UNRWA ERP Project

Technical Architecture Master Document
VERSION CONTROL AND CHANGE HISTORY

<table>
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<th>Date</th>
<th>Version</th>
<th>Author</th>
<th>Description</th>
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<td>2014 07 15</td>
<td>V1.0</td>
<td>Nicola Larocchia</td>
<td>Initial release</td>
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<td>2014 09 08</td>
<td>V1.2</td>
<td>Nicola Larocchia</td>
<td>Kristijan Horvat and Francia Peralta feedback.</td>
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<td>2014 10 01</td>
<td>V1.3</td>
<td>Nicola Larocchia</td>
<td>D/R Plan definition and Internet interaction details</td>
</tr>
<tr>
<td>2014 10 17</td>
<td>V1.4</td>
<td>Nicola Larocchia</td>
<td>HR details included (Content server for Document attachment and eTM component)</td>
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<tr>
<td>2014 11 26</td>
<td>V1.5</td>
<td>Alejandro Aracil</td>
<td>Backup and DR update</td>
</tr>
<tr>
<td>2015 01 15</td>
<td>V1.6</td>
<td>Nicola Larocchia</td>
<td>Nakisa /BW split.</td>
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REVIEW AND APPROVAL

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<td>C. Giulietti</td>
<td>Capgemini Quality Assurance</td>
<td>Version: 1.5</td>
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<tr>
<td>F. Peralta</td>
<td>UNRWA Technical Infrastructure</td>
<td>Version: 1.5</td>
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<tr>
<td>L. Baldini</td>
<td>UNRWA ERP Director</td>
<td>Version: 1.5</td>
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DISTRIBUTION

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SOURCE FILE LOCATION

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<td>Marta Roccas</td>
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<th>Access</th>
<th>Responsible</th>
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1. INTRODUCTION

The purpose of this document is to design the UNRWA ERP Technical Architecture. It establish the high level strategy for Technical Architecture Implementation addressing all the requirements such as High Availability, Disaster and Recovery, Virtualization and hosting, Scalability, Initial Sizing of the infrastructure etc.

It specifies the different layers and aspects of the Technical Architecture including the Core SAP System, presentation layer, reporting, integration Hub, user clients and networking.

This document is also the bundle of detailed additional technical documents, implementation guidelines and best practices.
2. APPLICATION MAP

The UNRWA Application Map is described in the diagram below:

UNRWA Application MAP

The detailed list and specifications of functionalities and business processes tasks supported are described in the related documentation produced by functional teams. The focus in these documents is only on technical requirements and constraints for the integration of the components in one comprehensive architecture.

In the annex “A.1 - Interfaces Inventory Catalog” is described the complete list of Application interfaces between components including details on schedule frequency, protocols and methods.

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In the following table are described the components of UNRWA Application Maps.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>SAP ECC 6.0 EhP 6</td>
<td>Functions and transactions to support financial and operations business processes using the standard module to cover the business processes for Finance &amp; Public Sector, Procurement and Logistics, and Human Resources. Implemented on ABAP stack. Public Sector Industry solution is activated. The users access the system via the SAP GUI, no Webdynpro and Portal publishing is foreseen. According to the Integration strategy, other than standard SAP methods (BAPI, IDoc, Web Services) publishing will be adopted. ECC Application is based on Netweaver 7.3.</td>
</tr>
<tr>
<td>Integration Hub</td>
<td>The Integration framework is a Service Oriented Architecture providing an out of the box integrated environment composed by a set of open source products. It is used for Managing outbound and inbound services and interfacing flows to SAP components for replicating Ramco views for satellite application operation continuity. The integration is based on web services wrapping (BAPI, IDOC, RFC) for cases of connection with SAP components; and using ODBC access from the legacy applications to a staging database. This approach requires a central MS SQL DB to implement the Staging Area part of the HUB. For the interfaces based on File exchange it act also as central file sharing. The File System used to store file central sharing is used also as “Content Server” for attachments documents to the business SAP Objects (Contracts or Donation Proposal, CVs) More detail on the technical architecture of Integration HUB is described in the annex “A.2 - Integration Hub Architecture”</td>
</tr>
<tr>
<td>SAP BW – Business Warehouse</td>
<td>Business Warehouse for information integration of, Financial Public Sector, Procurement and Logistic and HR contents. SAP BPC, Business Planning and consolidation is also included.</td>
</tr>
<tr>
<td>SAP BO – Business Object</td>
<td>Business Object Enterprise suite is used for reporting</td>
</tr>
</tbody>
</table>
### Technical Infrastructure – SAP System Landscape

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAP Nakisa</td>
<td>Org charter, Reporting tool for Organization structure representation defined in SAP ECC – HR</td>
</tr>
<tr>
<td>Citrix Presentation Server/XenApp 6.5</td>
<td>Citrix Presentation server is not an application component, but only part of the technical infrastructure required to publish the SAP GUI, and all integrated client for reporting: Webi, BPC Client via internet explorer.</td>
</tr>
<tr>
<td>uPerform</td>
<td>SAP Productivity Pack. Part of the training tools, used for training material preparation and training content store</td>
</tr>
<tr>
<td>Moodle</td>
<td>Part of the training tools, it is used for training session and training path publishing.</td>
</tr>
<tr>
<td>SAP Solution Manager 7.1</td>
<td>SAP Solution Manager is the component for central monitoring and maintenance.</td>
</tr>
<tr>
<td>e-TM</td>
<td>e-Time Management is a .Net custom web application.</td>
</tr>
<tr>
<td></td>
<td>“A.3 - eTM Electronic Time Management”</td>
</tr>
</tbody>
</table>

For all the components the basis platform is Windows 2012/MS SQL 2012 with the exception of uPerform and XenApp which are based on Windows 2008 R1/MS SQL 2012.

