Cloud. Pure and simple.

A closer look at performance

IBM PureApplication System hardware is expertly integrated
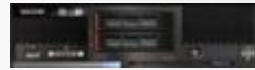
Chassis
14 half-wide
bays for nodes

Compute Nodes
Intel x86
POWER

Storage
Storwize V7000

Management Appliances

Networking
10/40 Gb ET,
8/16 Gb FC

Shown: PureApplication System W1500 Enterprise

…with hardware high availability built-in

- **Management Nodes**
  - Both run in active-passive mode, when a failure occurs the IP address is assigned to the new active one

- **Network Controllers**
  - Switches and cabling are redundant (2 of each).
  - Failure of 1 leads to reduced bandwidth, not service

- **Storage Controllers**
  - All storage volumes are accessible from each controller
  - If one fails, the other handles all I/O

- **Storage**
  - SSD storage is configured in RAID 5 array + spares
  - HDD storage is configured in RAID 5 array + spares

- **Compute Nodes (ITE)**
  - Management system will route around failed DIMMs or cores yielding reduced capacity (server rebalance)
  - If entire node fails, VMs can be moved elsewhere (workload evacuation)

3

Options in power source give customers flexibility and choice

PureApplication System provides choice in power source

1-phase power Mini: Upgradeable from 32 to 128 cores

- Energy efficient for reduced power consumption and cooling requirements

- Lower priced entry point

- Ideal for: emerging markets, medium-sized businesses, application development/test, regional datacenters, departmental use, initial cloud projects

3-phase power Enterprise: Upgradeable from 32 to 384 cores

- Highly upgradeable for Enterprise workload environments

No matter which option is chosen, each:

- Uses the same processors, storage, networking and software
- Have redundant compute, storage, networking, management and power
- Support the same patterns
- Are upgradeable with no down time

4   Based on IBM PureApplication System W2500 and W2700 announcement, April 22, 2014

What's physically in the box?

- Top-of-rack switches
  - 320 Gbps out of top of rack
  - 10/1 Gbps Ethernet

- V7000 storage with Easy Tier
  - 2.4 TB SSD, 24 TB HDD (in 1-phase rack)
  - 6.4 TB SSD, 48 TB HDD (in 3-phase rack)

- Compute capacity
  - Flex chassis (1 in 1-phase rack, 3 in 3-phase rack)
  - Intel Ivy Bridge EP 2.6 GHz or (2S/16C) or 4.1 GHz POWER7^{+} compute nodes

- Networking
  - Choice of: 10GbE Fibre, 1GbE Fibre, 1GbE Copper, (and additional Direct Attach Cabling (DAC / Twinax) choice for Intel system)

- Power
  - 4 redundant PDUs (only 2 required to power full rack)
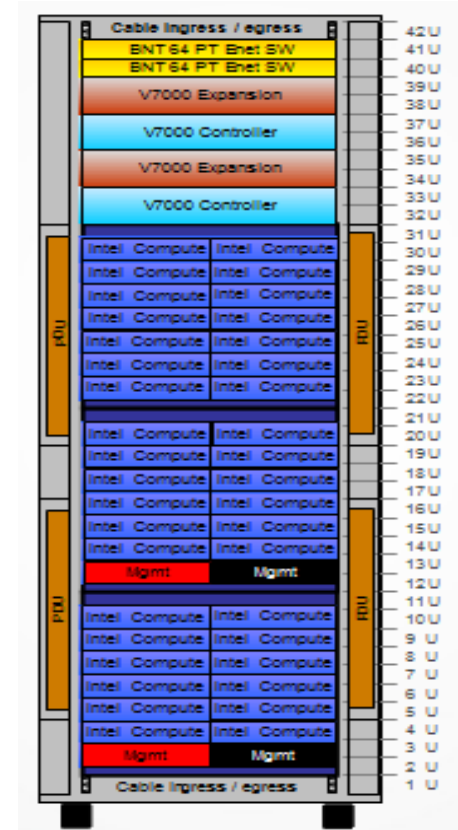
Based on IBM PureApplication System W2500 and W2700 announcement, April 22, 2014

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PureApplication System runs Intel or POWER

PureApplication (Intel)

PureApplication (POWER)

- State-of-the-art management

- Best practice workload patterns

- Fastest deployment

- Dynamic workload management

- Lowest cost of labor for private clouds

Same capabilities as Intel version, but adds:

