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iDA
Interchange of Data between Administrations

Technical description of target eGov infrastructure for delivering PEGS

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Technology and Market Trends

Version 1.2

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1 MANAGEMENT SUMMARY

This document gives an assessment of technological and market evolutions, which will likely affect the implementation of pan-European e-Government services (PEGS). The central question to this report is: "What are technologies and market offerings now and in the next five years that will enable the coherent and efficient composition of all government resources (data, application logic and local processes) such as to support pan-European eGovernment services in a fully distributed environment?"

There is an abundance of technologies which may have an indirect impact on PEGS, but the present report focuses on those technologies of interest to "interoperability" and "integration" at a European scale, and precisely in support for PEGS.

One can think of approaching PEGS in a “classical” way, by standardising to a large extent administrative procedures Europe-wide, and then mapping such standardised procedures onto precise interaction processes, with precise formats and error conditions. Such a standardised solution would be extremely difficult, if not virtually impossible to realise and to maintain in a pan-European context.

The interoperability issues in a pan-European context are not purely technical, but are predominantly situated at the semantic and organisational level[1]. Since the objective of this document is to describe technology trends which are relevant for the delivery of PEGS, it is no wonder that the actual emphasis is on technologies which support the semantic and organisational layer.

There are a lot of technology advances with possibly a large future impact on PEGS, but many of them are not yet fully mature. A careful approach in introducing these technologies will be required.

At the organisational level, PEGS could benefit from strong and sophisticated BPM (Business Process Management) technologies, but standards are not stabilised yet.

At the semantic level a limited and focused use of ontologies[2] may help. Doing more is likely too ambitious at this time.

[1] See EIF, European Interoperability Framework for pan-European eGovernment Services; Version 4.2; January 2004.

[2] A set of rules which can help drive semantic reasoning and matching, e.g. intelligent searching for services.

2 INTRODUCTION

2.1 OBJECTIVES

/1 The purpose of the present document is to "*consider the main trends in technology and market over the coming five years and describe these where relevant for the delivery of Pan-European e-Government services.* ".

/2 This document is designed as input to the next phase of the project, namely the PEGS architecture and infrastructure definition. So, anticipating on such architecture framework, a significant portion of the present report had to be dedicated to **scoping** and **positioning** technology trends and standards with regard to PEGS. Section 2.3 is dedicated to refining the scope and a reference taxonomy is selected in section 2.5.

2.2 RELATED PROJECTS AND INITIATIVES

/1 Appendix I gives a list of related EC projects which are an essential base and source for the present report.

/2 There are, of course, many Member State initiatives that weigh on the definition of PEGS infrastructure, handled in other streams of this project.

2.3 SCOPE

/1 The central question to this report is: "**What are technologies and market offerings now and in the next five years that will enable the coherent and efficient composition of all government resources (data, application logic and local processes) such as to support pan-European eGovernment services (PEGS) in a fully distributed environment?**"

/2 There's an abundance of technologies, many of which concern directly any PEGS infrastructure that could be designed, but also many others that could have **indirect impact** on the PEGS infrastructure; let's cite for instance *grid computing* that can open the way to new architectures, *ipv6* that may bring additional security capabilities into the network infrastructure, *autonomic computing* and *autonomous systems management*, new *XML language bindings* that can vastly transform the means to deal with XML documents by adapting oneself to available tags and relevant semantic subsets, advances in *biometrics* that could turn over current issues with *identity management and PKIs*, or side developments of the *semantic web* which may help achieving the vision of a "*sea of services*" where coordinated *multi-agent systems* can discover, adapt and invoke services to achieve goals on behalf of administrations, citizens and enterprises. One could also cite all advances related to *mobile technologies*, *wearable* and *pervasive computing* which can significantly affect the means to identify individuals, access services and pay for them. Some of these technologies will be lightly touched in so far they bear a potential impact within a five-year horizon, others will not be discussed at all because of their loose connections to any PEGS infrastructure.

/3 The present report focuses on those technologies of interest to "inter-operability" and "integration" at a European scale, and precisely in support for PEGS. In other words, those technologies:

- that permit building pan-European services **on top of** national or regional services;
- that allow discovery, inter-operation and monitoring of services and/or applications for the sake of supporting these pan-European services;
- that address the 'channels' of integration, i.e. the communication means and formats used for computerised exchanges, between a "enterprise application" or "portal", and the "applications" of the IT infrastructure of government institutions (of Member States or EU institutions).

/4 IDA, other EU institutions as well as EU-funded private initiatives have already carried on many projects in preparation for Europe-wide e-Government services. Some reports clearly lay out directions in terms of architectures and IT principles to apply to the present context. Other recent reports contain a quite exhaustive review of the technologies in a given area like for instance channels of communication between citizens and government institutions. Yet others specify precisely pan-European infrastructure elements, which are in diverse stage of construction at the time of writing.

/5 It is clearly not the intent of the present report to mimic or re-phrase these reports but well to complement these on the specific objectives cited before.

2.4 INFORMATION RESOURCES

See Appendix II for a list of consulted information resources.

2.5 SELECTING A REFERENCE TAXONOMY OR MODEL

/1 The selection of a reference taxonomy or model is guided by the following requirements:

1. The review can be structured and yield a sense of systematic coverage;
2. Most recent technology and market trends of interest can be positioned in it;
3. If such a model stands as a generic abstraction of the PEGS infrastructure then the impacts of the technology and market trends onto PEGS can be stated precisely.

/2 A classification based on the interoperability layers as defined in the European Interoperability Framework seems appealing but is not convenient for a review of technology and market trends. Some technologies fall in multiple categories, and there is no single technology alone that is covering a given domain.

/3 The following classification has been adopted as a means to present technology trends, market directions and their impacts to PEGS in the present report:

- **Process Management**
- **Discovery, Semantics and Matching,** for their role into enabling large scale distributed systems
- **Transaction,** facing significant challenges in SOA's
- **Security,** being a growing concern and major trend
- and other important issues
  - **Protocols,** do face significant evolutions still
  - **Common eBusiness Interfaces**, in the line of UBL / ebXML could have impacts on PEGS
  - **Data Transformation**, may become again a central concern
  - **Modelling, Methods and tools,** that would be required to go from the newest concepts to working systems
  - The **'Dataweb',** standing apart and which can't be ignored
  - **Management** facilities are just getting attention

2.6 THE UBIQUITY OF WEB SERVICES

/1 There is no chapter dedicated to 'web services' or SOA's (Service Oriented Architectures) in the present report, not as a mark of disinterest but just the contrary: because they are almost everywhere, especially, if one looks five years ahead.

/2 Web services could still be considered in infancy. Gartner positions SOAP and WSDL into the 'plateau of productivity' at the same time as qualifying Service Oriented Business Applications as 'embryonic'. Not long ago, Gartner also released quite good papers on the cautious use or miss-use of web services whose statements still hold true. If one looks at the flora of SOAP and WSDL-related amendments and propositions[3], it is easy to understand that they are not fully stabilised yet, neither their impacts to the design of complex distributed applications are fully grasped.

