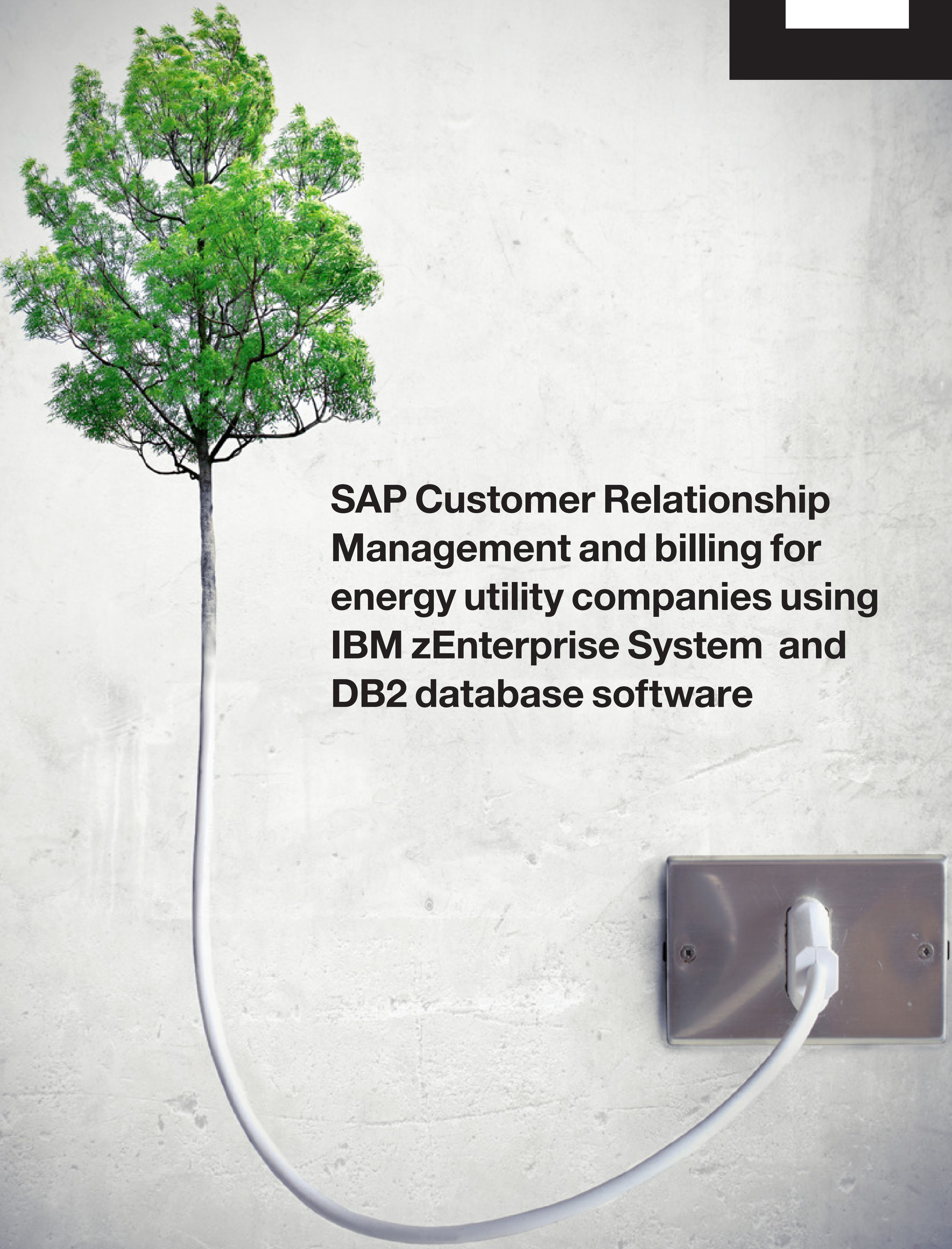
IBM SAP International Competence Center

SAP Customer Relationship Management and billing for energy utility companies using IBM zEnterprise System and DB2 database software



Answers to the IT challenges of business transformation in the energy and utilities

About this paper

The energy utilities industry is undergoing major transformations, such as embracing alternative energies, developing Smart Grids and adapting to restructured markets.