- POWER7^{+} processors for superior performance and price/performance

6

# Why is PureApplication with POWER so fast with great price/performance?

Higher performance per core achieved through:

- Massive parallelism (threads) compared to x86

- Higher clock frequencies

- 4-way SMT per core

- PowerVM placement optimization for PureApplication

- Larger POWER L3 on-chip cache

- Storwize V7000 storage with more efficient storage access

- IBM middleware optimizations
  - WebSphere and DB2 optimizations for POWER and AIX architecture
  - Leading SPECjEnterprise2010 publishes on POWER7^{+} at
    http://www.spec.org/jEnterprise2010/results

Lower cost/performance per core due to:

- No additional software cost for entitled software
  - i.e., AIX, WebSphere V7, V8, V8.5, DB2 V9.7, V10.1

PureApplication POWER7⁺ is designed for superior price/performance
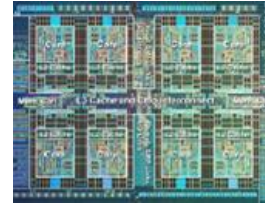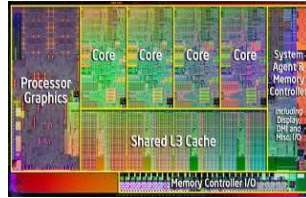
	Vblock Intel Ivy Bridge	Exalogic Intel Ivy Bridge	PureApplication POWER7+ Systems
Clock rates per processor	**1.7 – 3.5 GHz**	**2.7 GHz**	**3.61 GHz [4.1 GHz]**[1]
Symmetric multi-threading per core	**2**	**2**	**4**
On-chip L3 Cache	**Up to 30 MB**	**30 MB**	**80 MB**
Max threads per server	**Up to 80**	**48**	**128**

More processing power per core

Faster performing cache intensive workloads
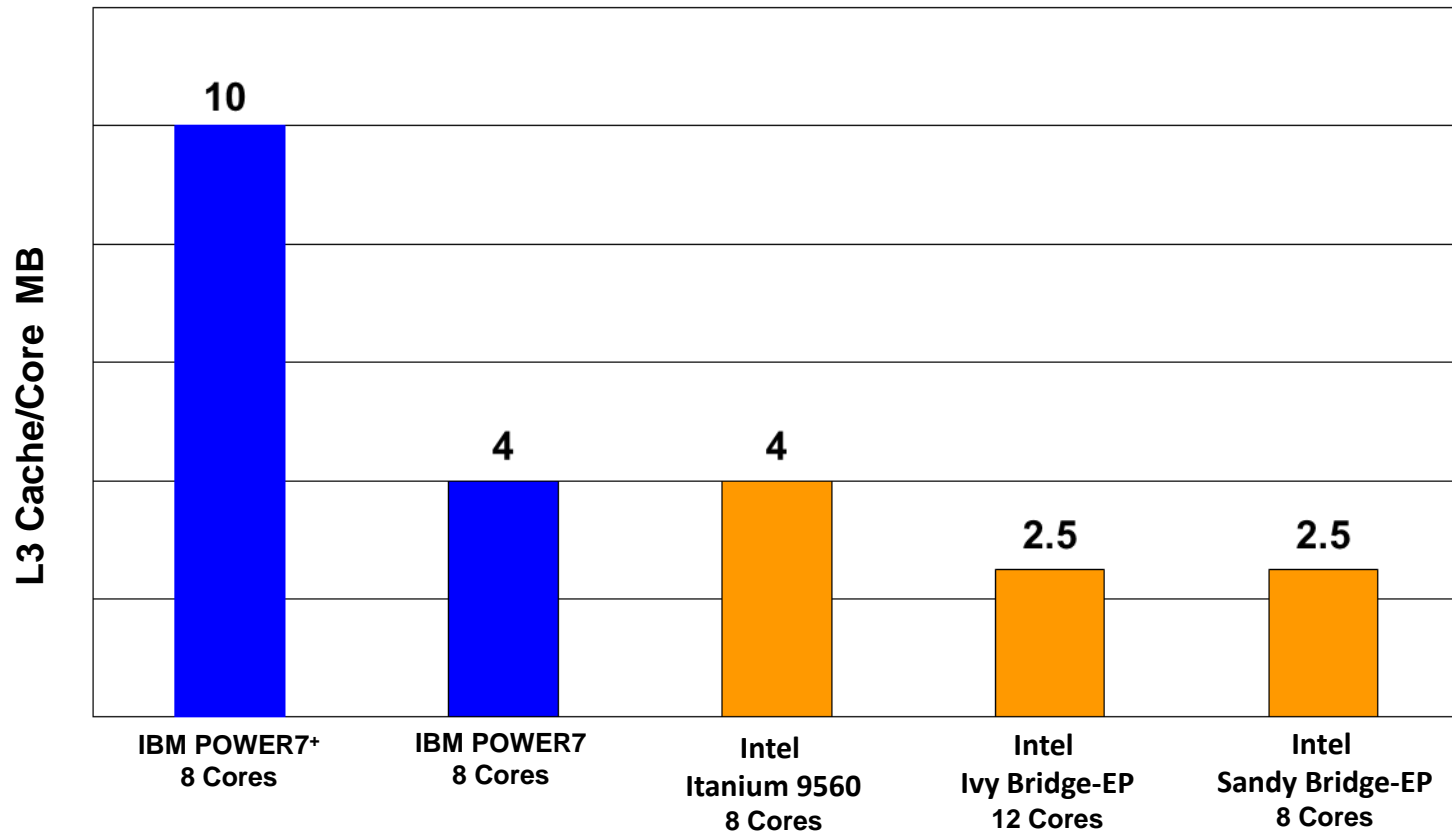
Larger servers for consolidation