/3 However the grounds of SOA's are now firmly established, independently of SOAP, WSDL, UDDI and others. HTTP as a preferred transport for SOAP has much facilitated implementation, but also shown its limitations. Clearly, the underlying technologies and protocols could still change (at least, significant evolutions are ahead), but the trend towards SOA is firmly established and poised to become state-of-the-art within the next 5 years.

[3] e.g. SOAP 2.0, WS-addressing, WS-Eventing, WS-Coordination, WS-Transaction, WS-Trust, WS-Authorization, WS-Reliable Messaging, …and many more

3 PROCESS MANAGEMENT

3.1 CHARACTERISATION

/1 Present and future progress in the domain of Distributed Business Process Management and Monitoring is possibly **the one factor that could have the biggest influence onto the evolution of the PEGS infrastructure for the next 5 years**.

/2 Amongst the technology areas of interest to PEGS, this is possibly the most active, both in terms of standards and product releases.

/3 The potential revolution behind process management theories should not be underestimated. It has been shown[4] that, mathematically, all what we previously understood as computation, and all what we previously understood as communication, can be modelled and understood as the same thing: **processes**. For some advocates of BPM, Business Process Management Systems (BPMS) is a new category of software, as much as RDBMS was before it.

/4 Its current evolution is much linked to the one of Web Services and Service Oriented Architectures (SOA), possibly due to the parallel development of both of these technologies, but also because service oriented approaches fit very well with distributed processes architectures. Some Process Management languages like BPEL are even only based on Web Services, which many would consider as being highly restrictive and limited. Products on the other hand are open to many other forms of interactions with processing resources.

/5 We can divide the Business Process Management domain into the following areas of interest to the PEGS infrastructure:

- **Business Process engines** as such, i.e. able to execute or orchestrate a number of activities within a single or multiple applications, with or without human tasks / workflow steps. Such engines can nowadays be centralised or fully distributed, up to the point of allocating dynamically the execution of process steps to physical nodes. There are two main types of Business Process Engines: prescriptive process engines and rule-based ones[5].
- **Formal Specifications** and the means to support **computerised representations of abstract business processes or interactions.** Or, in other words, defining the formats that a business process engine can import, export, interpret or execute.
- **Process and Interactions modelling** which can be divided in two main categories: **orchestrations** on the one hand, and **choreographies** on the other hand. The former describe processes as executed by a process engine, while the latter consists in describing the way a number of services interact with each other (or the way to use them to a given effect) instead of describing the process

[4] Prof. R. Milner, Cambridge, UK
[5] More precisely, we have the event-based (/rule based) process engines with mathematical foundations in Pi Calculus, and classical workflow engines putting emphasis on the flow of control with mathematical foundations in Petri Nets.

itself[6]. The terms *Contract Processes* (CP's) and *Execution Processes* (EP's) are sometimes used.

- The means to facilitate the **inter-operations** between multiple process engines; i.e. start a business process in some place and continue the process at another, or delegate the control of some steps to a remote process engine.
- The means to **manage and monitor** complex business processes, whether executed by process engines or taking place informally; this area is dominated by the concept of Business Activity Monitoring (**BAM**), an acronym largely promoted by Gartner.

/6 Business Process Management is largely dependent on other concepts like service oriented architectures (SOA), Web Services in particular, and transaction monitors, a quite mature technology that faces another challenge with its extension to long running processes[7]. Such extension is notably based on the concept of 'compensation', i.e. commanding to undo a past action, causing many problems when for instance other actions took place in between that were based on the result of the original action that is now 'compensated'. Quite creative solutions based on the alternative concept of 'reservation' are just taking shape.

/7 Business Process Management in turn is obviously a major source of events for **BAM**, (Business Activity Monitoring) as well as a significant driver behind most present vendor platform releases. It is now an essential ingredient of Application Platform Suites (**APS**) another concept ironed by Gartner that cover product suites offering presentation (Portal), integration (EAI, B2B) and application development environments, with BPM and workflow capabilities.

3.2 APPLICABLE STANDARDS

/1 There are no real official BPM standards at the time but a plethora of propositions. Let's position the leading ones.

/2 BPEL4WS or simply BPEL, is a proposed standard by BEA, IBM, Microsoft, later joined by SAP AG, Siebel Systems, Oracle and others.

The proposal has moved into the hands of OASIS and replaces many other proposals by the original authors, notably Xlang (Microsoft) and WSFL (IBM).

This proposed standard lacks many features for instance in term of variables, state, initialisation, transaction, arrays, dynamic lists, to be applicable as such to real practical cases.

[6] Like describing how a number of people interact with each other instead of describing the behaviour of each member in a group; the difference is subtle but significant, although both may yield the same result.
[7] Whose execution can span over multiple hours or days and generally involve loosely coupled systems.

/3 WSCI complements BPEL by describing the observable behaviour of a Web Service; incorporating many aspects of BPML, WSCI focuses on the choreography of web services, i.e. temporal and logical dependencies among the exchanged messages, featuring sequencing rules, correlation, exception handling, and transactions. WSCI takes more of a collaborative approach, requiring each participant in the message exchange to define a WSCI interface, while BPEL4WS takes an inside-out perspective, describing an executable process from the perspective of one of the participants. WSCI makes extensive references to WSDL.

/4 BPML (Modelling Language), BPMN (Modelling Notation), BPQL (Query Language) from the BPMI (Business Process Management Initiative) consortium is a more mature series of specifications than BPEL, and promoted by many common members. BPEL is specialised to web services whereas BPML is more generic and abstract.

/5 XPDL is the opponent to BPEL! It is proposed by the WfMC (Workflow Management Coalition), an industry association that standardises interfaces to workflow engines to allow them to interoperate. XPDL is based on a control flow model compared to BPEL that is event based. In XPDL, activities (units of work) are related together to form a control flow via transitions which can be guarded by a transaction.

/6 Wf-XML complements XPDL and defines the manner in which a process can instantiate other processes (on other servers or workflow execution engines), query such processes about their state, and in other ways control them. The queries are message-based but differ from the use of WSDL made by either BPML or BPEL.

/7 ebBPSS is the Business Process Specification Schema for the ebXML suite of standards[8]. It addresses the choreography of Business Transactions into Business Collaborations.

3.3 TECHNOLOGY TRENDS

/1 The battle between proponents of the pi calculus (event based process models) and those of petri nets (made of places, transitions and arcs linking places through transitions) is impeding the progress of BPM standards. On the one hand we have BPEL, backed up by BPMI and OASIS consortia, on the other hand we have XDPL backed up by the WfMC consortium.

/2 It seems demonstrated now that the power of pi calculus is greater (notably for fault management, compensation, dynamic composition), although the formalism requires to get acquainted with less-intuitive concepts. Graphical interfaces do a lot to hide most weird aspects of the pi calculus, to the point that very few users would notice such theoretical background while using current commercial products.

[8] Part of the suite is now published as ISO technical specifications, ISO/TS 15000, but not yet comprising ebPSS.