IT is the primary vehicle to introduce the new business processes that can deal with this upheaval. While the industry faces significant growth of business transactions, both in volume and complexity, the pressure to reduce charges to consumers and cut operational costs is constant, and can be exacerbated in weak economic conditions.

Efficient information management is the key to controlling an increasingly diverse and customized range of activities. In practical terms, this means standardization of business software for commodity jobs and flexible interaction with specialized line of business applications to allow complex business workflows.

The applications within the SAP Industry Solutions for Energy Utility solution suite are emerging as an industry standard for managing shared business functions. This is particularly the case with the SAP billing and invoicing solution for energy distributors and retailers.

The IBM PSSC in Montpellier conducted a solution scalability test for a very large energy distributor in Southwest Europe. The client expects annual growth of around 30 percent in its billing and invoicing transactions, and is working towards a target of 30 million transactions per year. The test that showed that a SAP application infrastructure based on IBM zEnterprise™ System and DB2 for z/OS scaled extremely well and met all key performance indicators (KPI) required by the client.

The IBM® zEnterprise™ System (zEnterprise) offers a revolutionary computing platform that addresses the complexity and inefficiency in multi-platform data centers. The zEnterprise extends the strengths and capabilities of the mainframe – such as security, fault tolerance, efficiency, virtualization and dynamic resource allocation – to other systems and workloads running on AIX® on POWER7 and Linux® on System x® – fundamentally changing the way data centers can be managed.

Additionally, proven strengths of the IBM System z platform – such as workload management and the efficient data and index compression support for DB2 for z/OS hardware – were seen to improve performance and to contribute significantly to the results of the PoC.

Transformation to SMART GRID influences billing practices and drives IT consolidation

Historically, power distribution companies have focused on energy transportation from bulk supply points to consumers, with responsibility for the entire value chain. As regulated businesses, they delivered steady returns to shareholders. These annuity-like returns are now under threat from external changes to the sector in general, and from internal business goals. Under pressure to deliver enhanced performance against falling prices, rising costs and increased reliability pressures, distribution companies must transform themselves into leaner, more agile businesses.

In developed countries, the electricity and utilities sector is facing mature markets, increasing diversification and competition. In emerging economies, however, significant growth of energy consumption goes hand in hand with environmental protection and infrastructure investment challenges.

In order to reduce CO_2 emissions and to be prepared for the foreseeable shortage of oil and gas, alternative power generation methods are being introduced. Some countries have based their energy strategy on the extended use of nuclear power generation, and others are forcing energy suppliers to utilize alternative power sources, including generation by private households.

On the distribution side, the politically-motivated break-up of the markets is enabling more competition. Grid owners no longer retain exclusive rights to sell the energy they transport, and the transmission network must be opened for other power vendors to use. This diversification is forcing traditional, monolithic energy businesses to operate the generation, transportation and distribution businesses as independent units, able to work with and profit from partnerships with smaller and regional players.

A host of new technologies are set to allow utilities to better control their costs. Smart metering, for example, will provide new ways to monitor usage and report consumption, which will enable providers to fine-tune power grid capacity.

The introduction of smart grid technologies in particular will add complexity to the network, moving power and information in multiple directions and enabling a wealth of new participants and business models.

Grid operators need these new methods in order to bill and compensate the new partner and client structures. The so-called new SMART GRID initiatives are not only a call for smarter operations and improvement of energy efficiency and service, but also a demand for consolidated and smart billing processes within the organization, required to maintain their financial performance. At the same time, clients and business partners demand precise and understandable charging and compensation processes.

IT has become critical to the industry, and deregulation has dramatically increased its importance to energy and utilities companies. For example, energy companies use IT to measure and maintain the cost-effectiveness of daily generation, transmission, and distribution operations, which in turn helps to inform pricing decisions.

SAP solutions sets standards for energy billing and invoicing
SAP has developed a specific set of applications for the energy industry, called SAP for Utilities (SAP IS-U), which support role-specific business processes in the utilities industry and are addressing the needs of companies in the energy generation, transmission and distribution, retail, and services.