The Application component Baseline (Support Package, Patch level, etc.) is described in detail in the Annex “A.10 - Application components Baseline”

### 2.1 SW Licenses

The table below lists the SW licenses needed for UNRWA SAP System Landscape implementation and for each item:

<table>
<thead>
<tr>
<th>Item</th>
<th>details</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAP ECC 6.0 EhP 6</td>
<td>SAP Application Developer User</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>SAP Application Professional User</td>
<td>1250</td>
</tr>
<tr>
<td></td>
<td>SAP Application Limited Professional User</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>SAP Application Employee Self Service User</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>SAP Payroll Processing for Non-profit Organizations (1 licence per 500 Employees)</td>
<td>60</td>
</tr>
</tbody>
</table>

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## Technical Infrastructure – SAP System Landscape

<table>
<thead>
<tr>
<th>Item</th>
<th>details</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAP Interactive Forms by Adobe, individual user (*)</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>SAP Interactive Forms by Adobe, external users (*)</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>Integration Hub</td>
<td>WSO2 Open Source SW</td>
<td>NA</td>
</tr>
<tr>
<td>SAP Business Warehouse 7.3</td>
<td>Included in the SAP ERP Licence</td>
<td>NA</td>
</tr>
<tr>
<td>SAP BPC 10.1 on SAP BW platform</td>
<td>BA&amp;T SAP BusinessObjects Planning &amp; Cons, vers f SAP NetWeaver (Users)</td>
<td>100</td>
</tr>
<tr>
<td>Sap Business Object 4.1</td>
<td>SAP BusinessObjects Enterprise Premium (CPU)</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>SAP BusinessObjects Web Intelligence (CPU)</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Xcelsius Enterprise Interactive Viewing (CPU) (*)</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>SAP BusinessObjects Explorer (CPU) (*)</td>
<td>2</td>
</tr>
<tr>
<td>SAP Nakisa 4.01</td>
<td>SAP Org Visualization by Nakisa, Org Chart</td>
<td>1250</td>
</tr>
<tr>
<td></td>
<td>SAP Organization Visualization by Nakisa, Org Planning (*)</td>
<td>10</td>
</tr>
<tr>
<td>uPerform</td>
<td>SAP Productivity Pak by ANCILE (Users)</td>
<td>1250</td>
</tr>
<tr>
<td></td>
<td>SAP Productivity Composer by ANCILE (Users)</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>SAP Enterprise Learning Environment (500 Learner)</td>
<td>3</td>
</tr>
<tr>
<td>SAP Solution Manager 7.1</td>
<td>Minimal service for mandatory no license is required. Included in the SAP ERP Licence</td>
<td>NA</td>
</tr>
<tr>
<td>Citrix Presentation Server/XenApp 6.x</td>
<td>Citrix concurrent user license - 400 licence reused from RAMCO</td>
<td>610</td>
</tr>
<tr>
<td>SAP Nakisa 4.01</td>
<td>SAP Org Visualization by Nakisa, Org Chart (Users)</td>
<td>1250</td>
</tr>
<tr>
<td></td>
<td>SAP Organization Visualization by Nakisa, Org Planning (Users) (*)</td>
<td></td>
</tr>
<tr>
<td>Infrastructure Services</td>
<td>MS SQL DB license will be not included in SAP and provided by UNRWA. Microsoft SQL Server Enterprise (64-bit) – per core</td>
<td>38</td>
</tr>
<tr>
<td></td>
<td>Windows Operating System will be included in the SAP Hosting Service. – Number of VM</td>
<td>50</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Item</th>
<th>details</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Availability and Virtualization Software (VMware) included in the SAP Hosting Service</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Storage Area Network SW, Storage virtualization included in the SAP Hosting Service</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Operational and monitoring tools (Legato, Sitescope, Vcops, Citrix Edgesight, Avamar 7.1) included in the SAP Hosting Service</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>SAP Landscape Domain Server, File Server, Firewall, Net appliance monitoring, …, included in the SAP Hosting Service</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Software for mirroring/replica system and D&amp;R implementation, included in the SAP Hosting Service</td>
<td>NA</td>
<td></td>
</tr>
</tbody>
</table>

(*) Not yet activated/implemented.

### 2.2 SAP Environments

For each component is defined a set of instances according to the best practices of the SAP implementation projects where there are defined multiple environments according to SW deployment lifecycle (Development, Quality, Training/Preproduction and Production).
UNRWA Landscape environments

The different project streams (HR/non HR) have a dedicated Dev instances (RED/UED). The convergence and integration testing start from Quality (UEQ).

The connection in the diagram defines the logical relationship between clients of different systems and the connections to be set up (i.e. RFC destination definition etc.) for application dependencies. All legacy applications (OMNI ...) are not represented in this diagram.

