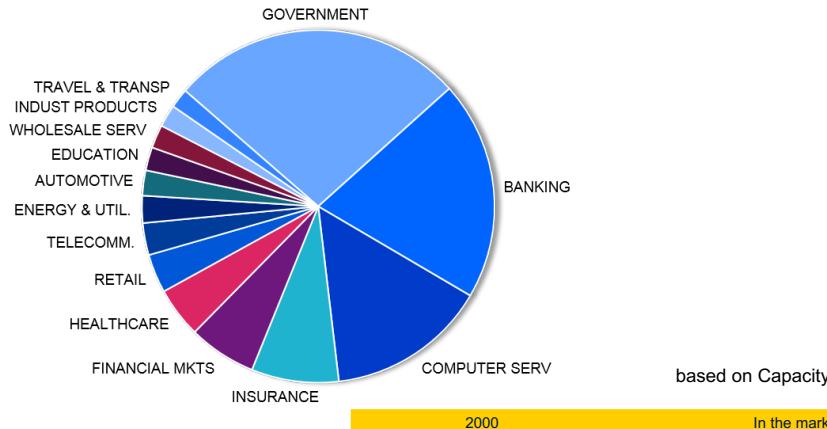
**OPEN REVOLUTION**

Driving an

# Who is using Linux on IBM Z today

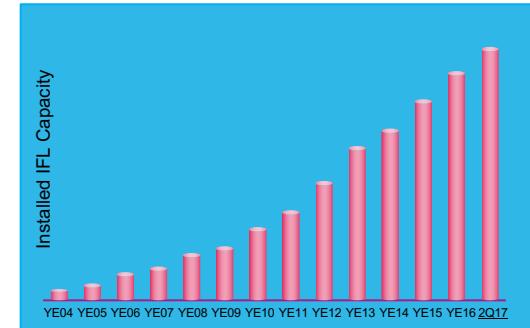
**Used in over 60 countries across 22 industries around the globe**

- Most used in:
- Banking and Financial Markets
- Government
- Insurance
- Computer Services
- Retail and Healthcare
- Transportation and Telecommunication



- 90 of the top 100 IBM Z clients are running Linux on IBM Z (based on total installed MIPS in 2Q2017)
- 49% of IBM Z clients have IFLs installed

**Installed Capacity Over Time**



- Very large installations with up to hundreds of cores/IFLs in USA, Japan, Brazil, Germany, UK and South Africa
- Small installations with 2 IFLs in all countries and on all IBM Z models
- Most clients run Linux co-located with z/OS®, z/VSE® and/or z/TPF on an IBM Z server



# The new OPEN BREAKTHROUGH

## The best of **IBM Z**

- Dynamic Resource Allocation
- Non-disruptive Scalability
- Continuous Business Availability
- Operational Efficiency
- Trusted Security
- Data and Transaction Serving

## The best of **LINUX & OPEN**

- Freedom & Agility
- Standards based
- Speed to Innovate
- Developer Productivity
- Community Collaboration
- Open source SW & applications

IBM LinuxONE™



Meet the  
**IBM LinuxONE Systems**

The most trusted, efficient and high performance  
enterprise-grade Linux platform