[1] IBM PureApplication System W2700 now with faster clock rate per April 22, 2014 announcement
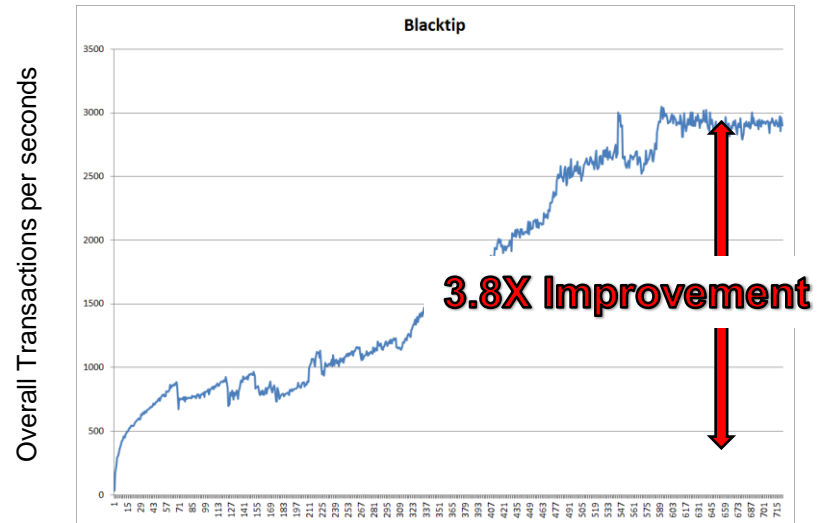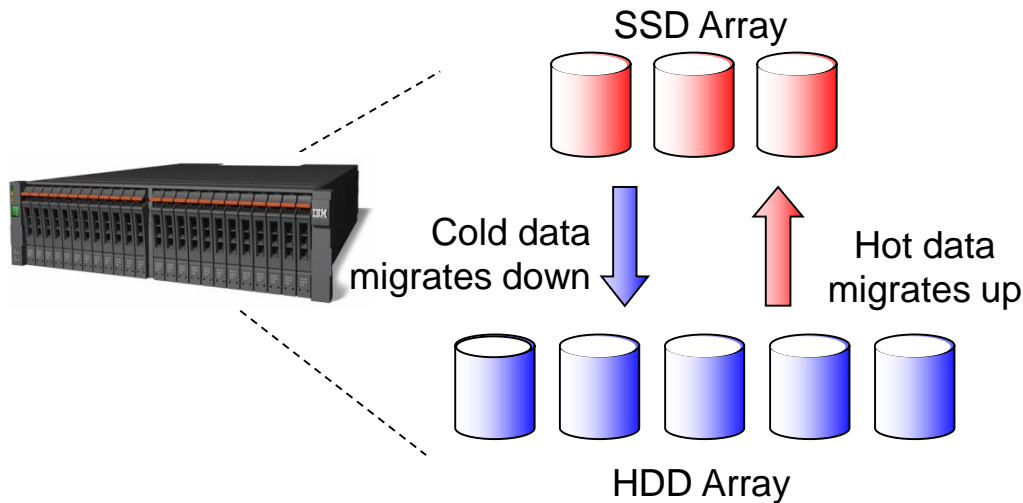
POWER7$^+$ has 4x more on-chip cache per core than Intel Ivy Bridge