The SAP solution for Utilities / Customer Relationship and Billing (also called SAP ISU/CCS) is a member of this suite. The solution supports the typical core processes of a utilities company: consumption and revenue collection. For consumption, meter-reading orders have to be created and printed, and the results have to be uploaded into the system. To collect revenues, client billing must be generated, invoices issued, and payment reconciled.

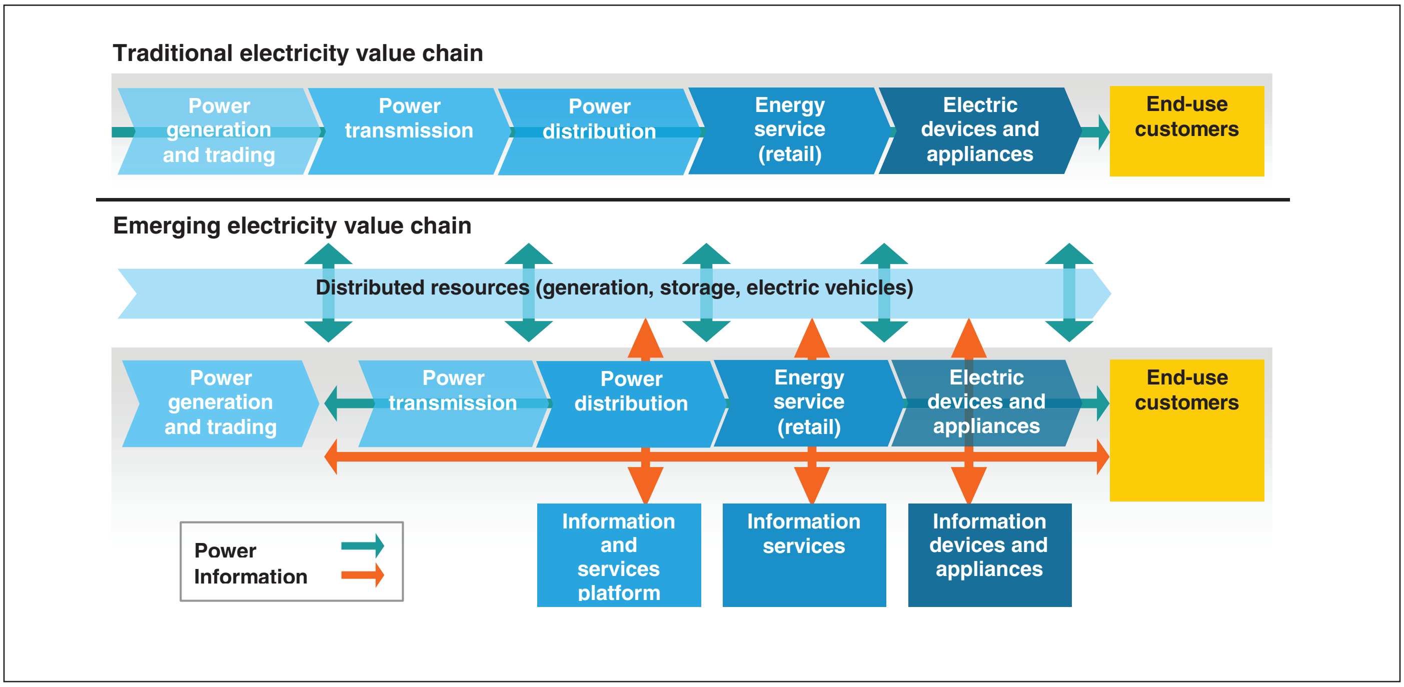


Figure 1: Transformation of the electricity value chain puts IT into a central role [Source: IBM Global Business Services]

Over the years the SAP energy billing solution has established itself as a proven standard in the industry. It is the ideal application to consolidate and standardize various billing process variations found in regionalized structures or in line of business units. SAP constantly updates the application to keep up with the industry trends such as Smart Grid, with innovative solutions to extend its power and reach.

Most importantly, by using the SAP for Utilities applications within a larger SAP ERP environment, data can be consolidated automatically into core business processes, enabling enterprise to track financial performance much more closely and more accurately than before.

Business environment and client motivation for the test

The large energy client involved in the solution scalability test has started a project to merge several billing systems into one standard system, based on SAP software.

This new system will become one of the largest utility billing systems. IBM supported the client's likely future growth path by setting up a test to help uncover the optimal hardware and database configuration at an early stage of the total billing project.