The system access path are listed in the annex “A.4 - System Access path”
2.2.1 SAP Client Approach
Within single ECC instances it is foreseen to use different clients to implement the standard implementation process of SAP, each of them with a different role.

The proposed strategy is to have for each SAP instance a client with the master role, the main use linked to the role of the whole instance.

This main client has the number 100, and differs as follows:

The development system will contain the configuration and objects SW consolidated baseline. It also named “Gold”.

The quality system will contain the configuration and objects released for integration test and application integration, and a significant set of data.

The production system will contain the client 100 with SW and data in use.

For the remaining clients this is the naming convention:

The first digit always identifies the instance where the environment is hosted:

“1” Development
“2” Quality
“3” Preproduction

The Second Digit identifies the role of the client in respect of the project activities that require a dedicated Environment:

“1” Data Migration
“2” Testing
“3” Training
“9” Parallel RUN

The following diagrams describe the Clients definition for ECC landscape:
Within the clients we differentiate the following roles:

**AA:** Authorization Administrator (Z_SAP_BC_SEC_AUTH_ADMIN): Role for role and profile maintenance

**BA:** Business Analyst (Z_BA_DISPLAY_ALL): Business Analyst All Authorization

**CNF:** Customizing Consultant (Z_CONSULTANT): Generic Role for CGI Consultants

**CNF-HR:** HR Customizing Consultant (Z_CONSULTANT_HR): Generic Role for HR Consultants

**DVP:** Developer (Z_DEVELOPER): Role for ABAP developers

**DVP-HR:** HR-Developer (Z_DEVELOPER_HR): Role for ABAP developers

**DA:** Data Analyst (UNRWA_DISPLAY_ALL): 

**TRN:** Trainer (Z_RWA_TRAINING, UNRWA_DISPLAY_ALL): Training Consultant Role

**UT:** Trainee User (UNRWA_TRAINING): UNRWA Training Role

**EU:** End User - > Final role

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### Technical Infrastructure – SAP System Landscape

**UUM: UNRWA User Management: Roles for Reset Password for UNRWA users.**

#### ECC Transport alignment path

The update list of the client and planning activities (refresh copy) and log is in the annex **“A.5 - SAP Client Master Plan”**

The component SAP BI instances are mono client, the same is also valid for SAP Solution Manager.

The client alignment strategy established the massive update start always from the top to the bottom: from 100 the gold configuration client to create empty or from “*20” if Application Sample Data is needed. The transports path follow the same strategy.

#### 2.3 SAP System Technical details

The technical infrastructure to implement the ERP Technical Architecture for UNRWA is described in the following paragraphs, with the distribution between Valencia UNGCS Data Center and Brindisi one.

In the annex **“A.7 - SAP Systems Master List”** for each system is described the hostname, the resource allocations, Network IP, storage layout out etc.

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2.3.1 **Backend infrastructure**

In the following diagram is described the Backend infrastructure:
2.3.1 Production Build approach
The UED, RED, UEQ and UET Systems have been installed (in April – July 2013) at SP7 Level. They have been upgraded to SP11 on April-May 2014.

During the implementation activities two sets of transports released from UED have been collected and imported into UEQ, UET and RED: Pre upgrade and post upgrade.

UET is a validate environment with UAT and training activities performed.

The adopted approach to build production is to use a UET System Export in order to reduce risk of errors and exceptions due to the complexity and the amount of the technical activities.

More detail are described in the annex “A.6 - Production Build Approach”

2.3.1 Frontend Infrastructure
In the following diagram is described the Frontend infrastructure:
The detailed “as built” documentation of Citrix farm, included the Client/User Interfaces published through Citrix is described in the document “\textit{A.15 - Citrix Infrastructure}”, while the Netscaler As built configuration is described in the annex “\textit{A.16 - Netscaler As Built Configuration}”.

Other than the access via Citrix there is another channel, the usage of VDI, Virtual Desktop Infrastructure, provided by UNGCS: there are two types of VDI:

- One for SAP Basis and System Admin
- One for Developer, which is an alternative to the other SAP clients, and development tools directly installed on the Developer PC.
  - In order to set Quality of Service on the Network, only VDI access will be allowed to developer.

UNRWA Frontend Infrastructure View
The VDI Master will be the same for all the developers (CGI, UNRWA ERP team and individuals). Eventually paths and ports accessible can be different according to the teams (BI, HR, etc.)

The ICA client installation and SAPGUI initial setup guideline is described in the annex “B.4 - Citrix - SAP Frontend Installation”

Some services are deployed via http protocol using internet browser. In particular there are the following applications:

- Solution Manager Service Desk (deployed to the end users and the support team).
- UPerform (used only by the training team, training material preparation)
- Moodle (used by the training management and the trainee)

Full user distribution between Backend Components and frontend clients is listed in the annex “A.8 – User Distribution and UI requirements”

2.3.2 Printing Infrastructure

The printing infrastructure is based on the concept of using the “Local” approach: the user can print on the printers accessible from his/her PC.

The Printer defined in SAP Systems will use the Method “F” (821519 - Front-end printing with control technology). There are no special printer defined in the architecture, the printer defined in the SAP system id type frontend for implementing the local approach. There are no requirement collected with the printers connected to the SAP Application Servers for a direct printing from batch processes and remote printing.
2.4 Security and Authentication Requirements

There will be a total separation of the Backend Application zone, defined within UNGCS data centre network, from the front end one. The presentation servers are exposed in the front-end zone connected to the UNRWA WAN. The users will access the UNRWA domain for authentication and will use User IDs/Passwords to access Citrix and SAP.