/3 Whether based on one or the other school of BPM design, current BPM engines are fairly declarative and propose rather fixed process schemas that fail short to adapt themselves in large and constantly moving environments. Service Oriented architectures and web services in particular have done a lot to reveal the limitations of current BPM technologies when applied outside the enterprise boundaries. Notably:

- The dynamic character of the 'outside' environment is difficult to follow; dynamic discovery capabilities (even limited to the resolution of the service location and address) are quite limited if not absent from most systems;
- The lack of central process controller in most distributed environments is putting emphasis on 'contract processes' versus 'executing processes' for which most systems are tuned.
- Support for long lasting / loosely coupled transactions is poor or must be wired by hand into the process logic.
- When dealing with multiple business partners, even for executing the same business, the process models become quickly intricate and complex to maintain. Exceptions and variants to a core process cannot be expressed
- Security is weak or impractical (blocked by NATs or incompatible implementations)
- Policy aspects (privacy, usage rules, disclosure, commitments) are just inexistent.

/4 Technology research is definitely aiming towards enabling the above and most of it shall mature in the next 5 years.

/5 One step further ahead, is to introduce negotiation capabilities, semantic handling of service definitions, self-adaptation to service interfaces, building goal-oriented processes (by opposition to declarative ones), and manage time-bound commitments. Such technologies are running in labs, and on quite specific domains. Rather than becoming commercially available within the next 5 years, some concepts can possibly be borrowed from these technologies and applied in specific domains.

3.4 MARKET TRENDS

/1 Gartner positions BPM suites into the 'peak of inflated expectations' (2004), while BPM in general is further ahead in maturity, and business rule engines are marked as entering the 'plateau of productivity'. Gartner cites the BPM market in general as an overcrowded one, likely to see consolidation in 2004 / 2005.

/2 Forrester research highlights the current instability of standards and the rapid changes in the area.

/3 A few open source products have been released, still in infancy, yet representative of the disagreements between OASIS/BPMI and the WfMC:

- activeBPEL by Active Endpoints, which competes with Intalio, FiveSight and Savvion
- WfMOpen is an OpenSource workflow engine that uses XPDL as its Interface format (http://wfmopen.sf.net)

/4 The company names now behind BPEL will likely make future versions of this proposed standard the winner. BPMN is a graphical notation[9] (complementing BPEL) now supported by an impressive list of companies.

However, BPEL in its current from has much limited capabilities: transactions, persistence, dealing with variables, arrays, non-web service interfaces, dynamic composition, etc…

/5 Oracle notably proposes a BPEL engine that can embed java language extensions, actually tuning this engine into a usable solution, but loosing standard compatibility of course. The orchestration server in Microsoft Biztalk 2004 integration platform proceeds exactly in the same way, now with C# or VB.NET extensions.

/6 Enterprise Service Buses (ESB's) (Sonic Software, Fiorano, IONA, actively followed now by major EAI vendors like Webmethods, TIBCO or SeeBeyond) propose the most advanced form of distributed process management. Processes can be centrally designed and monitored, but their execution is completely distributed. There's no central process engine as in most older systems. However, if the execution scheme is much different, the BPM models and capabilities proposed by these products do not differ significantly from those of classical BPM systems.

/7 All recent BPM system releases are much oriented to dealing with web services (if not exclusively) and this trend is getting stronger, posing web services as the universal interface to components built into the product (e.g. data transformation) as well as any piece of logic or resource to reuse from legacy applications.

/8 None of the BPM technologies commercially available show yet any capabilities to use ontologies for dynamically matching web services at run time. None is yet able to reason about the path to follow, none is goal oriented rather than declarative. The only degree of flexibility relates to the dynamic resolution of web service locations at run time. This is already a significant step forward, but far from the capabilities that a large scale and completely distributed infrastructure like PEGS may require.

3.5 POTENTIAL IMPACT TO PEGS

/1 Potential impacts of BPM technology and market trends onto PEGS are huge. Pan-European eGovernment Services can benefit from strong and sophisticated BPM.

/2 BPM standardisation efforts are still subject of much debate and the released draft standards fail short of delivering the degree of sophistication able to meet PEGS requirements.

[9] BPMN - Business Process Modeling Notation - contains Activities, Events, Gateways, Connections, Artifacts, Swimlanes www.bpmn.org

/3 However, focussing on BPM standards and process engines inter-operability may be a wrong target. As will be seen in the next chapter, any process engine may be able to fit, provided it would be capable of 'reflection', i.e. modify its own logic while a process is executed, or in other words, adapt itself to the context and circumstances using rules and goals able to deal with semantic matching and/or ontologies. To that extent, the defenders of pi calculus and event-based / rule-based process engines (BPMI, OASIS, BPEL-related works) have the lead.

/4 On the other hand, progresses in the standardisation of process choreographies (contract processes instead of execution processes) are immediately applicable to PEGS and shall be endorsed as the means to model interactions between government administrations.

/5 The present market trend for bigger, fully-integrated, full-featured process management platforms is possibly less relevant to PEGS than advances into the process management intelligence itself and in particular the ability to interpret choreographies, to extend processes, add variants and options in a smart way.

/6 ESB technologies on the other hand are quite interesting at a national level, in order to build infrastructures, but not much relevant Europe-wide, hence not relevant to PEGS: first because current products are proprietary and relevant standards would not be there before 5 years[10]; second because no model yet exists where central and distributed management of processes could be combined and support a hierarchy of authorities: e.g. template choreographies are centrally managed from which participants can derive local variants and manage within their private domains the execution processes able to support such choreographies.

[10] Let's first hope for the release of usable BPM standards before thinking into distributed BPM standards.

4 DISCOVERY, SEMANTICS AND MATCHING

4.1 CHARACTERISATION

/1 When considering to 'wire[11]' a new process in between many distributed applications, and where there is not a single authority but consensual business, the work for doing the 'wiring' itself would most likely represent only a small portion of all what needs to be done. The following list of tasks is just a summary:

- Agree on applicable IT principles, layout scope, goals and objectives of the new process, sketch use cases, agree on a global schedule and budget;
- Collect information about current data, process steps, and their variants/exceptions;
- Discuss and formalise a collaboration/exchange scenario / choreography and formal process layout; identify and formalise all variants, exceptions, as well as escalation procedures;
- Define all logical structures precisely: process schema, business transactions, message structures, data dictionary, etc;
- Agree on what is core and what will be options; foster convergence, harmonise. Anticipate progressive development paths and extension points. Release specifications.
- Define or confirm collaboration profiles, i.e. protocols and networks, exchange scenarios, etc.
- Map to resources and infrastructure;
- Detailed plan and schedule per application in scope.

The ratio between those 'pre-wiring' activities and the 'wiring' work itself is usually above 60% of the overall set-up lifecycle[12], also comprising 'post-wiring' activities like testing, deployment, configuration management, etc.

/2 Such pre-wiring activities multiplied by the number of processes and participants[13] would require enormous effort and take a very long time, not only to design, but also to develop (according to the many exceptions and variant cases to handle), and to maintain (think about the impact of changes or just adding a new participant with his variants).

/3 There are basically two ways for accelerating developments and attempt reducing the effort.

1. Ignore all options and variants! Force harmonisation over every body and impose a single simple process directly derived from the goals and use cases. Ask everyone to align and cut any debate regarding options and exceptions. The resulting system is completely fixed.