The data structures and the SAP customizations used reflect the main business practices of the client, to ensure valid real-world comparisons. The results produced, the customizations performed, and the findings delivered will be now incorporated into the client's new production environment to avoid later issues in the critical go-live phase.

Test requirements:

This new system needs to support the growth of billing volumes to up to 30 million customers, and is required to have a throughput of more than 150.000 bills/hour. The target platform will be able to support the business environment with following business and technical characteristics:

- Serving 30 million customers.
- Up to 40 TB database size.
- 1.5 million customers billed per day in a 10h batch window.
- Stable performance capable of delivering more than 150,000 bills/hour.
- Continuous infrastructure operation (no outage if a solution component fails or if the infrastructure is being maintained).

Business processes under test, and results

At the client's request, the desired platform was racked up in the IBM Montpellier client test center. The team deployed an IBM System zEnterprise z196 with the IBM BladeCenter zBX extension hosting PS701 Power7 blade servers for running the client's SAP Utilities software.

The SAP database server in the ensemble was DB2 Version 10 for z/OS, hosted on a z/OS logical partition in the z196 complex.

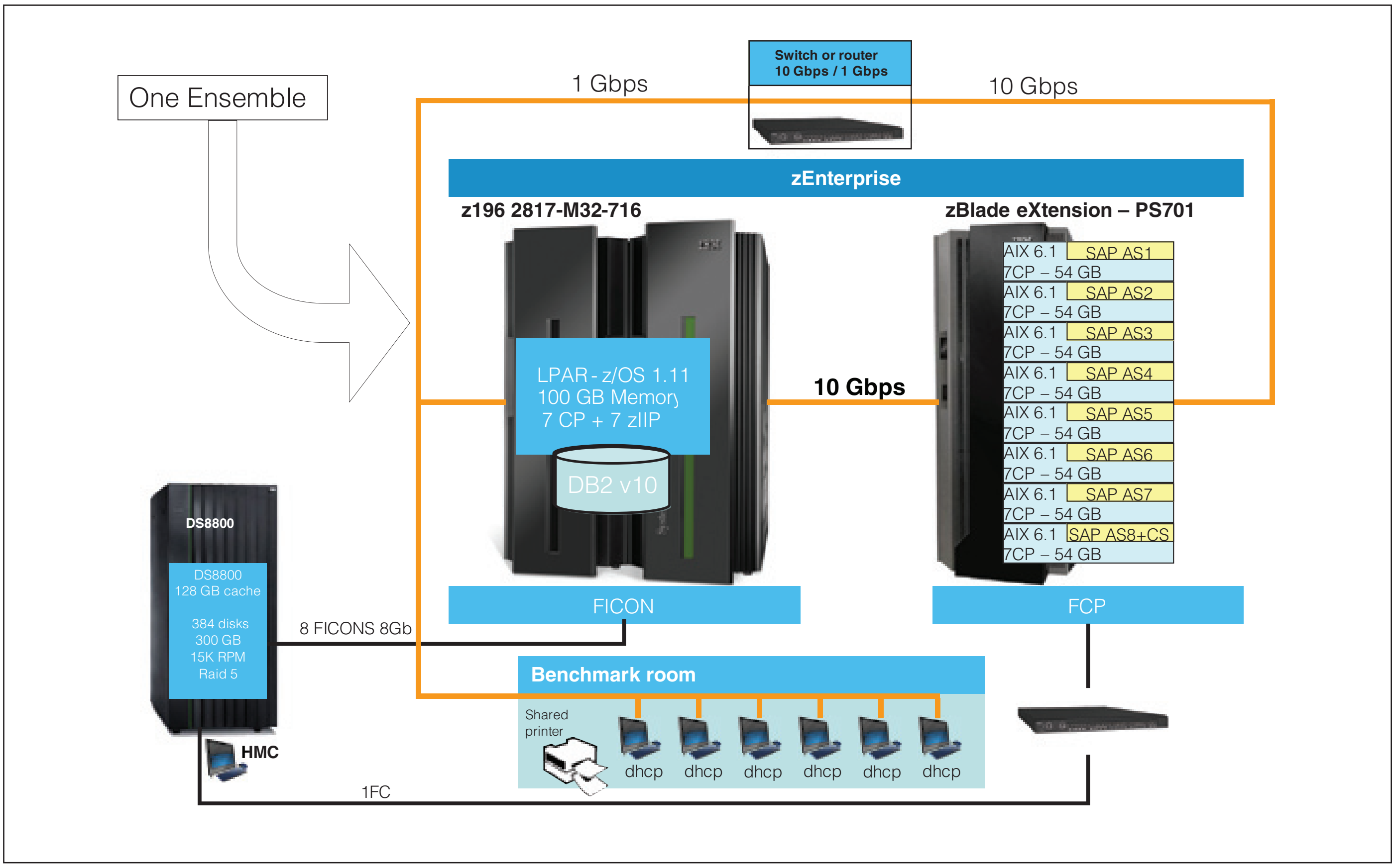


Figure 2: Hardware infrastructure used in PoC

SAP ISU business process

The SAP ISU module is composed of three main business processes: Consumption Entry, Contract Billing, and Invoicing & Printing (see Figure 3). Out of this functional portfolio, the team tested selected four scenarios as representative for KPI measurements:

1. Upload and aggregated posting of incoming invoices.
2. Billing – as Mass Activity.
3. Invoicing – as Mass Activity.
4. Print Bill – as Mass Activity.

In the diagram in Figure 3, the test scenarios are marked grey in the list of the SAP IS-U processing steps, while the others are preparations or intermediate steps with minor influence on the outcome.

Overview of the batch scenario

The client was particularly interested in scaling the mass activities, each of which runs in a batch job as a whole, as designed by SAP. The client was concerned that these jobs would not scale and that the processing window required would exceed their business goals.

The business process scenarios tested were all developed and provided by the client, and are listed in the table, in which the detailed SAP application step name and characteristics are spelled out (Figure 4).