- **Benefit of Larger On-Chip L3 Cache**
 - Support workloads with larger working sets; improves performance

Easy Tier in Storwize V7000 automatically optimizes use of SSD

SSD Array

Cold data migrates down

Hot data migrates up

HDD Array

Blacktip

Overall Transactions per seconds

3.8X Improvement

Example: Complex database transactional workload

- Migrates data between SSD and HDD in same pool (auto hotspot detection)
- Virtualized SSD is shared across all workloads using the pool
- More cost effective use of SSD versus ad hoc dedicated assignment
- Transparent to applications, no code changes required

Brokerage OLTP

TPS

BT + V7K(HD)

BT + V7K(ET)
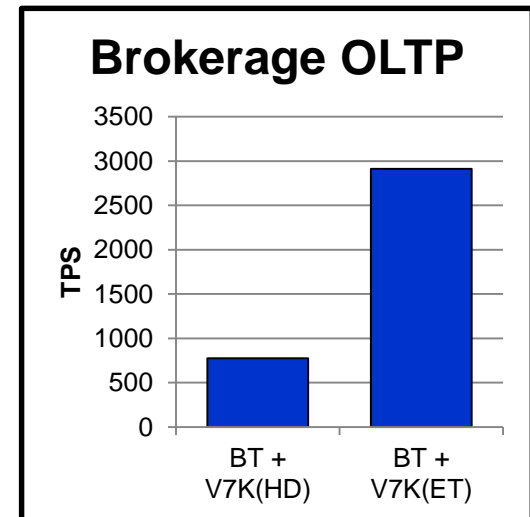
DEMO: Easy Tier's automated, intelligent data placement improves performance

OLTP DB **before** Easy Tier migration
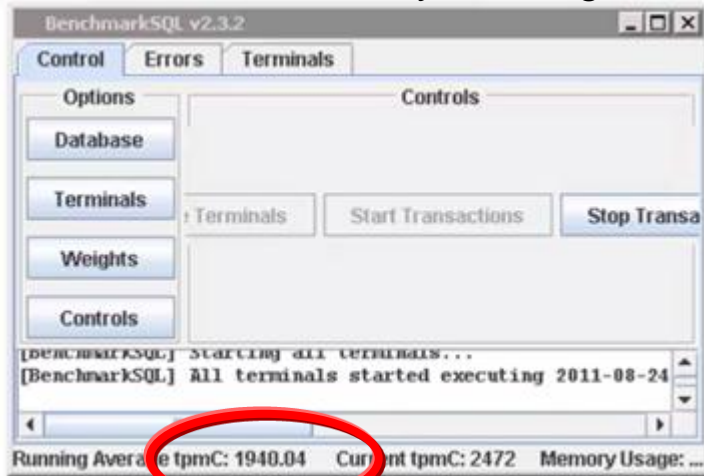
Pool: ETDEMO

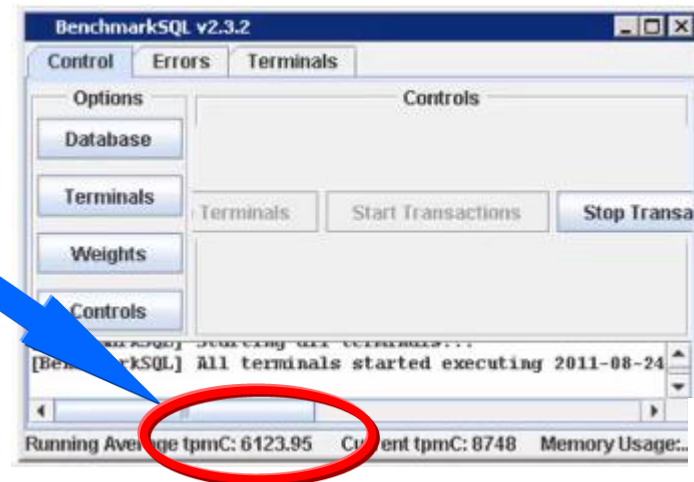*Striped*
Copy Status: Online
Easy Tier Status: Active