[11] Develop and code, inclusive of all data transformations, interface logic, adapters configuration, set-up of administrative and monitoring facilities, logging, etc.
[12] When the relevant applications are distributed on a large scale and governance is too distributed, even with the help of communication frameworks
[13] With options and variants growing with the number of participants.

2. Computerise the adapting to all options and variants! Push meta-data and reasoning into the system, up to embracing the vision of a system that could adapt itself to variants and exceptions as well as changes, being driven by goals and objectives instead of prescriptive processes. This is indeed the domain of intelligent agents and the semantic web. The resulting system is entirely smart.

/4 The best method is standing in between the above two extremes. In other words, imposing a core set of processes and formats and formalise additional processes or mechanisms (computerised and not manual ones!) to define and manage alternatives, extensions and changes to the former process. The resulting system is fixed for a part, and smart for the rest.

/5 The question for PEGS becomes: **how much balance between the fixed and the smart part of business processes would - on a five-year scale - bring optimum results**?

/6 WSDL and UDDI actually accelerate the building and maintenance of distributed systems, but to an extent that is largely insufficient.

- WSDL allows programmers to exchange meta-data about the interfaces to applications (/services) and thus speed-up the development work. However this helps in the 'wiring' phase and does nothing to reducing the largest part of the work in 'pre-wiring'. Moreover, dynamic support of service changes is far off current standards. Even proposed extensions like WS-Addressing do little in that direction but help relate services with each other and route SOAP messages.
- UDDI is a fairly basic system, helping to resolve service entry points at run time (with a potential positive impact on maintenance) using keyword based search facilities, hence far from the semantic matching that could be required to design systems able to adapt to service features, even if the needed flexibility is confined to precise domains.

/7 **The ability of a system to deal with alternatives and change can be ranked over the following scale**:

1. The system can absorb the move of remote resources and continue to inter-work with extended systems: this is supported by current directory services of all types and foundations for forward compatibility promoted by the Internet and XML technologies in particular;
2. New participants can register themselves, be discovered by others, and document their capabilities by reference to a catalogue of options. This is merely an advanced use of directory systems, but all participants share a common, - fixed, delimited and a priori - reference model.
3. Participants become able to match their own models and procedures with those of other participants: precisely, they would become able to adapt to the choreographies and data structures published by others and absorb (some) differences in the way to interact or structure information. The reference model is replaced by a common ontology (or set of) from which an infinite number of models can be derived. Ontologies may be limited to interpreting information

(as needed to discover a service, or handle a document[14]), or apply to reasoning on interaction sequences as well, i.e. building action plans! The latter is much more sophisticated and nearly worth a sub-level.

4. Participants become goal-oriented: they are able to interpret data, build action plans and are also able to build decision patterns. They can rate the value of their actions and results against goals. This is a research area and the preferred field of Intelligent Agent technologies.

/8 Semantic web and associated technologies become required from level 3 and above. 'Reflection' capabilities (the system can modify itself or develop the sequence of actions that it would use next) help at level 2 and become compulsory from level 3 and above.

4.2 APPLICABLE STANDARDS

/1 UDDI became inseparable from web services, although the much less known WSIL - almost equivalent to UDDI information laid out in an XML page - can provide a quite attractive and much cheaper alternative in many contexts.

/2 DSML has been approved as an OASIS standard and supplies an XML and SOAP equivalent of LDAP directory systems.

/3 OASIS and UN/CEFACT have published an important suite of works related to enabling the establishment of business links between enterprises, collectively known as **ebXML**. Part of it has reached international standard status as ISO technical specifications, ISO/TS 15000, and notably the *Registry Information Model* and the *Registry Services Specification*. JAXR is for instance the Java API to ebXML registries. It is based on XML Messaging (JAXM).

/4 The OMG (the Object Management Group) consortium who defined the CORBA model for distributed objects published many standards related to meta data like MOF and XMI but none is likely to get momentum.

/5 The real jump into semantics is accomplished with RDF (the Resource Description Framework). RDF provides a model for representing metadata that is now the base for many other specialised standards. RDF is the result of a number of metadata communities including Dublin Core and PICS. RDF makes assertions expressed as *triples* containing subject, predicate, and object terms. It is very generic in scope and shall be seen as a framework.

/6 OWL is the second leg, with RDF, of the semantic web. OWL is an ontology language[15], i.e. a means by which one can formally describe a knowledge domain, with the goal of enabling computers to provide various kinds of reasoning services about that domain.

[14] Ken Steel (University of Melbourne) was a precursor in the 90's: he defined an Interchange Structure Defintion document (ICSDEF) which, by reference to a common Basic Semantic Repositry (BSR), can be used to interpret EDIFACT data message on the fly. However, the associated ontology was missing (or implicit as there's always one!) and applicability was imited to resolve simple data mapping cases.

[15] Successor of SHOE, and DAML+OIL

/7 OWL-S (OWL for Semantic Web Services) is a precise ontology for dynamic web service discovery, based on the concept of *service profiles*. It is a practical application of ontologies to the precise domain of web services discovery.

4.3 TECHNOLOGY TRENDS

/1 WSDL is metadata in itself, but a basic form that allows at best to exchange interface declarations between programmers. Many extensions to WSDL and related repositories extend the coverage of such metadata; they are now in discussion. It's worth noting that all these WSDL-related standards stay in the domain of declarative information assuming implicit, fixed, models in the background.

/2 However, the ability to deal with such metadata in automatic ways is already a challenge that many integration platform vendors attempt to grasp. Within five years, the capabilities of systems to perform late bindings to resources and adapt to specific changes in metadata on the fly will be a reality and possibly a must.

/3 The limits of UDDI as a web service registry become evident and will significantly challenge its future, at least in the current form. UDDI was purported to provide sufficient information for using previously unknown services just as XML was touted as enabling the understanding of previously un-encountered data and information. Nothing is less true. UDDI support for automatic searching is even severely limited. Although the industry response to such limitations isn't known yet, one should expect a workable solution within 5 years.

/4 Systems able to perform dynamic web service discovery (with OWL-S) are still in research laboratories although the draft(!) standard is proposed already.

/5 **Indeed, the existence of standards in the area of the semantic web shall not be interpreted as a sign of maturity of the relevant technologies**. This is a major difference with any other standardisation area.

OWL and RDF are contributions from the W3C. W3C Working groups are not meant to do new work, but standardize existing and known stuff. The OWL Working group is a noteworthy exception to that rule!

SWRL is another illustration. SWRL provides means to add rules to an OWL knowledge base, and somehow capture the abstract content of an intelligent agent!

No system is able to interpret SWRL but in laboratories. Standardisation there accompanies basic research as it allows researchers to exchange formal data on their experiments.

4.4 MARKET TRENDS

/1 Gartner clearly states that "*Understanding, managing, controlling and reusing metadata is a key part of enabling SOA. Metadata management is also key to providing a common approach to business and technical views of a range of applications*".

/2 However, metadata contents are far from being shareable. The paradox is that those organisations that effectively achieve some integration through metadata are those using a proprietary broker suite because standards lag behind in term of capabilities.

/3 One shall expect to see systems discover and adapt themselves to web services within the next 5 years; however how that 'functionality' could be made available to users without requiring higher level education is a mostly open question. The only possibility is for **embedded capabilities** regarding **specific domains** (like discovery), dealing with **pre-defined ontologies** (by vendor consortiums).