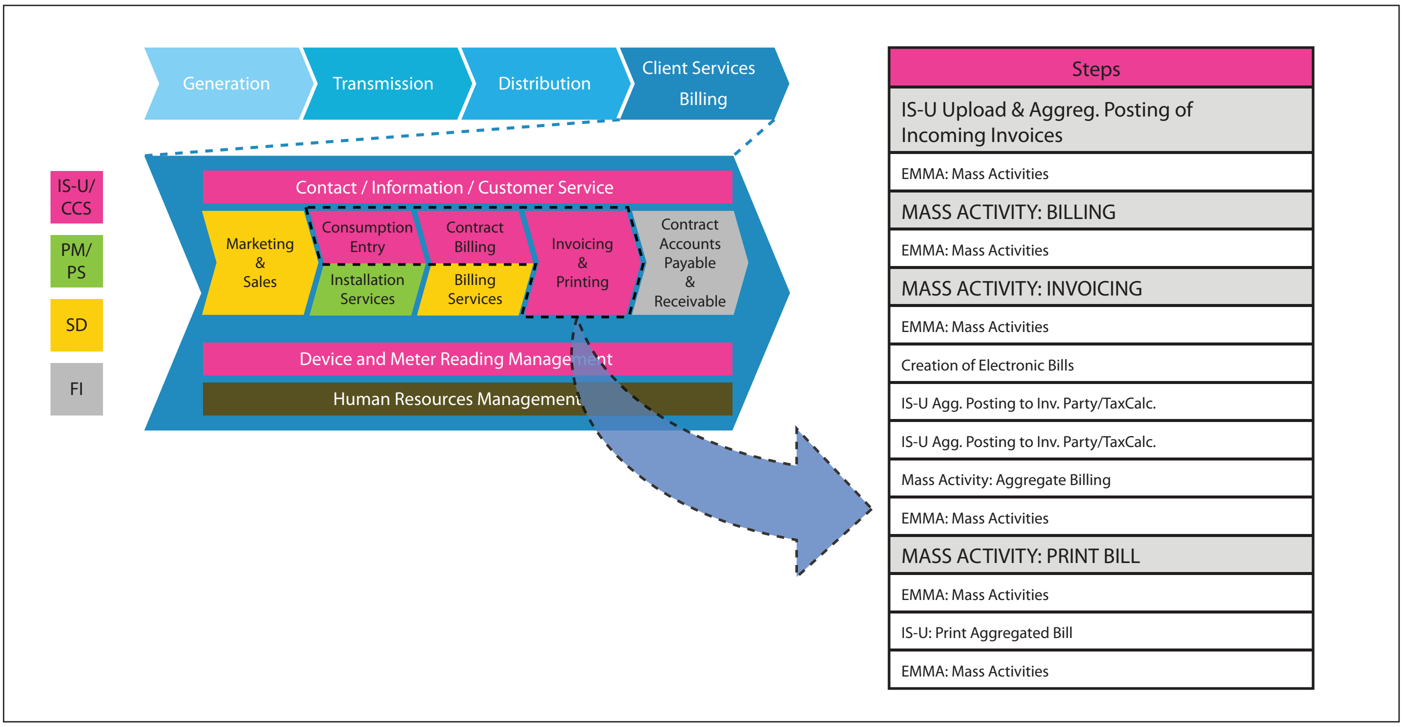


Figure 3: SAP IS-U functional scope and test steps

Jobname	Application	//Jobs	Description
UPLD201103200B111C	UPLD	100	IS-U Aggreg.Posting of Incoming Invoices
EMMR20110320_00007	EMMR	36	EMMA: Mass Activities
BILL201103200B111C	BILL	100	MASS ACTIVITY: BILLING
EMMR20110320_00008	EMMR	36	EMMA: Mass Activities
INVO201103200B111C	INVO	100	MASS ACTIVITY: CREATE BILL
EMMR20110320_00009	EMMR	36	EMMA: Mass Activities
EERD201103200B111C	EERD	60	Creation of Electronic Bills
ETHA201103200B111C	ETHA	60	IS-U Agg. Posting to Inv. Party/TaxCalc.
ETHA201103200B211C	ETHA	60	IS-U Agg. Posting to Inv. Party/TaxCalc.
ZAGR201103200B111C	ZAGR	20	Mass Activity: Aggregate Billing
EMMR20110320_00010	EMMR	36	EMMA: Mass Activities
BIPR201103200B111C	BIPR	100	MASS ACTIVITY: PRINT BILL
EMMR20110320_00011	EMMR	36	EMMA: Mass Activities
EAGB201103200B111C	EAGB	60	IS-U: Print Aggregated Bill
EMMR20110320_00012	EMMR	36	EMMA: Mass Activities

Figure 4: Table showing SAP application step names

For the solution scalability test scenario we ran the four main steps highlighted in green:

- Data upload
- Billing
- Invoicing
- Print Billing

These four steps represent the main workload contributors and scaling dimension of the planned system activities. Further intermediate steps can be identified by looking at the spikes on the performance chart, between invoicing and printing .

Batch process description

All the individual steps of the batch-processing mode serve a single purpose: the generation of utility bills for more than 150,000 customers an hour. One of the main objectives of this test was to prove that the solution is capable of handling the load within the given timeframe.

Data upload

The first step towards creating the final bill is injection of Meter Reading (MR) values from flat files into a generic structure on the database. From these structures, the billing process can retrieve the information needed.

Meter Reading information showing the amount of electricity used is derived from several sources, including:

- Meter reading by the utility company
- Meter reading by the customer
- Automatic estimation
- Interpolated meter reading

Various values of customer meter readings (MR) inputs were uploaded, and we tested varying numbers of SAP parallel jobs to discover the most efficient way to process the data.

Billing

Consumption of gas and electricity is calculated based on an existing or estimated figure. After the billing run for each customer is completed, the amount owed to the utility company is known.

Invoicing

In this step, the customer's bill is prepared. The result from the billing process is taken, applicable taxes are added, the amount is balanced with former customer payments and debts, and the bill shows the total amount due.

Bill Print

The name of this last step is somewhat misleading. The Print Bill step completes the aggregation, extraction and collection of personal and billing data from the system. The final bills are usually printed by a purpose-designed subsystem.

General influence of hardware and software setup for the test results

To achieve the target KPIs, balanced workload distribution and parallel processing turned out to be essential. The team undertook careful, step-by-step process and design analysis, aimed at identifying situations where one process might reserve a resource that is vital to another running in parallel, thus blocking the overall progress.

