

# Building Enterprise Applications with a Pro-Active Infrastructure

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**Abstract** — Reason for a strategic decision towards the enterprise-wide initiative “Pro-Active Infrastructure” (PAI) was that the decentralized IT explosion was not only difficult to manage, it was – first and foremost – expensive. Every custom-build system used its own infrastructure. The initiative PAI is part of DaimlerChrysler’s IT business strategy and has the goal to proactively provide necessary infrastructure to projects. But just writing down standards based on patterns, blueprints, reference architectures and then hoping that someone would adopt them – this seemed like too little to DaimlerChrysler.

**Index Terms** — *enterprise-wide IT infrastructure, on demand operating environment, service oriented architecture, SOA*

## 1. INTRODUCTION

THE combination of evolving business drivers, changing customer demands and the evolution of enabling technology has produced a business revolution. Electronic connections are changing the way companies deal with partners, with information access, services and speed as the key differentiators. In fact, Web connections make it critical to optimize business processes across enterprises, rather than just within an enterprise.

Organizations are morphing from vertically integrated supply chains to interconnected ecosystems of suppliers, partners and clients. All trading partners in global companies, this means employees, suppliers, customers and all products of the company, define an Extended Enterprise. In an Extended Enterprise business is done in connected value chains within and between companies by electronic communication such as the Internet. That leads to a new business model. It is the transformation into a networked company. The IT architecture of an Extended Enterprise is a key success factor for enabling the business in a global acting company.

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Building distributed systems for an Extended Enterprise is highly complex. Challenges are developing robust, scalable and secure applications with high quality. The IT-Life-Cycle with “Development for Operations” has to be implemented and managed. Applications have to be developed without knowing the details of the operations environment. Independent of the developer location or organization, applications should be managed similar in all datacenters. Worldwide global and regional development centers are building applications, which have to run in datacenters. Trends like “Outsourcing” or “Partner-Development” are dominant organizational development and execution models and have to be supported with a future IT Architecture.

Another dominant challenge is “On Demand Business”. An “On Demand Business” is an enterprise whose business processes—integrated end-to-end across the company and with key partners, suppliers and customers—can respond with speed to any customer demand, market opportunity or external threat.

## 2. WHY A PRO-ACTIVE INFRASTRUCTURE?

PAI provides an integrated application platform which forms the foundations of the support platforms for all Java-based custom-build systems. With the help of PAI platforms, programmers can concentrate primarily on developing the business logic, as they barely have to bother with topics as security or directory aspects example. In contrast, they can use a large number of reusable components and architectures. Instead of having to perform time-consuming tests, developers can leverage secure, scalable platforms and profit from the associated support organization.

Along with this, PAI enables the integration of the applications and infrastructure components within the datacenters. Therefore, PAI forms the bridge between the data centers and application development.

Summarized, PAI is needed for several reasons:

- Application projects need a powerful, tested and dependable IT infrastructure, which fulfills the corporate technology standards

and runs the corporate datacenter operating environments.

- The company needs a comprehensive enterprise architecture which includes products, infrastructure architecture and guidelines.
- Web and e-business projects should concentrate on the business application development rather than on infrastructure issues.
- Large scale infrastructure services still have to be provided by small scale projects.
- PAI is needed as basis for a future On Demand Operating Environment for building global, regional and local integrated applications.

By using PAI platforms, projects can leverage the best of both worlds: a supported standard platform as a solid foundation and the flexibility of custom build software. Today infrastructure and platform integration issues are addressed on a project level. If projects are building enterprise applications a lot of infrastructure related code has to build on applications servers, Web servers, and security servers. This is not the way, how applications should be realized. Even if you are building applications on standard products, every datacenter and project is running different version levels and fix-pack versions in the development and datacenter, see Figure 1. In this environment it is very difficult, to migrate versions or share environments. The product life cycle management is very expensive. The implications of today's "middleware zoo" can neither be fully supported nor tested.