No Single Sign-On (SSO) mechanisms are foreseen for the moment. The only requirement for future evolution on this area is that the naming convention for the User Master is the UNRWA Active Directory.

See the annex “A.9 - SAP ECC Production Details” for details.

Access to the Integration Framework will be dedicated application service and communication channels over TCP/IP (i.e.: via ODBC, FTPS, HTTP(S), SOAP etc.).

2.5 Network Infrastructure

VLAN have been introduced to segregate backend from frontend according to the SAP best practice and from “Prod” and “NON Prod” system

See annex “A.17 - UNRWA CED LAN Diagram” for detail while the following diagram shows the UNRWA WAN infrastructure and the main requirements for link establishment for connecting UNRWA to UNGCS datacenter. See annex “A.18 - Network Traffic Matrix” for details on ports and protocols.
UNRWA WAN infrastructure

Network infrastructure strategy for the ERP project will consider following set of guidelines and assumptions:

1. It is assumed that the connectivity to the ERP System (based UNGCS datacenter) for UNRWA users in Field Offices and HQs will be facilitated by expanding the existing Global MPLS network and applicable Local Field MPLS networks.

2. Below table illustrate indicative ERP system network bandwidth requirements based on current ERP user count estimates. Indicative bandwidth figures are end-to-end estimates from each Field/HQ to UNGCS datacenter based on the concurrent user estimates multiplied by the Citrix session requirements (20 kbps per user session).

<table>
<thead>
<tr>
<th>Field</th>
<th>Concurrent Users</th>
<th>Bandwidth (Mbps)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HQA</td>
<td>120</td>
<td>2.4</td>
</tr>
<tr>
<td>HQG</td>
<td>30</td>
<td>0.6</td>
</tr>
<tr>
<td>GFO</td>
<td>110</td>
<td>2.2</td>
</tr>
<tr>
<td>JFO</td>
<td>80</td>
<td>1.6</td>
</tr>
<tr>
<td>LFO</td>
<td>90</td>
<td>1.8</td>
</tr>
</tbody>
</table>
3. ERP Users based outside of the Main Field office building (i.e. Area office) will be connected to ERP system via Field office MPLS network. ISD will collaborate with Field ISO team to evaluate and, if needed, upgrade Local MPLS network connectivity outside Field office to accommodate ERP user requirements in Areas offices. There is no commitment from the MPLS service provider on the availability of the network.

4. Quality of Services on MPLS. There will be defined priorities on the different channel/protocols. Citrix priority one, VDI priority two, SAP direct clients priority three
   I. The ports for Citrix Receiver – Xenap Server are: 1494; 2598; 16500 – 16509
   II. SAP GUI/WEB UI 3200 – 3210, 50000 -50020

5. In case of unavailability of the MPLS
   I. Internet access is the cleanest alternative for end-user
   II. VPN individual for systems and SAP admins
   III. No access for Developers.

6. The URLs in effect in the system are:
   I. sap.unrwa.org for normal operation accessible from UNRWA offices across the MPLs; points to Valencia Citrix farm.
   II. remote.reachunrwa.org for external consultants’ access
   III. and sap.reachunrwa.org during DR operation, public on internet, points to Brindisi Citrix farm. Internal users will be entitled to use the Citrix farm behind this URL only during DR.

7. Internet access: the URL remote.reachunrwa.org is accessible from internet but only external consultants are entitled to this Citrix farm.

8. With the same approach the SAP applications/services have to be addressed using logical name/alias (uep.unrwa.org, uwp.unrwa.org etc.). That is mainly for segregation of application layer from the Network and addressing the VM motion, and D/R plan in a flexible and dynamic way as explained in the related chapter.

### 2.6 Sizing

The following table addresses a draft size estimation based on the WFP current configuration and a quick-sizing exercise done with the information collected during the Design phase and updated with the actual data from RAMCO.

<table>
<thead>
<tr>
<th>Application Component</th>
<th>Item</th>
<th>Named Users</th>
<th>Concurrent Users</th>
<th>SAPS</th>
<th>DB Space (Gbyte)</th>
<th>RAM (Gbyte)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOL</td>
<td>Solution Manager</td>
<td>USD  5</td>
<td>2</td>
<td>2000</td>
<td>150</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>USP  100</td>
<td>40</td>
<td>3000</td>
<td>150</td>
<td>12</td>
</tr>
<tr>
<td>ECC</td>
<td>SAP ECC 6.0 EhP6</td>
<td>UED  70</td>
<td>30</td>
<td>3000</td>
<td>250</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>UEQ  100</td>
<td>30</td>
<td>3000</td>
<td>250</td>
<td>16</td>
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## Technical Infrastructure – SAP System Landscape

<table>
<thead>
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<th>200</th>
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<th>4000</th>
<th>350</th>
<th>16</th>
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<tbody>
<tr>
<td></td>
<td>UEP</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>RED</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>BW</strong></td>
<td>UWD</td>
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<td></td>
<td>UWT</td>
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<td>500</td>
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<td>12000</td>
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<tr>
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<td>3</td>
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<tr>
<td></td>
<td>UOT</td>
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<tr>
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<td>15000</td>
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<tr>
<td><strong>IF</strong></td>
<td>UHD</td>
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<td>2000</td>
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<tr>
<td></td>
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<tr>
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<td>UHP</td>
<td>20</td>
<td>10</td>
<td>3000</td>
<td>100</td>
<td>16</td>
</tr>
</tbody>
</table>

Major inputs include: 600 concurrent users composed of 250 finance users, 200 procurement and logistics users, and 150 HR users. See annex "A.11 - UNRWA Landscape Sizing" for details.