Measures taken were:

- Partitioning of tables according to number range intervals so each batch job writes in its own partition.
- Distributing batch jobs over different application servers according to the objects they processed.
- Spooling output to the file system rather than the database, to permit a greater degree of parallelism.

A series of test runs were performed to find and analyze bottlenecks. Whenever possible they were eliminated, usually by fine-tuning the system or by adjusting the database parameters. The test runs were used to discover the number of SAP parallel jobs that resulted in the best overall throughput.

Batch results

After tuning the SAP system parameters and configuring the powerful zEnterprise environment, the IBM/SAP Benchmark team was able to reach and exceed the target KPIs – in fact, almost tripling them, an achievement clearly visible in Figure 5. For each run, the workload injection consisted of 1.6 million customer meter reading sets. This process loads the SAP application with sufficient data to generate the maximum number of bills per hour.

In the first series of test scenarios, the number of parallel jobs was initially set to 100, which acheived the target KPIs. The number of parallel jobs was then increased to 160, which produced very good throughput, and delivered twice the target KPIs.

In our second test series, we increased both number of the parallel billing jobs to 200 (the SAP billing application limit was 25 jobs per application server) and the number of application servers (blade servers) from six to eight, using 56 cores. In this session, we reached the maximum capacity of the SAP IS-U application, utilizing CPUs from the application server blades. We also increased the usage of the DB side for the UPLOAD phase, but this did not reach critical levels, such as an infrastructure limitation or SAP application limitation.

The IBM System z and SAP application scenario provides a very efficient and scalable solution, in both scale-in and scale-out capabilities. A customer who wants to grow its SAP IS-U solution can, within one System zEnterprise hardware infrastructure, meet its business requirements with confidence.

Parallel Jobs	Meter readings	AS x Cores	Result achieved	Database				Application	
				CP peak	CP avg	zIIP peak	zIIP avg	CPU peak	CPU avg
N.	Mil	p7 blades	bills/hour	z196 processors				Power 7 cores	
160	1,6	6 x 7	358 905	3,4	3,2	4,1	3,8	42	26
200	1,6	8 x 7	426 630	5,7	4,0	5,9	4,6	55	31