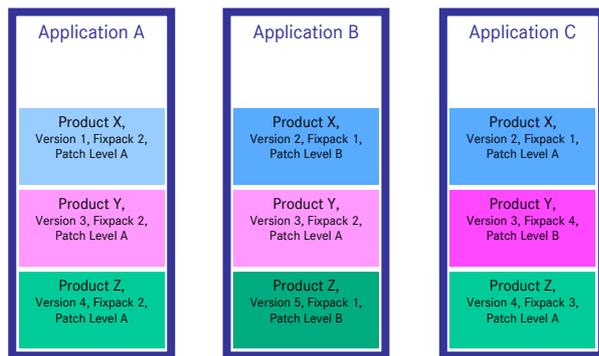


Figure 1 Too many variants of version levels

### 3. PAI SCOPE AND APPROACH

At DaimlerChrysler PAI is a central initiative with the goal to design, implement and deliver a common IT infrastructure based on PAI platforms for application projects, see Figure 2. PAI platforms are a stack of elements to support DaimlerChrysler specific application development. In particular it provides solutions in order

- to reduce the life cycle costs for application systems
- to enhance the quality, robustness and scalability of application systems
- to reduce the time to market for application systems
- to increase the control over external application development
- to ensure the interoperability between regional and global application systems
- to harmonize the architecture of application systems

This initiative was of large scope and significant complexity. Not only from a technical perspective but more from achieving enterprise-wide acceptance from all departments and from covering different disjunctive and partly contrary requirements/policies. The technical complexity comes from numerous products contained in the platforms from various suppliers such as IBM, Sun, Novell, Netegrity, Mercury, Merant, and Microsoft. Within PAI, these components are connected with each other, using integration components developed in-house. In our scope, the enterprise-wide departments (organized by brands) are

- Mercedes Car Group ITP (Mercedes-Benz, Maybach, smart),
- Chrysler Group ITN (Chrysler, Jeep, Dodge),
- Commercial Vehicles ITC (Mercedes-Benz Trucks, Freightliner, MercedesBenz Vans, Buses & Coaches),
- Services (Financial Services, DaimlerChrysler Bank),
- and strategic partners (Mitsubishi Motors Corp.,).

Target customers of PAI are basically DaimlerChrysler IT organization units and projects, external software partners developing for DaimlerChrysler in all different sourcing strategies and internal as well as external datacenter running these applications.

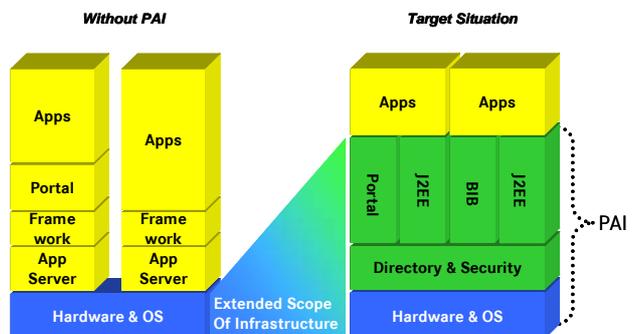


Figure 2 PAI extends the scope of infrastructure

In the last two years, our architecture strategy followed these three steps:

1. Migration of existing assets (PAI 1.0, delivered Sep 2002) and use of existing infrastructure wherever it is possible. Only those assets with low dependency to applications were taken.
2. Begin consolidation of existing infrastructure and take all those assets that need to be controlled by PAI, to ensure the scalability, availability and manageability of the delivered infrastructure with high potential for reuse (PAI 1.5 - 2.5, delivered June 2003 – Oct 2004).
3. Enhancing PAI release with new functionality in a more proactive way (PAI 3.0 and later, will be delivered Oct 2005). This was triggered by requirements of customers and new upcoming technologies.

#### 4. PAI PRODUCT ARCHITECTURE

The PAI architecture defines a set of tested compatible platforms, environments, and tools based upon the DaimlerChrysler enterprise architecture and strategic technology products.

The PAI product scope goes beyond delivering only software products. With the PAI approach we take strategic market products from several vendors and integrate these products to company specific PAI platforms. Hence, PAI is a product suite containing so called PAI platforms. Therefore, we must distinguish between PAI itself and a PAI platform. With this in mind, PAI can be seen as a brand for a set of products, whereas a PAI platform can be seen as a managed product.