**IBM LinuxONE**  
Emperor™



**IBM LinuxONE**  
Rockhopper™

# IBM Systems with z Architecture

IBM Z

IBM z14



IBM z13s



The world's  
**fastest processor**

**Massive I/O throughput**

**Dedicated cryptographic**  
processors

IBM LinuxONE Systems

IBM LinuxONE Emperor II



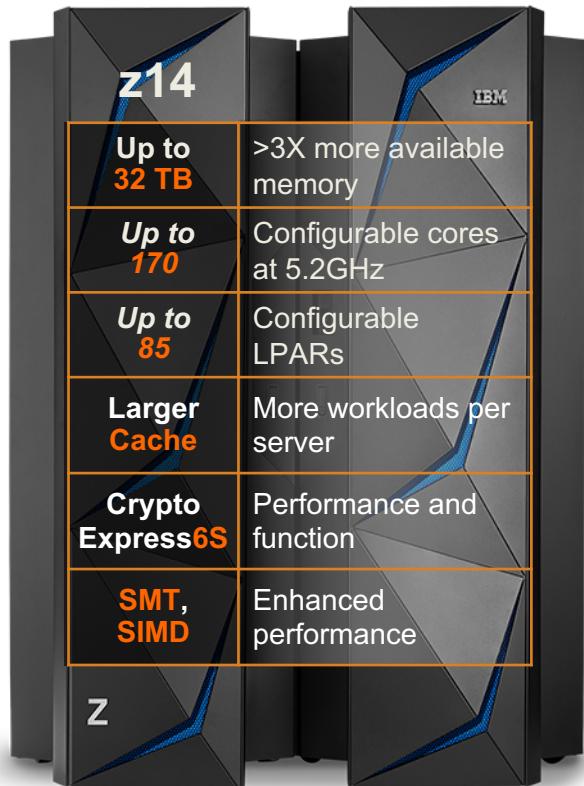
IBM LinuxONE  
Rockhopper



# Linux on z14 / Emperor II

and

# Linux on z13s / Rockhopper



<b>Up to 32 TB</b>	>3X more available memory
<b>Up to 170</b>	Configurable cores at 5.2GHz
<b>Up to 85</b>	Configurable LPARs
<b>Larger Cache</b>	More workloads per server
<b>Crypto Express6S</b>	Performance and function
<b>SMT, SIMD</b>	Enhanced performance

**IBM GDPS solutions**  
*Continuous availability & Disaster recovery*

**IBM Spectrum Scale**  
*Clustered file system*

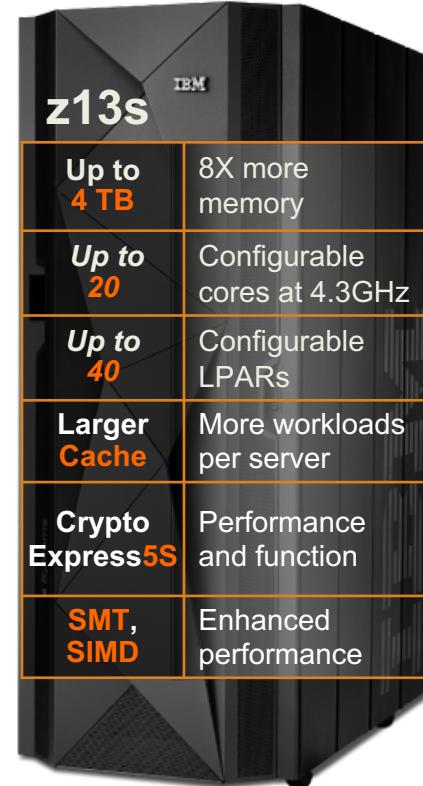
**IBM zAware functionality**  
*IBM Z Advanced Workload Analysis Reporter*

**IBM z/VM + IBM Wave**  
*Virtualization with efficiency at scale + Intuitive virtualization management*

**KVM on IBM Z**  
*Open source virtualization*

**Logical Partitions / Dynamic Partition Mgr**  
*technology & capacity*

**z14 and z13s**  
*Unmatched server technology & capacity*



# Linux on z Systems has a continuous focus on IBM Z characteristics the Business benefits from

## Security Capabilities:

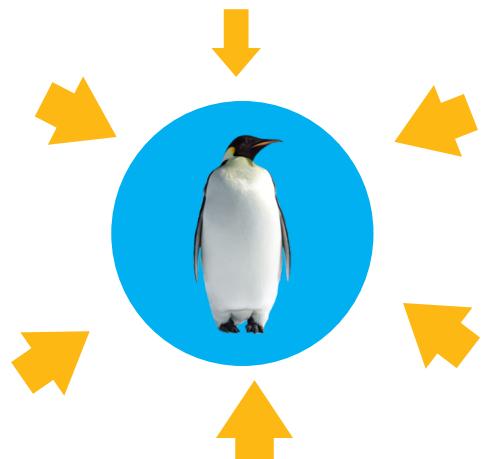
- Privacy,
- Regulatory requirements,
- Identity management,
- Common Criteria Certification,
- Image Isolation,
- Cryptographic Acceleration,
- Centralized Authentication,
- Physically secure communications with HiperSockets™ and Guest LANs

