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Scalable and Resilient Middleware to Handle Information Exchange during Environment Crisis

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The EU FP7 TRIDEC project focuses on enabling real-time, intelligent, information management of collaborative, complex, critical decision processes for earth management. A key challenge is to promote a communication infrastructure to facilitate interoperable environment information services during environment events and crises such as tsunamis and drilling, during which increasing volumes and dimensionality of disparate information sources, including sensor-based and human-based ones, can result, and need to be managed. Such a system needs to support: scalable, distributed messaging; asynchronous messaging; open messaging to handling changing clients such as new and retired automated system and human information sources becoming online or offline; flexible data filtering, and heterogeneous access networks (e.g., GSM, WLAN and LAN). In addition, the system needs to be resilient to handle the ICT system failures, e.g. failure, degradation and overloads, during environment events.
There are several system middleware choices for TRIDEC based upon a Service-oriented-architecture (SOA), Event-driven-Architecture (EDA), Cloud Computing, and Enterprise Service Bus (ESB). In an SOA, everything is a service (e.g. data access, processing and exchange); clients can request on demand or subscribe to services registered by providers; more often interaction is synchronous. In an EDA system, events that represent significant changes in state can be processed simply, or as streams or more complexly. Cloud computing is a virtualization, interoperable and elastic resource allocation model. An ESB, a fundamental component for enterprise messaging, supports synchronous and asynchronous message exchange models and has inbuilt resilience against ICT failure. Our middleware proposal is an ESB based hybrid architecture model: an SOA extension supports more synchronous workflows; EDA assists the ESB to handle more complex event processing; Cloud computing can be used to increase and decrease the ESB resources on demand. To reify this hybrid ESB centric architecture, we will adopt two complementary approaches: an open source one for scalability and resilience improvement while a commercial one can be used for ultra-speed messaging, whilst we can bridge between these two to support interoperability.
In TRIDEC, to manage such a hybrid messaging system, overlay and underlay management techniques will be adopted. The managers (both global and local) will collect, store and update status information (e.g. CPU utilization, free space, number of clients) and balance the usage, throughput, and delays to improve resilience and scalability. The expected resilience improvement includes dynamic failover, self-healing, pre-emptive load balancing, and bottleneck prediction while the expected improvement for scalability includes capacity estimation, Http Bridge, and automatic configuration and reconfiguration (e.g. add or delete clients and servers).