Capacity:
SSD Tier: 2.41 GB
HDD Tier: 47.59 GB
Total: 50.00 GB

OLTP DB **after** Easy Tier migration

> 3X OLTP performance increase with Easy Tier

IBM optimizations give PureApplication (POWER) a competitive advantage

Power7+ Technology

POWER7+
32 sockets/server
1024 threads

IBM Software

Superior Optimization

POWER7
BUILT ON
Power™

Best performance per core

Lower cost

Leading processor technology

Optimized and balanced for key workloads

Pre-configured
Pre-assembled
Integrated management

Run Web and database workloads on the same system with PureApplication System

App Server — Data Base

App Server — Data Base
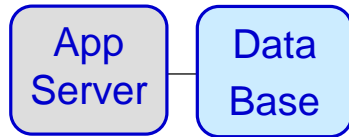
IBM PureApplication System

Coalition Competitor

- Optimized for both Web and database workloads
- POWER7^{+} processor plus efficient virtualization leads to best performance

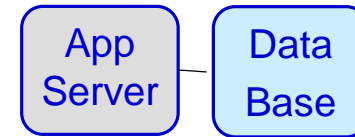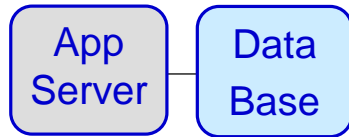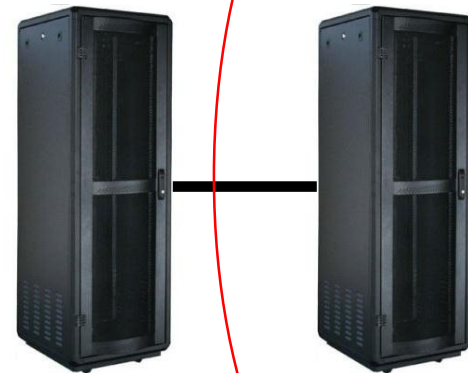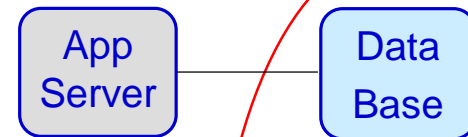- Designed to run both Web and database workloads on the same system. However, end to end solution does not deliver optimal performance

Run Web and database workloads on the same system with PureApplication System

IBM PureApplication System

- Co-location of database on the same system provides the best overall performance
  - Shorter path length

- Leads to lower cost per database workload

Engineered Web System   Engineered Data System

- Competitor recommends use of separate system for database workloads
  - Adds more cost to overall solution

- Leads to higher cost per database workload

PureApplication System has great performance, but can I run a lot more workloads on its compute nodes than the competition?

PureApplication with POWER technology can run the most workloads per compute node. Here's what we found…

Developer
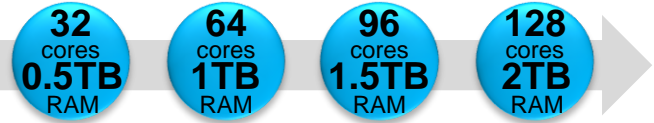
IBM

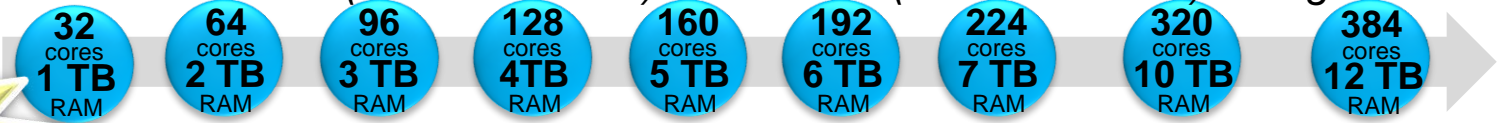# PureApplication System: More flexibility and choice to meet your needs

Pure Application System
Mini and Enterprise)
(both 42U rack size)

| 32 cores 0.5TB RAM | 64 cores 1TB RAM | 96 cores 1.5TB RAM | 128 cores 2TB RAM |

2.4 TB SSD, 24 TB HDD

Upgrade without powering down the installed machine

Available in Intel (W2500 models) or POWER (W2700 models) configurations

| 32 cores 1 TB RAM | 64 cores 2 TB RAM | 96 cores 3 TB RAM | 128 cores 4TB RAM | 160 cores 5 TB RAM | 192 cores 6 TB RAM | 224 cores 7 TB RAM | 320 cores 10 TB RAM | 384 cores 12 TB RAM |