## Operational Simplification Capabilities:

- Virtualization,
- Single Point of Control,
- Single System Image,
- z/OS Similarities/Synergies,
- Resource Sharing

## Consolidation Capabilities:

- Server, Network, Storage, Staff, Skills, Utilities, Environmental, Applications
- Hosting of different workloads at the same time



## Business Resiliency Capabilities:

- High Availability,
- Disaster Recovery, xDR, Serviceability, Reliability
- Storage failover (HyperSwap™), Data replication (Metro / Global Mirror)

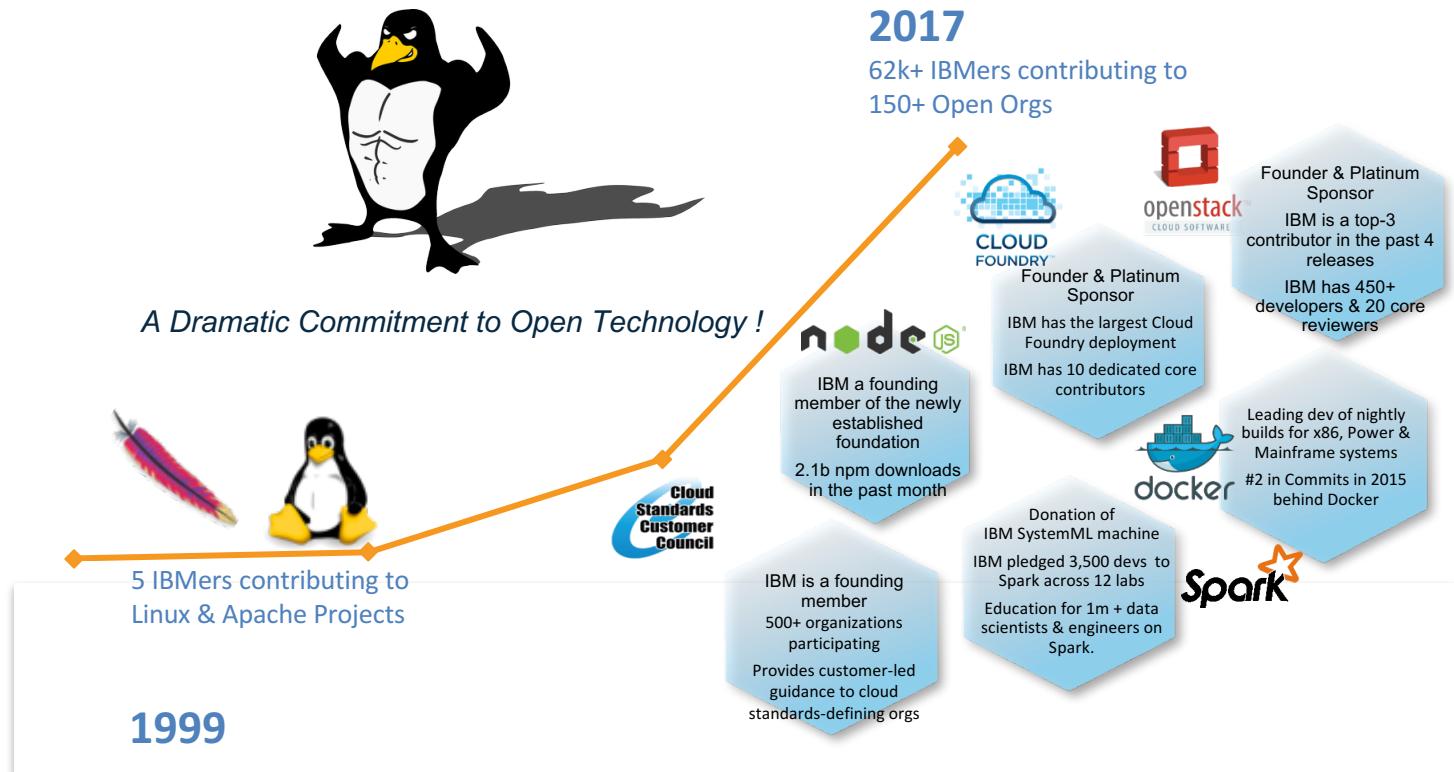
## Flexibility / On demand Capabilities:

- Mixed Workloads: Scale-up & scale-out,
- Rapid server (de)commissioning,
- Idle Servers don't consume resources

## Proximity / Collocation to z/OS data:

- Increased transaction throughput, HiperSockets
- Shared data access
- Integrated storage management

# Open Source participation is crucial to the IBM Strategy



# Linux your Way - Greater flexibility and choice

Choose the distribution, runtime, hypervisor, database and analytics – it's the Linux you know and love with the openness, flexibility and agility you need for your business.