A PAI platform is defined by the following characteristics:

- A PAI platform is a package of functionality (vendor products and DaimlerChrysler self developed components) that provides higher level services to applications.
- The main criterion of packaging the functionality is the granularity of the existing strategic vendor products, e.g. IBM WebSphere Application Server for the PAI J2EE Application Platform.
- A PAI platform is a managed product within the PAI brand, i.e. we deliver explicit configuration settings.
- It is integrated with other PAI platforms; these relationships will be implemented as parts of the corresponding platforms to guarantee the integration.
- A PAI platform is well-tested inside the DaimlerChrysler infrastructure.
- An application can use only one or many of these PAI platforms, depending on its requirements and the type of this application.

Our first area of focus was on J2EE applications, portal, directory, security, process and business integration, see Figure 3. The next phase will include data management, .NET

applications, SAP applications, and operation services (provisioning, problem determination and resolution).

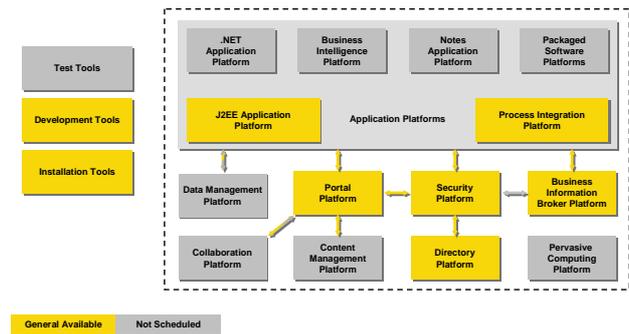


Figure 3 PAI Platforms 2.5 – PAI High Level IT Architecture

We categorize the platforms of this overall architecture in the following three types:

- *Application Platforms*, which are containers where application code for presentation, business and process logic can be deployed. They provide built-in components for applications to ensure standardized operations. All resources within the platform are used exclusively by the application. Examples for this kind of platform types are the J2EE Application Platform as well as the Process Integration Platform.
- *Shared Services Platforms*, which provide services that can be used and shared by different applications. The Application Platforms contain APIs to provide applications the access to the services provided by the Shared Services Platforms. The Directory Platform and the Security Platform are examples for this platform type.
- *Integration Platforms*, which form containers for providing capabilities for the integration of different applications. They provide reusable components and templates for a standardized usage of the platform. We can take the Portal Platform and the Business Information Broker Platform as examples of this platform type.

These PAI platforms are built with a Java framework, a set of reusable components, applications and glue-code to deliver a powerful integrated product, which can be used modular. The platforms are implemented according to an architectural model for development and operations, which comes with the product. Architectural models are available for the platforms, the physical environments and the tools for development and operations in the PAI Centers. PAI Centers are development, test&integration, and production datacenter (internal and external). With the environments, PAI delivers a full set of automated installation

procedures and descriptions, including the operational models. It is planned to integrate these procedures in "Provisioning Technology" from system vendors, which will enable better "On Demand" usage of hardware and software. Additionally a set of tools for development, test (functional and load tests) and operations are offered, which allow efficient development and operations for PAI platforms and environments. These tools are more an option and can be used by IT customers. In addition to these PAI platforms, environments and tools, a set of services will be delivered through service people, which are focused to PAI. Examples for these services are "Architecture-Consulting," "Application-Testing," "Environment-Installation" for PAI. These services are so called "value added services." At the end processes between development and operations could be standardized like Change Management, Problem Management, Error Handling.

In the following subsections we describe the six fully featured platforms of the current PAI release 2.5.

#### A. PAI Directory & Security Platforms

The Directory Platform is a shared platform of the PAI 2.5 product suite. It provides a central data store for security-related data. This data is used for user management of local users, authentication services for local users, and authorization management for all kinds of PAI based applications.