For the HW resource requirement the following rules have been applied:

- Reference of SAP SD benchmark on BL620c G7 with Xeon E7- 2820 processor with a capacity to support \( \geq 1800 \) SAPS per Core. See annex “A.12 - BL620c SAP SD Benchmark”
- We assume to map 1 physical Core with 1 vCPU.
- Based on SAPS results the resources required are increased of contingency of 30% because on virtual. A ratio between number of vCPU and GByte of RAM is applied
  - 1 vCPU 4GB RAM if ABAP System
  - 1 vCPU 6GB RAM if Java System
  - Actual tuning resource allocation will be based on the performance system test.
- SAP allocates memory permanently and does not release it again. To enforce this policy, we assume to have "Memory Reservation" to the amount of memory configured for the VM. This will ensure that the VM with the SAP instance will always have the full amount of memory available.
- Given the total number of SAPS of system, in case of distributed system we have a ratio
  - OLTP (ECC,..) : 30% DB - 70% Application Servers
  - OLAP (BW-BPC) : 40% DB – 60% Application Servers
  - Presentation/Reporting (BO, Citrix) 10% DB – 90% Application Servers

For Virtual Machine configuration see annex “B.2 - VMWare configuration guideline” for the guideline best practice adopted and for the as built configuration see “A.13 – VMWare as built configuration”
3. **HIGH AVAILABILITY**

An SAP system (whether ABAP or Java) includes the following single Points of Failures (SPOF).

- **The Database:**
  The Database is the heart of the system. It holds the application data, the customizing, the user’s accounts, the program... In short, almost everything. It is a highly critical component: the unavailability of the database results in a complete unavailability of the SAP system.

- **The enqueue server:**
  The enqueue server manages the SAP lock objects in a table kept in its memory. It is a simple process but its failure results in the unavailability of the system and may result in inconsistencies in the database.

- **The message server:**
  The message server is a process allowing SAP application servers to exchange data and internal messages. It is a “pure execution” service: it processes requests as they come but holds no data. Its unavailability results in an unavailability of the SAP system. Most of the time, message server and enqueue server run on the same machine (or virtual machine).

- **The central file share:**
  The central file share hosts central system logs and instance profiles (among other).
  Generally this file share is hosted by the same machine hosting enqueue and message server and exported using NFS. If it is not the case, it is a supplementary Single Point of Failure.

The following SAP components can be defined based on the *Message and Enqueue Services*:

- **Central Instance (CI):**
  The central instance is the first installed instance of the application server and includes up to NetWeaver Release 7.0 Message and Enqueue Services and in addition to SAP work processes enabling execution of batch and background workloads. The CI is a possible SPOF if it includes the described Message and Enqueue Services.

- **SAP Central Service (ASCS/JSCS):**
In newer versions of SAP NetWeaver, the Message and Enqueue Services have been separated from the CI and are operated as standalone services. Separate Central Services exist both for ABAP and for Java—based NetWeaver application servers. For ABAP environments, they are referred to as ABAP Central Services (ASCS).

- Replicated Enqueue:

The Replicated Enqueue Server run on a different host system (or virtual machine) and contains a replica of the lock table in a shared memory segment. If a standalone Enqueue Server fails, it must be restarted by a high availability solution (cluster software) on the server on which the Replicated Enqueue Server is running. The restarted Enqueue server connects to the shared memory segment of the replicated Enqueue server and makes the existing locks available again after the move to the new host. The Replicated Enqueue Server can then be restarted on another host to provide continued redundancy.

3.1 “VMware High Availability”

The principle here is to install in the same virtual machine the CI (enqueue server + message server) and the DB (database), whether it is an ABAP or JAVA system:

SAP HA with VMware HA

The application and DB are not available during the failover for a duration equivalent to the total time for the migration of VM1 (between 10 and 20 seconds) and restart SAP (about 3 minutes, considering a UNRWA system size). All the activities on SAP are then interrupted instantly and without control and can only resume after a few minutes at the end of the migration and restart the SAP instance.

This solution will be applicable for all “non distributed systems”, everything in one box.

3.2 VMware HA + Fault Tolerance

An alternative solution to protect the ASCS (enq + mess servers) is VMware Fault Tolerant (FT). A second virtual machine is created to work in tandem with this virtual machine with the FT enabled.
In case of failure on the Host1 there is unavailability of a duration for the VM1 migration (SAP DB) to second node (between 10 and 20 seconds) and restart the SAP database (about 1 min). All activities on SAP are then instantly interrupted and will resume only after a few minutes at the end of migration and restart of the SAP database, but unlike the previous case (only VMware HA), the management of the lock, then the consistency of the activity, it is guaranteed by the constant operation of the SAP ASCS.