/4 What interface, what development station could one expect for designing and dealing with ontologies in the next 5 years? In fact, real effective products are unlikely to appear in the next 5 years.

4.5 POTENTIAL IMPACT TO PEGS

/1 The key in getting benefits from smarter distributed systems, able to dynamically discover, interact and complete processes in an environment overcrowded with alternatives and exceptions, is to develop ontologies and the systems able to manipulate them.

/2 The IDA community shall pay attention to the proper use and implications of ontologies. Either all participants share a common reference model, either not (each participant has its own individual model). There's no room in between and a big jump from one to the other space.

One should be careful for not using an ontology so simple or so generic that it wouldn't make any difference but provide a level of indirection. The case of MDL - the Meaning Definition Language - is quite representative of such missed ambition. MDL is an isolated proposal that went straight in the same direction as the works from Prof. Ken Steel[14] with EDIFACT. It's an attempt to tag XML documents with meaning in addition to structure, hence facilitate the automated handling of arbitrary document structures. Yet, there's no domain-specific ontology behind it so it doesn't make much more than defining a "pivot" semantic format in between any pair of XML documents!

/3 However, the above does not mean that PEGS shall be based on ontologies for everything. On the contrary. A careful approach to services and process definitions in PEGS shall identify the areas where *dynamic'ness* could bring savings in time and effort. No other argument could be invoked here than bold economic ones. 'Anticipating the future' does not hold, because the field is much too young to take any long term position. However, the concepts and techniques are already applicable in isolated areas, and can effectively yield savings.

/4 Therefore, ontologies and associated interpretation rules/engines could be developed by IDA for those specific areas of the PEGS development lifecycle where savings are actually feasible.

/5 On the other hand, very little data is available on the effort required to develop an ontology itself, and very few experts are available. IDA shall adopt the 'small winning team' approach if any further investigation is made in such direction. OWL-S is certainly worth considering in that area.

/6 Otherwise, a proper use of directory system technologies and web service extensions in the area of addressing and routing, combined with 'light' semantic tagging could help provide a base of service discovery and capability to deal with options using rules instead of prescriptive processes. This would mean reaching level 2 of the *smart'ness* scale presented in §4.1/7.

/7 IDA shall be able to learn from the SWWS project too, an IST programme 2002-2005.

5 TRANSACTION

5.1 CHARACTERIZATION AND APPLICABLE STANDARDS

/1 Transactional systems technologies have developed within the confines of tightly coupled systems and applications. The technology matured around the concept of ACID rules[16] and two-phase commit protocols.

/2 Extending such concepts to Web services is already a challenge, as the SOAP protocol (the cornerstone of today SOA's) does not have any provisions for coordinating resource managers, i.e. those systems that locally ensure the preparation and then commitment of resources involved in a transaction. Not surprisingly a number of proposed standards define extensions to SOAP for transactions: these are WS-C and WS-T (IBM, Microsoft, BEA). WS-C is a generic coordination framework whereas WS-T is a first use of WS-C for two transaction models: Atomic transactions, bearing ACID properties, and Business Transactions where resources are committed immediately, hence ACID properties do not hold and there's no 'transaction' at all unless through the execution of compensating actions which the protocol advocates.

/3 Yet the above directions do not solve the fundamental problem of moving transactions into long-haul, largely distributed, and loosely coupled systems! ACID properties in such a context are too strong, because resources would be locked for the duration of the transaction and this is in basic conflict with the essence of distributed loosely coupled systems, the preferred landscape for web services indeed.

/4 OASIS was proposing a fairly different approach with BTP. BTP permits the composition of atomic units of work (atoms) into cohesive business transactions (cohesions) which allow application intervention into the selection of the atoms which will be *confirmed*, and of those which will be *cancelled*. Hence it is a framework inside which application logic would be executed that is specific to the context and role of transaction participants. BTP provides the means to coordinate participants. It can be bound to Web Services but other protocols as well. BTP is based on a permissive and minimal approach, where constraints on implementation choices are avoided. Such loose coupling is praiseworthy but may weigh heavily on its future in practice, as it opens the way to many incompatible implementations and others fed with a priori business logic that can then be used in other contexts.

/5 BTP is based on the concept of compensating actions in case a unit of work is *cancelled* instead of being *confirmed*. The means and logic required to actually compensate previous work is left open for implementation in the target node. In many cases, this could be a really ill-conditioned problem. For instance a resource has been allocated to an account, which in the mean time used it for other purposes, when the request to cancel the resource arrives!

[16] ACID: **Atomicity** - either all or no operations are completed. **Consistency** - all transactions must leave the systems and information in consistent state. **Isolation** - transactions can't interfere with each other's work and incomplete work isn't visible to other transactions. **Durability** - successful transactions must persist through crashes.

/6 SUN Microsystems with the help of Oracle, IONA and others released the Web Services Composite Application Framework (WS-CAF), a collection of three specifications now under the OASIS umbrella: Web Service Context (WS-CTX), Web Service Coordination Framework (WS-CF), and Web Service Transaction Management (WS-TXM). WS-CTX is an original piece that maintains information about the transaction identifier and who's involved with it. Contexts may be nested and concurrent. SW-CF is almost a superset of WS-C cited above. WS-TXM embodies three separate extended transaction protocols. Like WS-Transaction and BTP, WS-TXM provides models that are designed to accommodate tightly coupled intranet-based transactions (TXACID), Internet-scale, long-lived transactions (TX-LRA), and business process-oriented transactions (TX-BP).

/7 WS-C/WS-T, BTP and WS-CAF/TX-BP (by order of publication), offer each a different transaction model at the uppermost layers!

/8 Intel is proposing through THP a very attractive alternative. The concept of compensation is replaced by the one of reservation. With THP, clients request tentative, non-blocking, time-limited reservations on multiple business resources. The client can then confirm a hold, let it expire, or cancel it explicitly before expiration time. Competition between clients for holding resources may then be allowed or denied, according to the resources at stake and business context. Clients know whether resources are already on-hold by others, and notified whenever another client makes a confirmation on a resource being held.

/9 There are also much simpler alternative approaches: a multi-participant 'transaction' is possibly more than most business contexts would require. SOAP is very weak - especially when bound to HTTP - as a means to guarantee the execution of an operation by a remote service. Unless the other side is idempotent (i.e. repeating the invocation will have the same effect as making it once only), and in case of absence of response from the called party, the caller may not know at all whether the request was lost (and nothing at all was executed) or the response was lost (and the execution went through). All that is required can just be a reliable link, and that is exactly what Microsoft proposes with WS-Reliable Messaging.

/10 The ebXML suite of specifications is worth considering just along the same line. ebMS is the reliable messaging part and now an international standard as ISO Technical Specification ISO 15000-2. ebMS is based on SOAP for message envelopes and makes use of MIME attachments to carry one or multiple business data payloads in a single message.

5.2 TECHNOLOGY AND MARKET TRENDS

/1 It is fairly clear that the potential unreliability of Web service invocations will be cured within the next 5 years. However, the winning standard isn't known yet and it is likely that multiple approaches will coexist.