#### B. PAI Directory & Security Platforms

The Security Platform is also a shared platform. It provides an end-to-end security solution for PAI-based applications based on authentication, Single Sign-On and URL-based authorization services. It relies on user directories like the DaimlerChrysler Corporate Directory as data store for authentication data and the PAI Directory Platform as data store for authorization data. Furthermore it supports applications using HTTP as communication protocol.

#### C. PAI J2EE Application Platform

The J2EE Application Platform builds the basis for delivering J2EE compliant rich client and thin Web applications. It also provides core application integration services to enable integration between applications, store and resume features, as well as consistent system management integration, by providing a powerful logging mechanism. A Web application framework is included, first to ensure long-term migration, and second, to deliver powerful multi-variant application management features.

#### D. PAI Portal Platform

The Portal Platform provides a portlet-based environment, which supports assembling web pages from various sources that are using portlets. The portal provides user-customized pages, a range of portlets integrating with external systems, and existing web content. The PAI Portal Platform is complemented by a number of product extensions to integrate with the existing DCX infrastructure.

#### E. PAI Process Integration Platform

Process Integration is one of the focal points of the PAI business integration strategy, which addresses integration of applications, data, and processes from both, business and IT perspectives. Business integration is the coordination and cooperation of all the business processes and applications within and external to the enterprise. It involves bringing together the data and process intelligence in the enterprise, and harnessing these to enable all applications and users to achieve their business needs.

#### F. PAI Business Information Broker Platform

The Business Information Broker platform is another focal point of the PAI business integration strategy. It addresses integration of applications and data. By bringing together the data, business rules, and process intelligence in the organizational unit, or on a higher level in the entire enterprise, on this integration point, reuse of existing application logic can be leveraged and management can be simplified. Besides the foundation for application inter-communication this platform provides data transformation capabilities and event brokering.

### 5. SERVICE ORIENTED ARCHITECTURE

A service oriented architecture (SOA) is an enterprise-scale IT architecture for linking resources on demand. In an SOA, resources are made available to participants in a value-net, enterprise, line of business (typically spanning multiple applications within an enterprise or across multiple enterprises) where the primary structuring element for applications is a service (as opposed to subsystems, systems, or components). It consists of a set of business aligned IT services that collectively fulfill an organization's business processes and goals. These services can be choreographed into composite applications and can be invoked through open protocols.

The vision of PAI is a system architecture in which applications are integrated using service interactions that are *loosely-coupled* and *well-defined* to support interoperability, and to enable flexibility and reuse. *Loosely-coupled* implies that the underlying implementation is hidden from the

application that invokes the service. And *well-defined* suggests a common definition of services which is independent of any particular technology but can be used by all technologies.

Today, PAI has implemented an Enterprise Application Architecture where broker-specific adaptors provide pre-built connectivity to a wide variety of applications and platforms. Next major shift for PAI will be a service oriented integration using Web Services to have open standard interfaces and to be flexible and cheaper for new business requirements. That means our vision is a service oriented integration of all applications in the enterprise where changes of internal components should not change other parts in the enterprise environment since even the internal components are loosely coupled.

## 6. CONCLUSION

Between 2002 and 2004, about 70 applications worldwide have been developed based on PAI at DaimlerChrysler. Many of these systems have a development budget of over 1 million euro. The first was the employee portal, which is used throughout the company. Other examples of successfully supported product developments are the supplier portal (also used internationally), and a dealer platform. The latest project is the development of a materials purchasing system, which is to go on stream shortly.

DaimlerChrysler expects PAI to deliver significant advantages regarding costs: a best practice survey commissioned from Gartner, demonstrated that the greatest potential for cost reduction is by far to be found in operation management. PAI calculates, that applications which have been developed on a PAI basis, will result in an overall cost reduction of between 25% and 30% during these solutions' lifecycle, see [4].

Even if you consider that the initial learning curve prevented the company from reducing costs by the above-mentioned sum, the result is still a cost factor which provides a clear overview of the investment for PAI development: in 2003 and 2004, DaimlerChrysler did a two digit million euro investment in PAI development and support. PAI has already fulfilled its profitability.

We summarize our lessons learned similar to playing chess: First, you have to play it very carefully. Second: sometimes I have to lose an important chess piece if I want to win the chess match.

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