When a fault is detected only on the VM2, with primary ASCS, the second ASCS takes the place of the first one with no service interruption nor data loss.

However VMware FT has one main drawback: it can handle only one vCPU (so no more than the power of one core).

This approach allow a higher granularity in the scalability of each single components and a DB license cost reduction for the dedicated VM due to the cores dedicated to DB server.

This configuration will be partially adopted for the distributed systems.
The installation will be for a distributed system ready to be enhanced eventually in the future. The second virtual machine ASCS backup under VMware FT will be not installed, and also the second application server, it will be introduced only upon business need/requirement to dedicate a specific Application Server for a user group or process (payroll batch process, or interfaces etc.). All the VMs are with the VMware HA activated.

ESX 1, 2, ... are host belonging of the VMware cluster for ERP, defined in the Valencia VMware vCenter. The physical allocation is managed by UNGCS according to the SLA of 99.9% of Availability of the VM with HA.

For details see annex “A.9 - SAP ECC Production Details”
3.3 Storage Layout, Backup and Restore

SAP System is based on MS SQL Data base. All the Virtual Machine hosting SAP Systems have been structured with the following partitions:

- C: Operating System;
- W: Swap;
- K: Kernel;
- S: (SQL+temp +masterdb);
- D: Data;
- L: Log

(See annex “A.7 - SAP Systems Master List” Disks definition for each System)

MS SQL fully persists any transaction that changes the data, such as row insertions, deletions and updates, so it can resume from a power-outage without loss of data.

A transaction redo log is used to record a change. To make a transaction durable, it is not required to persist the complete data when the transaction is committed; instead it is sufficient to persist the redo log. Upon an outage, the most recent consistent state of the database can be restored by replaying the changes recorded in the log, redoing completed transactions and rolling back incomplete ones.

Full data backups, which can be used to restore a database to a specific point in time. In addition to data backups and snapshots, smaller periodic log backups ensure the ability to recover from fatal storage faults with minimal loss of data or in the event of some business or application event requiring the roll back to a consistent point. The Best Practice from SAP is to:
Use full database backups as often as possible, if it is possible also once per day eventually using on line method.

Back up the transaction log every 30 to 60 minutes during normal production. The frequency of transaction log backups depends on the transaction rate on your system and the transaction log size. If the transaction log fills, the database stops processing and the SAP system is also forced to stop.

The Backup solution is based on EMC Avamar v7.0 with agents for DB and File System backups. There is a SAP native agent backup is not used because database uses MS SQL Server as the DB backend, which is an unsupported SAP platform for native backups, therefore, a combination of SQL online backups and File system backups has been implemented to protect SAP. "A.14 - Storage and Backup solution" for more details.

The policy is the following:

- **Productive Instances:**

<table>
<thead>
<tr>
<th>Type</th>
<th>Frequency</th>
<th>Retention</th>
</tr>
</thead>
<tbody>
<tr>
<td>SQL Full</td>
<td>Daily</td>
<td>5 Years</td>
</tr>
<tr>
<td>SQL Incremental (redo log)</td>
<td>Hourly</td>
<td>3 Months</td>
</tr>
<tr>
<td>File System</td>
<td>Daily</td>
<td>2 Months</td>
</tr>
<tr>
<td>Offline</td>
<td>Weekly (Saturday)</td>
<td>2 Months</td>
</tr>
</tbody>
</table>

  We are doing one SQL full backup every day that is being kept for 5 years and incremental backups hourly that are being kept for 3 months. With this solution we can restore the database to any point in time 3 months in the past using a combination of full and incremental backups and to any day (12:00 AM) 5 years in the past using only full backups.

- **Non-Productive Instances:**
  
<table>
<thead>
<tr>
<th>Type</th>
<th>Frequency</th>
<th>Retention</th>
</tr>
</thead>
<tbody>
<tr>
<td>SQL Full</td>
<td>Weekly (Saturday)</td>
<td>2 months</td>
</tr>
<tr>
<td>SQL Incremental (redo log)</td>
<td>Daily</td>
<td>2 months</td>
</tr>
<tr>
<td>File System</td>
<td>Daily</td>
<td>2 months</td>
</tr>
</tbody>
</table>

Reference: Version: 1.6 | Date: 2015 02 03
In the annex “A.7 - SAP Systems Master List” there is the detailed backup schedule definition for each UNRWA ERP system.

### 3.4 Disaster Recovery

VMware (SRM) provides an industrialized and proven DR solution: VMware Site Recovery Manager (SRM). The following schema (extracted from VMware documentation) summarizes the principle of functioning.

**SAP D/R with VMware SRM**

SRM requires an underlying solution to replicate virtual machine data between production and SRM site.
Site D/R Site alignment options

- These two solutions implement block replication: they are designed to make sure that at any time source and target systems are identical.

- But if for any reasons, block changes in the source do not arrive in the target (network problem, etc…), datafiles in the target may be corrupted resulting in a corrupted database or, in the worst case, in a database that does not start.

- Also, if blocks are corrupted in the source (faulty HBA card driver for example), this corruption is propagated to the target.