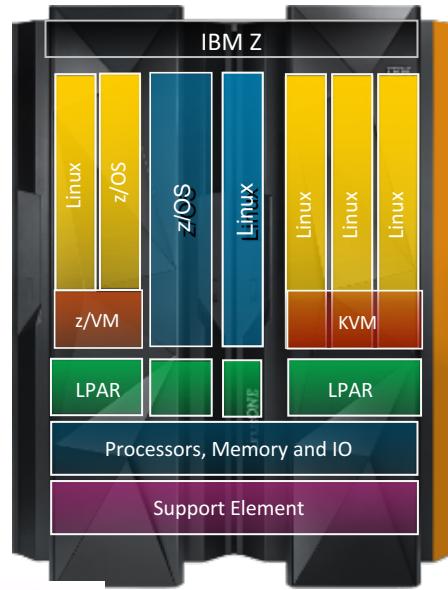
# IBM Z Virtualization Overview for Linux on z Systems

## LPAR virtualization

- Virtualization at the firmware (think BIOS) level via **PR/SM**

### IBM z/VM

- World class quality, security, reliability - powerful and versatile
- Extreme scalability creates cost savings opportunities
- Exploitation of advanced technologies, such as:
  - Shared memory (Linux kernel, executables, communications)
- Highly granular control over-resource pool
- IBM Wave provides graphical “drag & drop” management interface



## KVM virtualization

- Standardizes configuration and operation of server virtualization
- Leverage common Linux administration skills to administer virtualization
- Flexibility and agility leveraging the Open Source community
- Turns a Linux into an hypervisor
- available in your Distro:
  - SLES 12.2
  - UBUNTU 16.04

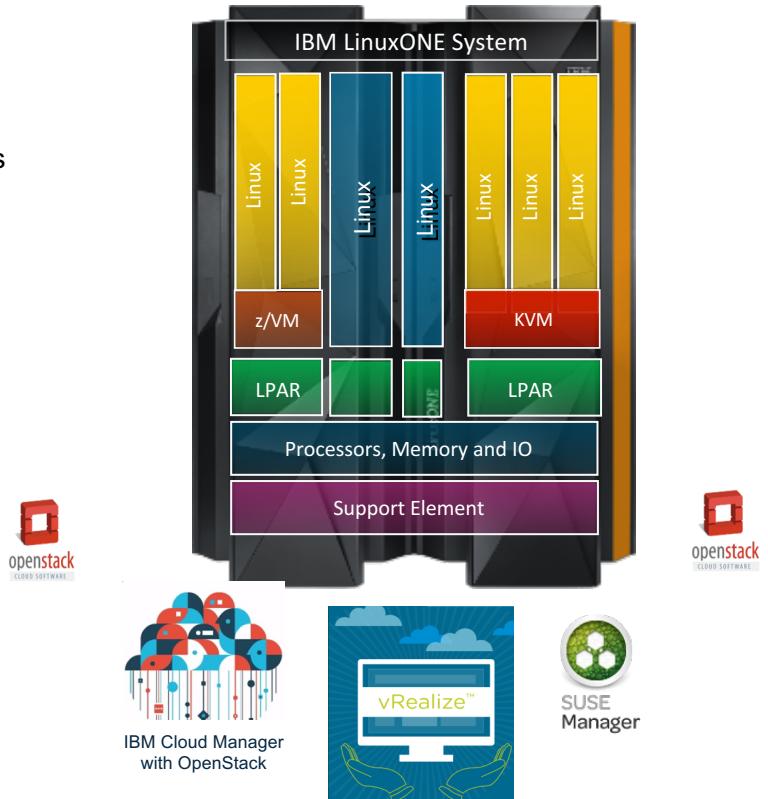
# IBM LinuxONE Systems Virtualization Overview