And at more memory per core

6.4 TB SSD, 48 TB HDD

Exalogic Elastic Cloud X4-2

1/8 rack   1/4 rack   1/2 rack   Full rack

| 96 cores 1TB RAM | 192 cores 2TB RAM | 384 cores 4TB RAM | 720 cores 7.5TB RAM |

6.4 TB SSD, 80 TB HDD
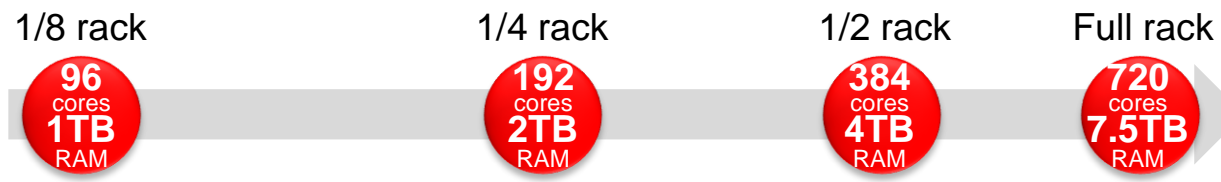
Vblock System 340 EX

Minimum of 4 blades, upgrade in increments of 2 blades

| 96 cores 1TB RAM | | | | | | 384 cores 4TB RAM |

1 to 4.2 TB SSD, HDD can be customized

22

PureApplication System has a lower total cost of ownership per core

PureApplication System W2700-96	Vblock System 340EX	Oracle Exalogic Elastic Cloud X4-2	Exadata X4-2
$42,075/core	**$99,920/core**	**$64,415/core**	**$111,449/core**
Assembly/Installation Included	Assembly/Installation[1] $2,106	Assembly/Installation[1] $182	Assembly/Installation[1] $212
PureApplication Management	Cloud services ** $1,758	Cloud services Included	
	Cloud Enterprise Software $2,515	Cloud Software and Management Packs $14,110	
	Application server & Database Management Pack $22,410		Storage Cell SW $14,525
WAS	Application Server EE $20,750	App Server Suite $37,350	DB Mgmt Pk $27,390
DB2	DB EE $39,425		Oracle DB EE+RAC $58,515
AIX	Linux $609	Linux	Linux $1,563
PowerVM	Leading Hypervisor Included	Competitor Hypervisor $150	*Virtualization Not Supported*
Hardware (POWER7^{+})	Hardware (Ivy Bridge) $10,347	Hardware[2] (Ivy Bridge) $12,623	Hardware (Ivy Bridge) $9,245

23   All prices are list USD prices as of February 2014 and based off of 96 core configurations and 3 year cost of hardware, software license and support plus installation. PureApplication pricing hasn't changed for 96 core system per April announcement.

[1] Estimated costs based on a single installation
[2] Exalogic hardware includes costs for Elastic Software

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Pre-optimized, pre-entitled software on PureApplication System (POWER)

- "All you can eat" entitlement to run the following software on the full capacity of the System
  - Full stack monitoring (hardware, OS, entitled middleware)
  - Patterns:
    - IBM OS Image for Power Systems (AIX v6.1 Tech level 5 & AIX v7.1)
    - IBM WebSphere Application Server Hypervisor Edition v7 with IMP (WAS 7.0.0.21)
    - IBM WebSphere Application Server Hypervisor Edition v8 with IMP (WAS 8.0.0.2)
    - IBM WebSphere Application Server Hypervisor Edition v8.5 with IMP (WAS 8.5.0.0)
    - IBM DB2 9.7 FP5 Enterprise Server Edition HV*
    - IBM DB2 10.1 Enterprise Server Edition HV*
    - Automation Framework HV (for migrating applications)
    - Java Pattern v1 (64-bit Java 7 SDK)
    - IBM Workload Deployer Pattern for Web Applications v1 (with WAS v7)
    - IBM Web Application Pattern v2 (with WAS v8)
    - IBM Transactional Database for Cloud v1.1 (with DB2 9.7 FP5)
    - IBM Data Mart for Cloud v1.1 (with DB2 9.7 FP5)