- Unless VMware or EMC can guarantee that using these mechanisms will never result in a corrupted or non-restarting database, we prefer the following alternative solution (described only for ECC component):
The alignment of the SAP instance VMs is done using EMC Recoverpoint as the data replication solution that is fully integrated with VMware Site Recovery Management (SRM) tool to the DR site (The replication is at block-level of the EMC VNX storage arrays from Production to the DR site via the RPA). This replica is done weekly SAP system down, while the data are refreshed using online backup files.

- The solution chosen is Active - Active, during the normal condition the both sites are utilized.
  - Some dev instances, will be hosted in the Brindisi site and will be lost and replaced by production in case of disaster.
- The sizing of the infrastructure allows 50% on performance degradation
- The RPO is 24 hours and RTO 48 hours.
- In case of disaster only the production environment will be available. For long disaster duration, the development/test environment will be eventually built starting from the Restore Backup procedure, with a higher RTO.
- The D/R solution is completed by usage of logical host name linked to different Network in case of disaster.
- Furthermore, as described in the technical infrastructure details, there is reachability from the Brindisi frontend to Valencia backend. That path could be used in case of Network unavailability in the Valencia frontend. It would be possible to divert the user
access through Brindisi frontend. The UNRWA DNS will solve [http://sap.unrwa.org](http://sap.unrwa.org) with Valencia Netscaler VIP during the normal operation, while in case of disaster Valencia frontend/Network unavailability a new url will available [http://sap.reachunrwa.org](http://sap.reachunrwa.org) linked to Brindisi Netscaler VIP.

- SAP Germany support is currently linked to SAP Router in Valencia via a public IP address. Due to the face that it not possible to move a public IP from one country to another.
  - We foresee to have one public IP address to dedicate to SAP Router Service also in Brindisi.
  - SAPRouter is installed as a service within the SAP Solution Manager Box (USP). Moving USP with SRM Move we will have also the SAP Router service moved from Valencia to Brindisi, within the DR Plan we have to manage only the firewall rules implementation to adjust the public IP link with the moved SAPRouter IP.

- The detailed allocation of the resources between Brindisi and Valencia is detailed in the Annex "A.7 - SAP Systems Master List"

### 3.4.1 Disaster Recovery High level Plan

The High Level D/R Plan consist of the following main steps:

- During the normal operation the following backups are performed (all of them sent from Valencia to Brindisi):
  - Weekly full offline backup of the VMs. This backup will take place on Saturday night within the time window of the offline backup downtime, and must be done following these steps:
    - Stop SAP (full)
    - Full file system backup
    - Restart SAP
  - Daily full online backup
  - Hourly incremental backup

- In case of disaster following steps must be followed:
  1. Shut down Development and Quality instances hosted in Brindisi (VMs hosting UED and UEQ in the diagram).
  2. Switch Production VMs to Brindisi using SRM.
  3. Verify DNS hostnames are updated accordingly.
  4. Startup SAP in Brindisi.
5. Check for consistency of SAP DB.
   a. In case of inconsistency, recover from the offline backup of previous Saturday, then from the last available full online backup and then recover from last incremental backup.

6. Perform Functional Check and Test.

7. Switch Citrix infrastructure VMs (SQL, License and EdgeSight monitoring).
   a. All users will connect through http://sap.reachunrwa.org/

The detailed Disaster and recovery Plan is described in the Annex “A.19 – DR Plan”
4. ANNEX LIST
The following table recap all the detailed documents referenced in this Master Document (A, Technical Specification and B Procedure and guidelines):

<table>
<thead>
<tr>
<th>Document</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.1 - Interfaces Inventory Catalog</td>
<td>The document list the current interface in scope, describing schedule frequency, volumes protocols and ports needed.</td>
</tr>
<tr>
<td>A.2 - Integration Hub Architecture</td>
<td>The document describe the Integration HUB architecture</td>
</tr>
<tr>
<td>A.3 - eTM Electronic Time Management</td>
<td>The document describe the eTM component</td>
</tr>
<tr>
<td>A.4 - System Access path</td>
<td>It contain the path, url for accessing the UNRWA ERP application components/Services</td>
</tr>
<tr>
<td>A.5 - SAP Client Master Plan</td>
<td>It contain the SAP client Master list with ownership and history log</td>
</tr>
<tr>
<td>A.6 - Production Build Approach</td>
<td>The document describe the Approach adopted to build production</td>
</tr>
<tr>
<td>A.7 - SAP Systems Master List</td>
<td>It contain the inventory of the Systems Virtual Machine, the resource allocated (CPU, RAM and storage details and Backup schedule definition)</td>
</tr>
<tr>
<td>A.8 – User Distribution and UI requirements</td>
<td>It contain UNRWA user distribution, and the UI group (Standard, Advanced, Super) for different Citrix desktop application provisioning according to the group</td>
</tr>
<tr>
<td>A.9 - SAP ECC Production Details</td>
<td>Production configuration details</td>
</tr>
<tr>
<td>A.10 - Application components Baseline</td>
<td>SAP System Patches and SP level baseline</td>
</tr>
<tr>
<td>A.11 - UNRWA Landscape Sizing</td>
<td>UNRWA sizing estimation</td>
</tr>
<tr>
<td>A.12 - BL620c SAP SD Benchmark</td>
<td>SAP certificate for the HW used.</td>
</tr>
<tr>
<td>A.13 - VMWare As Built configuration</td>
<td>Technical document with the AS Built configuration of the Virtual Machines in the landscape</td>
</tr>
<tr>
<td>A.14 - Storage and Backup solution</td>
<td>Solution description used based on EMC2 and AVAMAR</td>
</tr>
<tr>
<td>A.15 - Citrix Infrastructure</td>
<td>Technical document with the AS Built configuration of the Citrix infrastructure components</td>
</tr>
<tr>
<td>A.16 – Netscaler As Built Configuration</td>
<td>Technical document with the AS Built configuration of the Netscaler</td>
</tr>
<tr>
<td>A.17 - UNRWA CED LAN Diagram</td>
<td>Detailed Network Diagram on the UNRWA CED, including Valencia and Brindisi DC</td>
</tr>
<tr>
<td>A.18 - Network Traffic Matrix</td>
<td>Detailed Network ports and protocols opened between VLAN</td>
</tr>
<tr>
<td>A.18 - DR Plan</td>
<td>Detailed Disaster and Recovery Plan</td>
</tr>
<tr>
<td>B.1 - SAPGui Installation</td>
<td>SAP GUI Installation guide to be provided to the non Citrix and non VDI users.</td>
</tr>
<tr>
<td>B.2 - VMware configuration guideline</td>
<td>VMWare Best practice, SAP Note and Guideline for SAP System hosted on Virtual</td>
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</table>