## LPAR virtualization

- Virtualization at the firmware level via **DPM** (graphical tool) or **PR/SM**

### IBM z/VM

- World class quality, security, reliability - powerful and versatile
- Extreme scalability creates cost savings opportunities
- Exploitation of advanced technologies, such as:
  - Shared memory (Linux kernel, executables, communications)
- Highly granular control over-resource pool
- IBM Wave provides graphical “drag & drop” management interface



## KVM virtualization

- Standardizes configuration and operation of server virtualization
- Leverage common Linux administration skills to administer virtualization
- Flexibility and agility leveraging the Open Source community
- Turns a Linux into an hypervisor
- available in your Distro:
  - SLES 12.2
  - UBUNTU 16.04

# Our Security Differentiation for Linux on Z & LinuxONE:

## Secure Service Container; Crypto Express & LPAR

### ▪ SSC: Protection against misuse of privileged user credentials

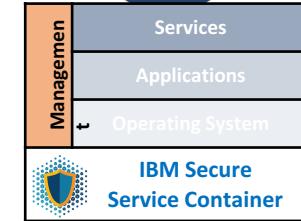
- Docker execution environment where the infrastructure & and data are protected against access and abuse by root users, system administrator credentials and other privileged user access
- Eliminates any back doors for an internal threat (malicious or accidental) as SSH is disabled
- Malware (e.g ransomware) is prevented from being installed or spread
- Security is whitelist or opt-in based at appliance creation time

### ▪ Key safety

- Value further extended by safeguarding all communications & data in SSC
- Encryption with highest US government computer security standard (FIPS 140-2 level 4)
- All keys held in a tamper resistant HW security model (HSM) certified to same security standard
- Data is only as safe as the keys: Keys are never in the clear
- x86 systems do not offer the level of integration with FIPS validated HSM

### ▪ LPAR: Protection of peers in cloud environments

- Multi tenancy peers run in protected isolated environments to prevent deliberate or unintentional leakage of information
- EAL 5+ certification