/2 All vendors provide alternative transports to HTTP for web services and supply the means to reliably execute web services in loosely coupled environments. These are at present proprietary variants even if based on standard protocols and technologies. The most representative platforms are ESB products (e.g. Fiorano, Sonic Software, IONA…) in which the support for transaction demarcations within distributed processes is fully integrated into the design itself.

5.3 POTENTIAL IMPACT TO PEGS

/1 IDA has developed the eLink specifications and operates TESTA, a managed IP network. In such an environment the support for reliable services would be easy. A careful design of the PEGS processes and services[17] combined with the good use of existing infrastructure may well offset any concern for implementing any of the transactional web services proposals.

/2 The potential remaining problem to solve by PEGS in the line of "transactions" may actually lie in a completely different space: the one of **commitments**. Commitments are obligations from one entity to another. Many business or administration contracts involve clauses with time periods of reference for which classical approaches based on time triggers or timers may not be adequate:

- *Time intervals* affect decisions on the satisfaction or breach of commitments. Commitments must often be satisfied in a fixed time interval or at a specified instant in the future.
- *Maintenance*: real-life commitments are not depending on conditions for the achievement (like a process could check at a precise time) but also on the maintenance of these conditions. Hence qualified dependencies may have to be maintained during and after a process completion.
- *Temporal anaphora*: Time moments are implicitly bound to many actions; e.g. an action may be triggered and return immediately OK with the actual meaning that "the effects will take place at a future time", or "this can be requested at this or that time, and not any time", as well as "delivery of such document will occur in 3 weeks" which can drive a system to reject this path.

[17] e.g. favour idempotent ones (every read-only operation is by essence idempotent)

6 SECURITY

6.1 CHARACTERIZATION AND APPLICABLE STANDARDS

/1 One of the most active areas of SOA's is about security. A lot of proposals for standards have been recently published or updated and the industry is still filtering out the good from the bad.

/2 A major proposal is the WS-Security specification initially proposed by Microsoft, later supported by IBM and VeriSign, then endorsed by the OASIS Web Services Security (WSS) Technical Committee and recently approved as OASIS standard. The WS-Security specification defines enhancements to SOAP messaging to provide three capabilities: credential exchange, message integrity, and message confidentiality.

/3 WS-Security has since evolved into a deeper stack, called WSS-SMS, which includes the following specs for shoring up Web services: WS-Trust, WS-Federation, WS-Policy, WS-SecurityPolicy and WS-SecureConversation.

/4 Another main and stable suite of standards are the XML Signature / XML Encryption Recommendations. They defines standard means for specifying information content to be digitally signed (or encrypted), including the ability to select a portion of an XML document to be signed or encrypted.

/5 Privacy and policy issues are at least addressed by respective WS-Privacy and WS-Policy proposals, but none could be said to be stable.

6.2 TECHNOLOGY TRENDS

/1 The tunnelling of web services through HTTP port 80 is raising many concerns. It certainly helped support the current success of web services and SOAP in particular, but is due to become a major concern as soon as these web services will cross the enterprise boundaries and be used outside on the public networks. The remedy is surprisingly easy on paper, i.e. define another (better suited and secure) transport than HTTP for web services. But the HTTP train would unlikely be stopped, even to the point of weighting on web services adoption by the industry.

/2 A lot of maturity has been acquired about PKI infrastructures and the limitations of associated technologies (LDAP, OCSP) outside a closed community / single CA context. Inter-working between multiple CA domains is still an issue and there are multiple approaches with no clear trend: cross certification / mutual trust relationships, CA hierarchies, or bridge CA's? Certificate validation in such contexts is not fully reliable and the black list concept behind OCSP is much criticised. These issues weigh on the wider adoption of electronic signatures despite the legal frameworks now being incorporated into national laws (following the EC directive on electronic signatures).

/3 Identification technologies and digital identities (the electronic representation of an individual's information) are just acquiring momentum. Issues like the management multiplicity and dependability are just addressed. Significant progress shall be expected within the next 5 years.

/4 The sector is also heavily affected by patenting issues, royalty schemes, regulations, the opposition between SUN & co and Microsoft+IBM, and the long debate between proponents of making security technologies publicly available against distilling their use.

6.3 MARKET TRENDS

/1 Support for WS-Security already exists in IBM products, Microsoft's .NET platform, as does BEA and webMethods for instance.

/2 The Liberty Alliance's Liberty Web Services Framework proposes another way to do secure Web services. It is directed at a well defined set of scenarios versus the WS-Security "toolbox" design.

/3 The industry remains too fragmented on security issues to ensure inter-operability.

/4 But security software is a necessity and prices may at last start to go down.

/5 Identity and access management solutions are expected to grow significantly over the following years.

/6 Microsoft .NET passport on the one hand and SUN's led Liberty Alliance illustrate the opposition between a security architecture centrally managed and a federated one.

/7 The potential of identification and security devices (e.g. fingerprint recognition with matching taking place on the smart card itself) in ensuring the "autonomy of proof" is largely un-exploited and years ahead may show a significant turn.

/8 Technology specifications and application in particular has been so far much guided by engineering designs. "Keeping the bad guys out" and letting the "good guys in" has so far been the central focus. This may change as systems designed with the legal effects first in mind could take precedence over those that are pure engineering constructs. Indeed, in contexts like PEGS, the legal value of a consent of a signatory of a document may take as much importance as the control of who has access to what.

6.4 POTENTIAL IMPACT TO PEGS

/1 Most of the security technologies required by IDA for PEGS are already there. Member State administrations form a closed community around the s-TESTA infrastructure which also is a base for enhanced security.

/2 IDA projects already cover PKI issues, the security of the network, and the authentication of exchanges (in IDA eLink). Hence, a good use of those infrastructure and recommendations is possibly matching PEGS requirements.

/3 The above statement assumes a security infrastructure whereby Member State governments will be in charge of identifying, authenticating and protecting their exchanges with local citizens and enterprises, whereas the processes supporting PEGS across multiple national domains will be based on trust relationships between administrations. In other words, it would not be needed for a Member State administration to check the identity, signature or credentials of anyone else (citizen or enterprise) registered in another Member State. On the other hand, a same person or company may apply for registration in multiple Member States in which case the question will raise about the one security token to use (and cross-certify at registration time?) or the impact of delivering additional ones.

/4 The case for **Policy** issues is a much different story and exhibits potential difficult issues; PEGS will definitely challenge the "who can do what on behalf of whom".

For instance, once, say, the copy of an administrative document - possibly electronically signed - has left an administration to be used in some process, how can the originator of the document restrict the use of it to a given process for a given time? What would be the legitimate other uses of the document copy into other processes?

/5 Privacy is also a PEGS challenge. Privacy is often misunderstood as an issue whose natural solution consists in good security mechanisms. While information is retrieved by a process in a perfectly controlled and secure way, additional process steps may reuse the information towards other services and not select the proper subset that could be made public to those services, hence challenging privacy, actually raising also policy issues in this example (see previous). What control would a user have on the use of his private information into multiple process contexts?

/6 The above issues would have to be analysed in detail and in view of the PEGS scenarios to support. Recent technology and market trends will have little or no influence on such studies.