PureApplication System Unlimited License Agreement (ULA) gives you even more flexibility

- Flexibility to run any IBM software patterns

- Entitled for the full capacity of the system

- Pay a single price for entire solution
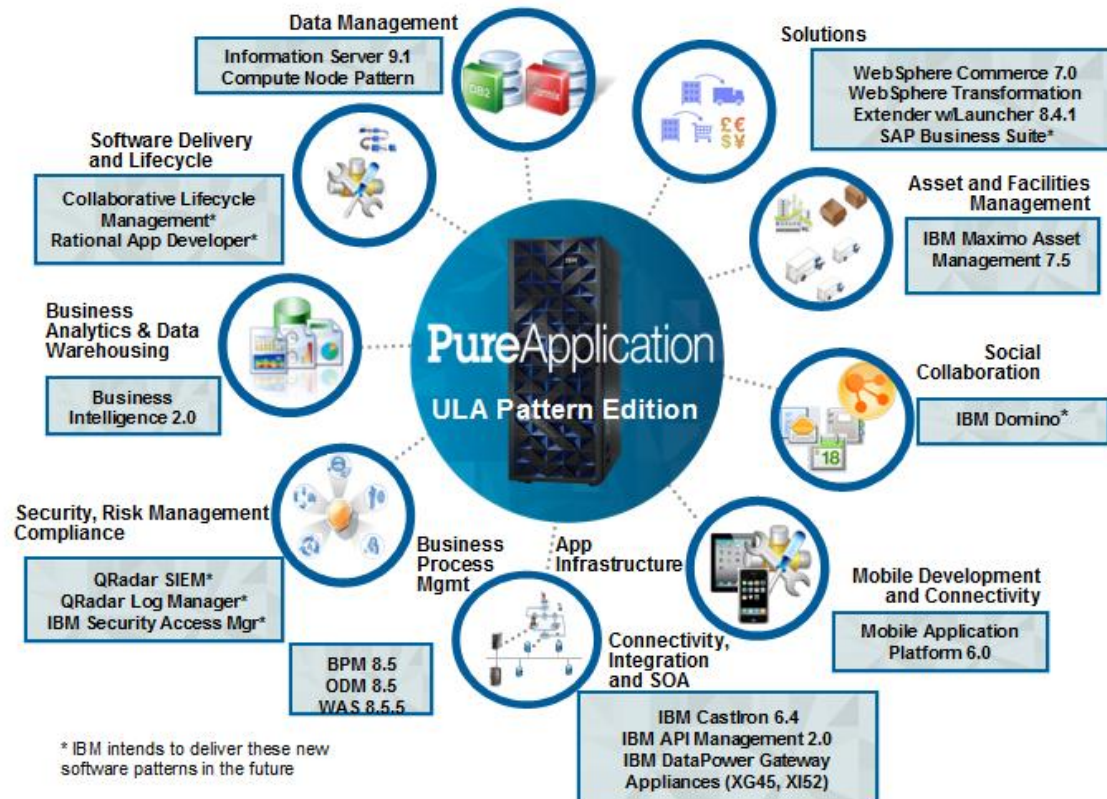
Oracle Exalogic requires most expensive WebLogic Edition, plus charges premium

- There are multiple editions of WebLogic at various price points
  - WebLogic Standard - $10 K
  - WebLogic Enterprise - $25 K
  - WebLogic Suite - $45 K

- On Exalogic, Oracle requires WebLogic Suite, the most expensive edition

- If a customer has existing WebLogic Standard or WebLogic Enterprise Licenses, then they must acquire WebLogic Suite Licenses

- Exalogic Elastic Cloud Software priced at $10,000 per core is required when running WebLogic Suite on Exalogic or SuperCluster
  - Represents an **additional 22% premium** that Oracle charges

North American insurance firm builds private cloud to improve customer experience

Increase flexibility
with PaaS capabilities enabling quick deployment of new solutions

Streamline
application consolidation of current workload environment

Faster time to market
for new business solutions

Business Challenge:
To build a dynamic and flexible cloud environment that can host thousands of applications across numerous lines of business with a limited IT budget

Solution components
IBM® PureApplication™ System

PureApplication delivers great performance and best price/performance

- ✔ POWER7$^+$ superiority

- ✔ IBM software optimized to run on POWER7$^+$

- ✔ Great performance for Web applications

- ✔ Lower cost per core

- ✔ Best for price/performance