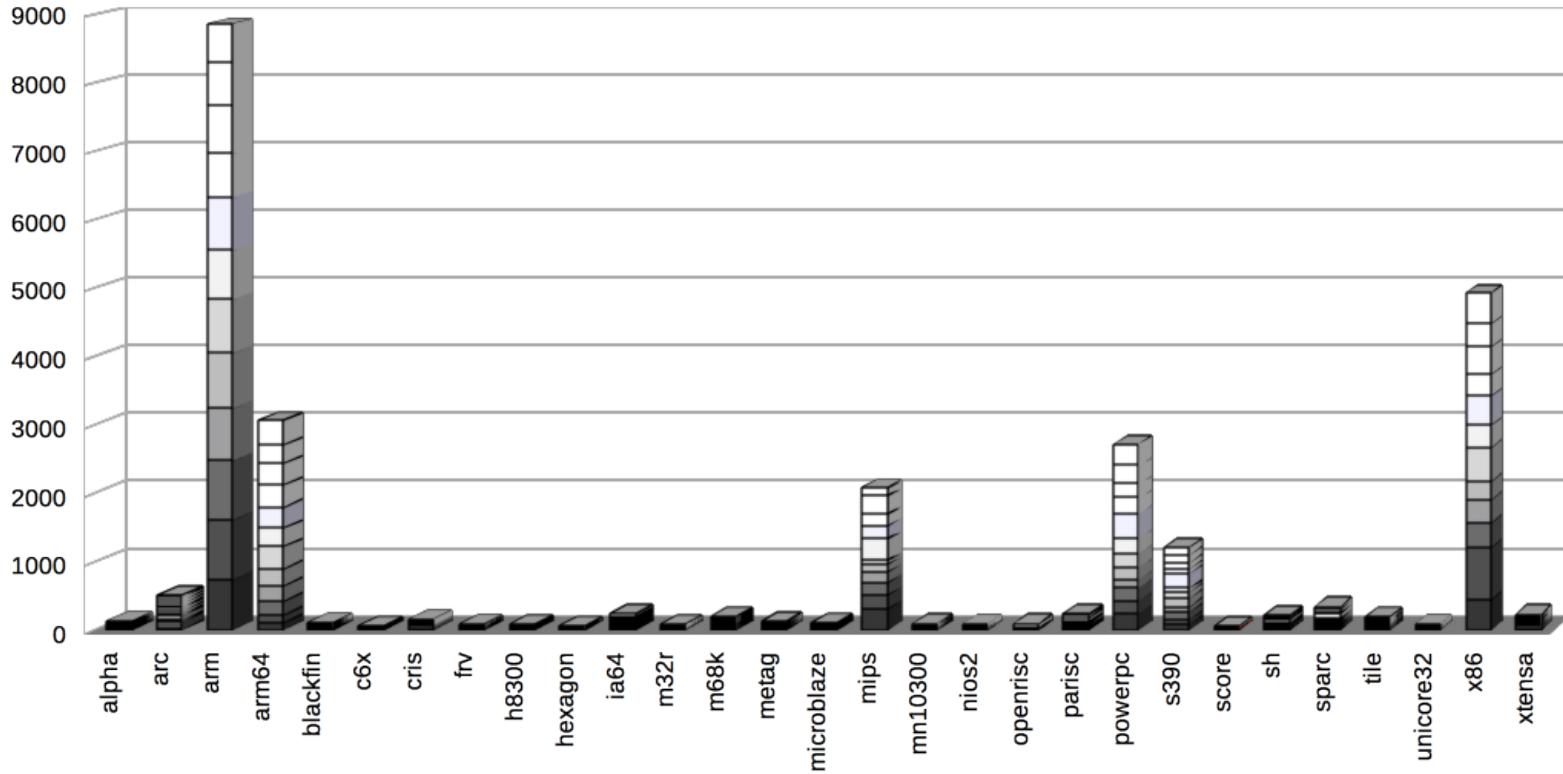


*Application, storage, memory and network is protected  
with no changes to application code needed !*

# Fun facts around Linux on IBM z Systems

- How many git commits are there in the main Linux repository up to v4.12?
  - 679419 commits (630031 without merge commits, %7 merge commits)
- How many of these git commits are s390 related?
  - ~7354 commits (~1.1%)
- What is the maximum of lines added by a single git commit up to v4.12?
  - git commit d7e09d0397e84eef “staging: add Lustre file system client support”, 258994 insertions(+)
- What is the maximum of lines added by a single git commit for s390?
  - git commit 4a71df50047f0db6 “new qeth device driver”, 13498 insertions(+)
- What is the average size of a git commit in v4.x (patch lines)?
  - 148.33 over all git commits in v4.0 – v4.12
- What is the average size of a s390 commit in v4.x (patch lines)?
  - 215.03 lines for s390 related git commits in v4.0 – v4.12

## Git commits per architecture in 4.x



# Linux on IBM Z & LinuxONE Systems Value Proposition

## EXTREME SCALE

- 6:1 or better core consolidation for Oracle DB
- 1M Docker containers in a single Emperor system
- 30 billion web transactions / day
- Up to 8,000 Virtual Machines in a single box
- Worlds largest single instance MongoDB
  - 470K read/write per second
  - no sharding required

## EXTREME PERFORMANCE

- Worlds fastest commercially available microprocessor
- MongoDB 2x faster than x86
- Up to 10TB of shared RAIM Memory
- Up to 640 Dedicated I/O processors to ensure I/O heavy workloads perform even under extreme load FYI x86 servers have zero I/O processors

## DESIGNED FOR 100% AVAILABILITY

- Redundant Array of Independent Memory (RAIM) a unique for a server means memory redundancy
  - Designed for 100% availability over decades
  - Earthquake tested
  - IT Analytics software included

## WORLDS MOST SECURABLE PLATFORM

- Tamperproof built-in CryptoExpress 5S card gives up to 28x performance vs x86 for Secure key
  - The only server on the market with EAL 5+ security
  - FIPS 140 security rating
- Up to 85 Logical Partitions (LPARS) ensure workloads isolation



The world is changing,  
**SO ARE WE**

# Questions?



# Notices and Disclaimers

Copyright © 2016 by International Business Machines Corporation (IBM). No part of this document may be reproduced or transmitted in any form without written permission from IBM.