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<table>
<thead>
<tr>
<th>Document</th>
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<tbody>
<tr>
<td>B.3 - Citrix Guide - Publish Application</td>
<td>Procedure for publishing new Application on Citrix</td>
</tr>
<tr>
<td>B.4 - Citrix - SAP Frontend Installation</td>
<td>Procedure for frontend (Citrix Client) installation guideline</td>
</tr>
<tr>
<td>B.5 - Add user to Citrix Group</td>
<td>Procedure to Add users on Citrix application group</td>
</tr>
<tr>
<td>B.6 - Citrix Guide - Load New License</td>
<td>Procedure for adding Citrix license</td>
</tr>
<tr>
<td>B.7 - Citrix Guide – Monitoring</td>
<td>Procedure and guideline for Citrix Monitoring</td>
</tr>
<tr>
<td>B.8 - SAP BW-BO clients installation</td>
<td>SAP BW/BO Installation guide to be provided to the non Citrix and non VDI users.</td>
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<tr>
<td>B.9 - uPerform Front end Installation</td>
<td>Uperform frontend installation guide for non citrix and non VDI users.</td>
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<tr>
<td>B.10 - VDI definition</td>
<td>Procedure for VDI SW installation</td>
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<tr>
<td>B.11 - User Reset Password Guideline</td>
<td>Procedure for first level of support to reset password to the UNRWA users</td>
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## ABBREVIATIONS

<table>
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<tr>
<th>Abbreviation</th>
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<tr>
<td>A2A</td>
<td>Application to Application</td>
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<tr>
<td>AA</td>
<td>Asset Accounting</td>
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<tr>
<td>ABAP</td>
<td>Advanced Business Application Programming</td>
</tr>
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<td>Accounts Payable</td>
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<td>API</td>
<td>Application Programming Interface</td>
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<td>AR</td>
<td>Accounts Receivable</td>
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<tr>
<td>BAPI</td>
<td>SAP Business Application Programming Interface</td>
</tr>
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<td>BO</td>
<td>SAP Business Object</td>
</tr>
<tr>
<td>BPC</td>
<td>SAP Business Planning and consolidation</td>
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<td>BW</td>
<td>SAP Business Warehouse</td>
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<td>B2B</td>
<td>Business to Business</td>
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<tr>
<td>cccBPM</td>
<td>PI cross-component Business Process Management</td>
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<td>CO</td>
<td>Controlling</td>
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<td>CR</td>
<td>Change Request</td>
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<td>Disaster &amp; Recovery</td>
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<td>EAI</td>
<td>Enterprise Application Integration</td>
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<td>SAP Enterprise Core Component</td>
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<td>FI</td>
<td>SAP Finance</td>
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<td>FM</td>
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<td>File Transfer Protocol</td>
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<td>Secure File Transfer Protocol</td>
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<td>GUI</td>
<td>SAP Graphical User Interface</td>
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<td>SAP Finance General Ledger</td>
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<td>PI Integration Directory</td>
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<td>SAP Intermediate Document</td>
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<td>Java To Enterprise Edition</td>
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<td>Simple Mail Transfer Protocol</td>
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<td>SOA</td>
<td>Service Oriented Architecture</td>
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<tr>
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<tr>
<td>SOAP</td>
<td>Simple Object Access Protocol</td>
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<tr>
<td>TR</td>
<td>Treasury</td>
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<tr>
<td>TCO</td>
<td>Total Cost of Ownership</td>
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<tr>
<td>TM</td>
<td>Time Management</td>
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<tr>
<td>TS</td>
<td>Travel Service</td>
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<td>WAS</td>
<td>SAP Web Application Server</td>
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<td>WSDL</td>
<td>Web Services Description Language</td>
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<td>WINGSII</td>
<td>World Food Program SAP ECC Component</td>
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<td>XML</td>
<td>Extensible Markup Language</td>
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<td>XSLT</td>
<td>eXtensible Stylesheet Language Transformation</td>
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