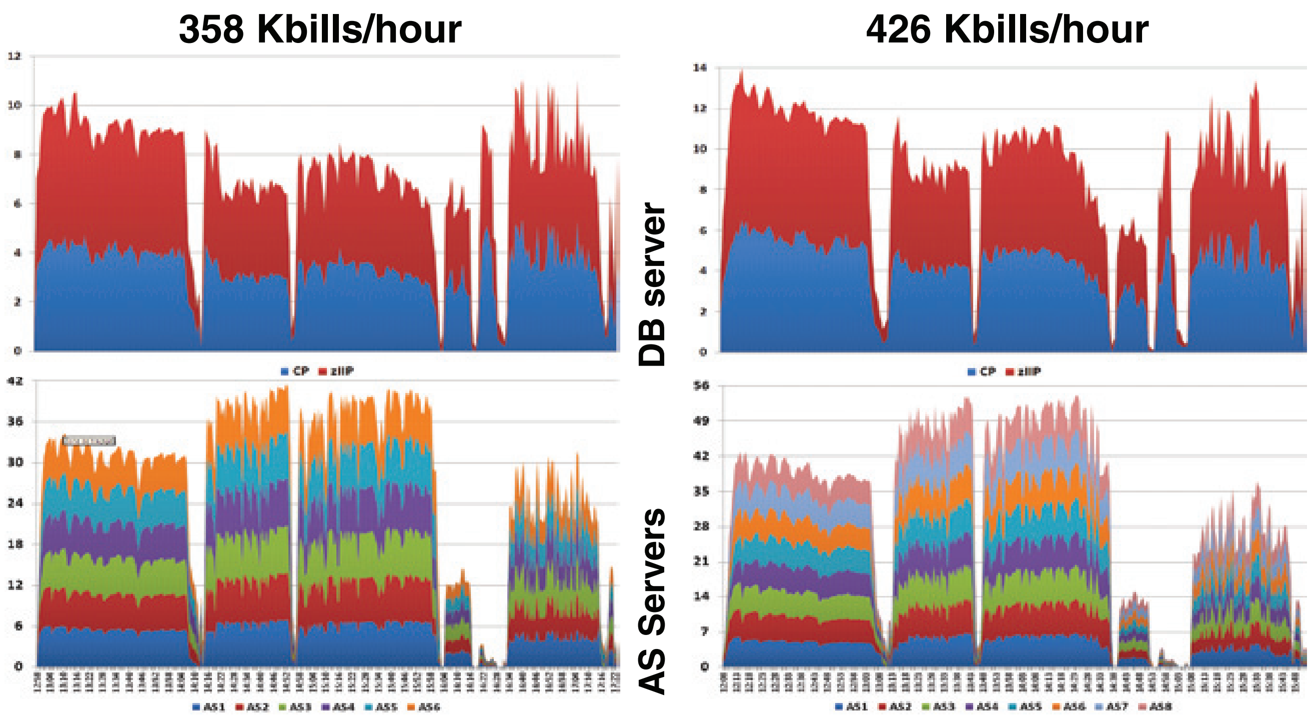


Figure 5: Summary table of results

Test summary

This solution scalability test demonstrated that customer KPIs were acheived using the new zEntreprize and zBX-PS701 Infrastructure without changing the customer SAP application, and showed the scalability of the SAP solution on zEnterprise in Ensemble mode. The solution is able to exploit the scale-up capabilities of the database server running on DB2 Version 10 for z/OS. The scale-out capabilities of the zBX-PS701 blade servers as SAP application servers can be leveraged, and shown to offer specific throughput increases.

Running SAP applications on the zBX-PS701 Blade servers using AIX and IBM PowerVM virtualization enabled us to increase and optimize the number of parallel jobs in the SAP application over the target threshold by taking advantage of the POWER7 processor cores in the ensemble.

With help of the zManager tool, which manages the configuration and setup of a zEnterprise ensemble, we controlled and ensured the network bandwidth for comminucation of SAP AS on the blades with SAP databases on DB2 in the z/OS partition.

The DB2 engine scaled smoothly during all the tests, and did not need to be tuned specifically to handle the increase of parallel job requests from the SAP application servers. The average database response time remained constant during all the tests.

There is still ample headroom for further scaling of the database server; however, we were limited by the SAP IS-U application, which allows a maximum of 200 parallel billing jobs.

Technical details of the scalability test

Hardware platform

- Database server: IBM zEnterprise in Ensemble mode
  z196 mainframe model 2817-M32-716: 16 CPU / 100GB as SAP DB server, using seven CPUs and seven zIIPs, eight gigabit Ethernet cards and eight Ficon channels
- SAP application servers on zBX blade extension
  Eight IBM PS701 blade servers featuring POWER7 processors of 3.0GHz, with eight cores and 64 GB main memory, with ten gigabit zBX intra ensemble network cards for data flow from the application servers to the database server, and one Ficon channel for access to data storage
- Storage: IBM System Storage DS8800 with 128 GB cache

Software

- Database server: Operating system IBM z/OS 1.11, with IBM DB2 for z/OS V10
- Application servers: Operating system IBM AIX 6.1 with SAP ERP ECC 6 with NetWeaver 7

The Energy Utilities Industry can be structured into three business areas:

- Generation – Companies that own power plants and generate the energy (nuclear, natural fuel, solar energy etc.).
- Transmission – Companies that own the network of high-tension wires, poles, pipes, and land easements that originate at the generation utility and end at points of distribution. These companies provide a way to transmit the energy and do not own the product.
- Distribution – A company that usually owns the infrastructure (low-tension wires, pipes, poles, meters, and so on) for distribution to the consumer.
- Some large generation companies also own energy transmission and distribution. Most utility companies operate both transmission and distribution networks, but some own only transmission lines, providing transmission services to other utility companies.
- The generation component is the most expensive part of the value chain piece, with an investment share at around 55 percent. Transmission represents 12 percent and distribution roughly 29 percent of the industry investment share.
- It is anticipated that world electricity consumption will about double between 2011 and 2030, with average annual increases of 2.7 percent.
- China and India account for more than 70 percent of global electricity consumption growth.
- Electricity generation is the largest producer of CO_2 emissions in the energy and utilities industry.

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