## **U.S. Government Users Restricted Rights - Use, duplication or disclosure restricted by GSA ADP Schedule Contract with IBM.**

Information in these presentations (including information relating to products that have not yet been announced by IBM) has been reviewed for accuracy as of the date of initial publication and could include unintentional technical or typographical errors. IBM shall have no responsibility to update this information. THIS DOCUMENT IS DISTRIBUTED "AS IS" WITHOUT ANY WARRANTY, EITHER EXPRESS OR IMPLIED. IN NO EVENT SHALL IBM BE LIABLE FOR ANY DAMAGE ARISING FROM THE USE OF THIS INFORMATION, INCLUDING BUT NOT LIMITED TO, LOSS OF DATA, BUSINESS INTERRUPTION, LOSS OF PROFIT OR LOSS OF OPPORTUNITY. IBM products and services are warranted according to the terms and conditions of the agreements under which they are provided.

IBM products are manufactured from new parts or new and used parts. In some cases, a product may not be new and may have been previously installed. Regardless, our warranty terms apply."

## **Any statements regarding IBM's future direction, intent or product plans are subject to change or withdrawal without notice.**

Performance data contained herein was generally obtained in a controlled, isolated environments. Customer examples are presented as illustrations of how those customers have used IBM products and the results they may have achieved. Actual performance, cost, savings or other results in other operating environments may vary.

References in this document to IBM products, programs, or services does not imply that IBM intends to make such products, programs or services available in all countries in which IBM operates or does business.

Workshops, sessions and associated materials may have been prepared by independent session speakers, and do not necessarily reflect the views of IBM. All materials and discussions are provided for informational purposes only, and are neither intended to, nor shall constitute legal or other guidance or advice to any individual participant or their specific situation.

It is the customer's responsibility to insure its own compliance with legal requirements and to obtain advice of competent legal counsel as to the identification and interpretation of any relevant laws and regulatory requirements that may affect the customer's business and any actions the customer may need to take to comply with such laws. IBM does not provide legal advice or represent or warrant that its services or products will ensure that the customer is in compliance with any law

# Notices and Disclaimers Con't.

Information concerning non-IBM products was obtained from the suppliers of those products, their published announcements or other publicly available sources. IBM has not tested those products in connection with this publication and cannot confirm the accuracy of performance, compatibility or any other claims related to non-IBM products. Questions on the capabilities of non-IBM products should be addressed to the suppliers of those products. IBM does not warrant the quality of any third-party products, or the ability of any such third-party products to interoperate with IBM's products. IBM EXPRESSLY DISCLAIMS ALL WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

The provision of the information contained herein is not intended to, and does not, grant any right or license under any IBM patents, copyrights, trademarks or other intellectual property right.

IBM, the IBM logo, ibm.com, Aspera®, Bluemix, Blueworks Live, CICS, Clearcase, Cognos®, DOORS®, Emptoris®, Enterprise Document Management System™, FASP®, FileNet®, Global Business Services ®, Global Technology Services ®, IBM ExperienceOne™, IBM SmartCloud®, IBM Social Business®, Information on Demand, ILOG, Maximo®, MQIntegrator®, MQSeries®, Netcool®, OMEGAMON, OpenPower, PureAnalytics™, PureApplication®, pureCluster™, PureCoverage®, PureData®, PureExperience®, PureFlex®, pureQuery®, pureScale®, PureSystems®, QRadar®, Rational®, Rhapsody®, Smarter Commerce®, SoDA, SPSS, Sterling Commerce®, StoredIQ, Tealeaf®, Tivoli®, Trusteer®, Unica®, urban{code}®, Watson, WebSphere®, Worklight®, X-Force® and System z® Z/OS, are trademarks of International Business Machines Corporation, registered in many jurisdictions worldwide. Other product and service names might be trademarks of IBM or other companies. A current list of IBM trademarks is available on the Web at "Copyright and trademark information" at: [www.ibm.com/legal/copytrade.shtml](http://www.ibm.com/legal/copytrade.shtml).