7 OTHER ISSUES

7.1 PROTOCOLS

7.1.1 Bulk Data Transfer

There is no standard successor to FTP as bulk data transfer protocol, although FTP is inadequate in B2B contexts because of the built-in commands like "change directory", "remote delete" and other login and permissions issues. On the other hand, many proprietary vendor products are available with adequate features.

OFTP, from the ODETTE consortium in the automotive industry, is the only publicly available alternative that was designed for B2B contexts from the origin.

The requirements for massive data transfer are also handled in the IDA eLink specifications.

7.1.2 Messaging

Messaging (message queuing) APIs are standardised but not the protocols. Inter-operability of the message queuing solutions form different vendors is not feasible except through bridges.

7.1.3 e-Mail

The eXtensible Mail Transport Protocol (XMTP) is a mapping of MIME/SMTP to XML but has no success.

Internationalisation of e-mail addresses (and domain names) is an important issue at this time that will (hopefully) get fixed within the next 5 years.

The use of multiple European alphabets is a challenge in IDA.

7.1.4 The Web Services Family of Protocols

There's above 30 web service related protocol extensions under discussion at this time. WS-Addressing is worth noting but yet incomplete. ASAP (a simple extension of Simple Object Access Protocol (SOAP)) enables generic asynchronous web services or long-running web services. We could also cite again all the security-related or transaction-related protocol from the former sections.

This volume in itself is an issue as the proper directions are blurring within ambient noise while vendors attempt to concentrate attention on their proposals.

However, PEGS could be defined in such a way not to depend on the details of protocols available in the infrastructure.

7.2 COMMON E-BUSINESS INTERFACES

The ebXML international initiative established by UN/CEFACT and OASIS is worth noting. A comprehensive technical framework is now available to enforce consistent exchange of all electronic business data between enterprises and enterprise and administrations.

A number of government authorities endorsed this family of standards as part of their eGov frameworks.

The International Standards Organization (IS0) has approved in April 2004 four of the ebXML standards:

- ISO 15000-1: ebXML Collaborative Partner Profile Agreement
- ISO 15000-2: ebXML Messaging Service Specification
- ISO 15000-3: ebXML Registry Information Model
- ISO 15000-4: ebXML Registry Services Specification

UBL (Universal Business Language) another OASIS Committee Draft is complementing ebXML in the arena of e-business message exchange standards development.

IDA shall carefully consider alignment to UBL and/or ebXML for the exchange of data between administrations, as it would likely impose itself to the exchanges between enterprises and national administrations.

7.3 DATA TRANSFORMATION

It is worth noting that the great majority of data transformation tools available from the vendor platforms are XML based and more precisely, constructed around XSLT parsers. Such design brings a lot of limitations into the ability to arbitrarily map data from one message onto another.

In the context of PEGS, this means that – where feasible - one should promote alignment to common formats directly handled by process and application logic.

7.4 MODELLING, METHODS AND TOOLS

RM ODP / ISO/IEC 10746 is a fairly 'old' standard by ISO but still applicable to much distributed SOA's. RM ODP (Reference Model for Open Distributed Processing) provides a framework to understand and develop distributed processing in heterogeneous environments. There are recent testimonials of its successful use in eGovernment context, as a tool to define and document an interoperability architecture. RM ODP forces architects to consider high level issues (e.g. policy) as well as low level issues (e.g. data formats).

The WSA (Web Services Architecture) by the W3C is another reference model worth considering by IDA.

7.5 THE 'DATAWEB'

XDI[18] (XRI data Interchange where XRI stands for eXtensible Resource Identifiers) defines a new general framework for hyper linking information that takes advantage from web services and XML.

The Web	The Dataweb
URIs globally identify documents	XRIs are compatible with URIs and identify documents independently of a specific location, application, directory or domain
HTML represents and links documents. Web hyperlinks are one-way links between resource representations.	the XDI meta data schema uses XRIs to identify, describe and link distributed data in a domain independent format. Dataweb links are two-way "pipes" between XML documents.
HTTP is used to exchange documents	an XDI web service is used for sharing and synchronising XDI documents
	XDI link contracts can mediate authentication, authorization, access control, usage control, distribution and forwarding, synchronization!

The dataweb, especially for its ability to embed security and policy features may be a great tool for PEGS. However, the specifications are too recent drafts for being considered for short term implementation.

7.6 MANAGEMENT

There are a few extensions of XML and web services into the area of managing distributed systems (CAP, JMX, the recent OASIS Web Services Distributed Management, …)

These works shall be monitored and reviewed where applicable for a possible application to IDA in general, and PEGS in particular.

This is carried through by other projects.

[18] http://www.oasis-open.org/committees/tc_home.php?wg_abbrev=xdi

APPENDIX I. LIST OF RELATED PROJECTS AND INITIATIVES

1) Related IDA initiatives:

- **Multi-channel delivery of eGovernment services [13 July 2004]**
- **OSS (Open Source Software) [15 June 2004]**
- **MIReG: Management Information Resources for eGovernment [31 March 2004]**
- **MIDDLEWARE XML [25 March 2004]**
- **IDA eLINK [24 March 2004]**
- **EUROPEAN INTEROPERABILITY FRAMEWORK FOR PAN-EUROPEAN eGOVERNMENT SERVICES [24 March 2004]**
- **Bridge/Gateway CA (Certification Authority) [24 March 2004]**
- **ARCHITECTURE GUIDELINES [24 March 2004]**
- **PKI: Public Key Infrastructure [24 March 2004]**
- **MOREQ: Model Requirements for the Management of Electronic Records [19 March 2004]**
- **SECURITY STUDIES [04 February 2004]**
- **TESTA: Trans European Services for Telematics between Administrations [30 January 2004]**
- **eOBSERVATORY: eGOVERNMENT Observatory [29 January 2004]**
- **Quality Assurance, Project Assessment and Evaluation [29 January 2004]**
- **CIRCA: Communication and Information Resource Center Administrator [29 January 2004]**
- **PORTAL OF THE EU ADMINISTRATION (Your Europe) [27 January 2004]**

2) Under IST programme:

- **GovML**: An Integrated Platform for Realising Online One-Stop Government (eGOV), IST project 2000-28471, 1998-2002
- **TERREGOV**[19] : Impact of eGovernment on Territorial Government Service, Project IST-507749
- **SWWS**[20] : Semantic Web Enabled Web Services, is an IST project, 2002-2005

[19] http://www.terregov.eupm.net/my_spip/index.php
[20] http://swws.semanticweb.org

APPENDIX II. INFORMATION RESOURCES

/1 Research institutions:

Ref #	Document title or site name	Description
1.	Techwatcher Butler	Butler Group by Martin Butler and Tim Jennings – June 2004
2.	FutureScan	The 24-Month Future Scan – Networked Research group
3.	Technologies to secure federal systems	GOA Report – March 2004
4.	Service component Based Architectures	CIO Council study – June 2004
5.	Comparison o XPDL and BPML – BPEL	Cape Visions – Robert Shapiro 2002
6.	BPEL for programmers and Architects	FiveSight Technologies, Inc. – Paul Brown and Maciej Szefler - 2003
7.	Client Issues for Emerging Technology Trends	Gartner Research 2003
8.	Update on Emerging Technologies	Gartner Research 2004
9.	Security Software Market forecast, 2003-2007	Gartner Dataquest - 2003
10.	Gartner Predicts 2004 Web Services	Gartner Research 2003
11.	Market Trends Consulting and Systems Integration WorldWide	Gartner Research 2004
12.	Management Update client Issues for Emerging Technology Trends	Gartner Research 2003
13.	IT Security Services	Gartner – IT Security Services forecast : Western Europe, 2002-2007
14.	Hype Cycle for Web Services, 2004	Gartner Research – Strategic Analysis Report, 2004
15.	Hype Cycle for Information Security , 2004	Gartner Research – Strategic analysis Report, 2004
16.	Hype Cycle for Application Development	Gartner Research – Strategic analysis Report, 2004
17.	Customer Goods Technology 2001	Capgemini Report
18.	Hype Cycle for Application Integration and Platform Middleware	Gartner Research – Strategic analysis Report, 2003
19.	Picking the Right Interoperability strategy for SOA	Gartner Research - Research Note, 2003
20.	The integration enterprise 2003 to 2012	Gartner Research - Research Note, 2002
21.	Understanding Grid and Utility markets	Capgemini Presentation, 2003
22.	Integration Technology	Forrester study – John R. Rymer
23.	Are you ready	Forrester study – John R. Rymer
24.	Where and When	Forrester Study – Uttam Narsu
25.	Secure Web Services	Forrester Study – Randy Heffner
26.	Beware of Opportunistic Web Services Projects	Gartner Research - Research Note, 2003
27.	Event-Driven Architecture Complements SOA	Gartner Research - Research Note, 2003

/2 Main Internet resources:

Ref #	Document title or site name	Description
28.	http://www.bpmi.org/	Business Process Management Initiative
29.	http://www.bpmn.org/	Business Process Modeling Notation
30.	http://www.daml.org/	The DARPA Agent Markup Language Homepage
31.	http://www.ietf.org	The Internet Engineering Task Force
32.	http://www.mindswap.org/	Maryland Information and Network Dynamics Lab Semantic Web Agents Project
33.	http://www.ontoknowledge.org/	On-To-Knowledge: Content-driven Knowledge-Management through Evolving Ontologies
34.	http://www.semanticweb.org	Semantic web community portal
35.	http://www.serviceoriented.org/	The Service Oriented Enterprise
36.	http://www.w3.org	the World Wide Web Consortium
37.	http://www.webservicesarchitect.com	Web Services Architectures
38.	http://www.wfmc.org	the Workflow Management Coallition
39.	http://xml.coverpages.org http://www.xml.com	sources of summary information/pointers on all XML technologies
40.	www.oasis-open.org	the OASIS Technical Committee, Organisation for the Advancement of Structured Information Standards

/3 **Professional and Scientific Communities**:

Ref #	Document title or site name	Description
41.	http://www.ieee.org/	IEEE scientific publications (notably Internet computing, IEEE Security & Privacy) and digital library
42.	http://www.acm.org	ACM scientific publications (notably ACM Queue) and digital library

APPENDIX III. ABBREVIATIONS

AG	cf IDA AG
APS	Application Platform Suite
ASAP	Asynchronous Service Access Protocol (OASIS-open.org)
BAM	Business Activity Monitoring
BOF	Business Object Facility
BPEL BPEL4WS	Business Process Execution Language for Web Services
BPMI	Business Process Management Initiative (BPMI.org)
BPML	Business Process Modeling Language
BPMS	Business Process Management System
BTP	Business Transaction Protocol
CAF	cf WS-CAF
CAP	Common Alerting Protocol (OASIS-open.org)
CASE	Computer Aided Software and Systems Engineering
CDIF	CASE Data Interchange Format (EIA)
DAML	DARPA Agent Markup Language
DSML	Directory Services Markup Language (OASIS-open.org)
DSML	Directory Services Markup Language
ebPSS	ebXML Business Process Specification Schema
ebXML	electronic business XML (OASIS & UN/CEFACT)
EIA	Electronic Industries Association
ESB	Enterprise Service Bus
IDA	Interchange of Data between Administrations
IDA AG	IDA Architecture Guidelines
IDA IEF	IDA European Interoperability Framework
IDA MoReq	Model Requirements for the management of electronic records
IDA QA	IDA Quality Assurance
IEF	cf IDA IEF
IOTP	Internet Open Trading Protocol
JAXM	Java API for XML Messaging
LDAP	Lightweight Directory Access Protocol
MDA	Model Driven Architecture
MDL	Meaning Definition Language
MIPS	Metadata Interchange Patterns (OMG)
MOF	Meta-Object Facility (OMG)
MoReq	cf IDA MoReq
NAT	Network Address Translation
OA&D	Object Analysis & Design
OAI	Open Archives Initiative
OASIS	Organization for the Advancement of Structured Information Standards
OCSP	Online Certificate Status Protocol
OIL	Ontology Inference Layer

OMG	Object Management Group (www.omg.org)
OWL	Web Ontology Language (W3C)
PEGS	Pan European eGovernment Services
PICS	Platform for Internet Content Selection (W3C)
PMH	Protocol for Metadata Harvesting (Open Archives Initiative)
POP	Process Oriented Programming
QA	cf IDA QA
RDBMS	Relational Data Base Management System
RDF	Resource Description Framework (W3C)
RM-ODP	Reference Model for Open Distributed Processing (ISO)
SAML	Security Assertion Markup Language (OASIS-open.org)
SHOE	Simple HTML Ontology Extensions - obsolete
SOA	Service Oriented Architecture
SOAP	Simple Object Access Protocol… at the root of Web Services
SPML	Service Provisioning Markup Language (OASIS-open.org)
SWRL	Semantic Web Rule Language (DAML.org)
SWWS	Semantic Web Enabled Web Services (EC IST project)
THP	Tentative Hold Protocol (Intel)
UDDI	Universal Description, Discovery and Integration
WAPI	Workflow Client API Specifications (WfMC)
WfMC	Workflow Management Coalition
WPDL	is an ancestor of XPDL, now obsolete!
WSA	Web Services Architecture (W3C)
WS-C	Web Services Coordination
WS-CAF	Web Services Composite Application Framework (SUN & OASIS-open.org)
WS-CF	Web Service Coordination Framework, a part of WS-CAF
WSCI	Web Services Choreography Interface
WS-CTX	Web Service Context, a part of WS-CAF
WSDL	Web Services Definition Language
WSIL	Web Services Inspection Language (IBM and Microsoft)
WSRP	Web Services for Remote Portals
WSS	Web Services Security
WSS:SMS	Web Service Security: SOAP Message Security (OASIS-open.org)
WS-T	Web Services Transaction
WS-TXM	Web Service Transaction Management, a part of WS-CAF
XCBF	XML Common Biometric Format (OASIS-open.org)
XDI	XRI Data Interchange (OASIS-open.org)
XMI	XML Metadata Interchange (OMG)
XPDL	XML Process Definition Language (WfMC)
XRI	eXtensible Resource Identifiers (OASIS-open.org)

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