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“Support to the Improvement of Statistical Information System” - Albania

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Output 2.2.1:

Technical specifications for the data warehouse(s), and requirements for infrastructure to be acquired, taking into consideration also data sharing between the different parts of the national statistical

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PROJECT REFERENCES

| | |
|---------------------------------|-----------------------------------------------------------------------------------------------------------|
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BACKGROUND

The production processes for the various statistical domains within INSTAT over recent years have been subject of changes due to increment of the work program and the introduction of the new methodologies, technologies and technics. This has contributed to the progress of the Institute towards its alignment with the European best practices and the EU acquis in statistics. However, this expansion may lead to the devoting insufficient attention to the standardization and integration of processes and the usage of common tools and applications.

The report is related to the work within the IPA 2013 Project: Support to the Improvement of Statistical Information System. The **main objectives** of the Project are:

- Improving the quality, sustainability and efficiency of statistical data production as produced by INSTAT and other official statistics producers in Albania.
- Strengthening the institutional capacities of INSTAT and further aligning the statistics produced in Albania with the EU acquis in statistics.

The **specific purpose** of this project is to strengthen the capacity of INSTAT in the three main selected domains:

- Corporate statistical business processes, especially in the fields of Agricultural and Labour Force statistics;
- Corporate ICT infrastructure; with inclusion centralized Data Warehouse(s);
- Communication function and statistical coordination role of INSTAT with focus on dissemination, and quality management.

The project is conceptualized into three main components with large number of activities, sub-activities and tasks having a different degree of complexity and largely depending on a number of various factors, of internal and external nature.

Component 1 - Redesign and improve corporate statistical business processes and enhance institutional capacities in the production and usage of Agricultural and Labour Force statistics

Component 2 - Develop and test system for upgraded corporate ICT infrastructure with inclusion of establishment and pilot implementation of centralized Data Warehouse(s)

Component 3 - Strengthen communication function and statistical coordination role of INSTAT with focus on dissemination and quality management.

Functional interrelations between project/components results and activities may be presented graphically in the simplified way:

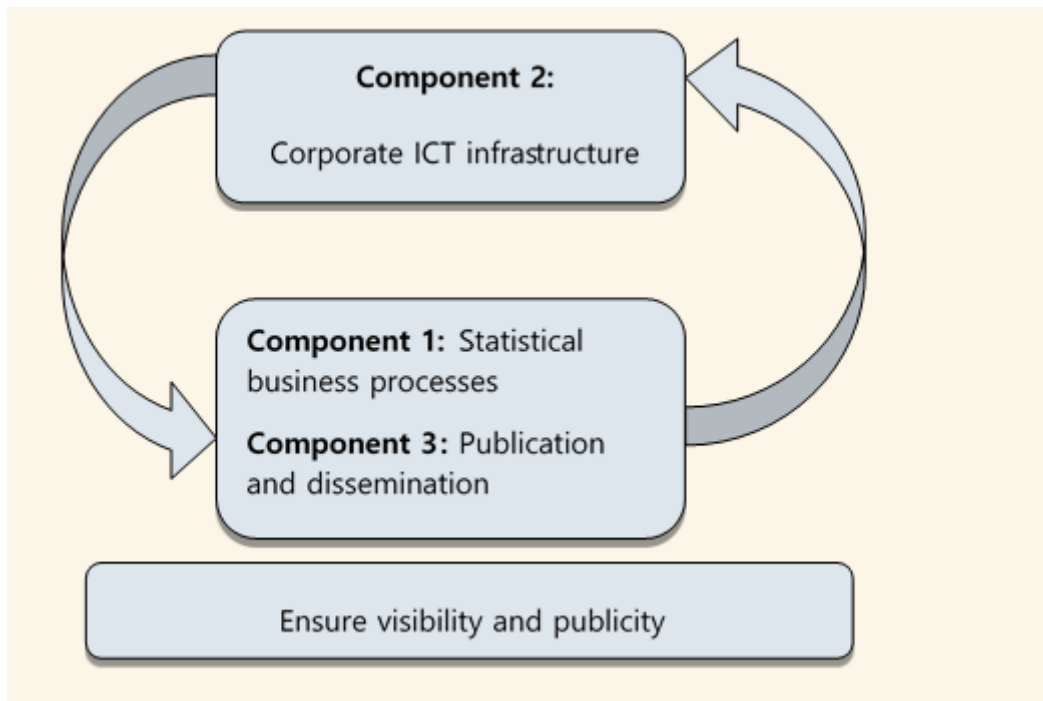


Figure 1. Functional interrelations between project/components results and activities

The activities to be performed during the Project have been singled out according to the objectives of the Project and were further defined according to discussions made during the meetings with the beneficiary's - Institute of Statistics of Albania (INSTAT) nominated experts. The institutional framework provides solid background, so that the project is managed in an efficient and transparent way at high professional level and respecting existing legislation.

This document is Technical specifications for the data warehouse for the:

Component 2 – Develop and test systems for upgraded corporate ICT infrastructure;

Sub-component 2.2 Design blueprint for an integrated corporate technical IT infrastructure for INSTAT, including technical specifications for the data warehouse(s);



STATISTICAL INFORMATION SYSTEM ARCHITECTURE OVERVIEW

High-level statistical information system architecture is described in detail in document *Design of blueprint for an integrated corporate technical IT Infrastructure for INSTAT*. The architecture was proposed to achieve the following goals:

- minimize usage of software that stores and processes data on end-user computers and move data storage and data processing to server side
- maximize usage of RDMS for data storage, as opposed to storage in diversity of different file formats
- minimize number of different tools and software components used to accomplish the same task
- choose the best tool for a specific task and use it
- simplify the architecture as much as possible in order to accomplish software and process standardization, easier maintenance and manageability of the overall system
- keep in mind existing infrastructure and its constraints
- keep in mind software costs and try to find the best balance between architectural goals and software costs

Proposed architecture is shown in Figure 1: Statistical information system architecture.

It is based on SQL Server Standard Edition, since all modules use SQL Server database to store data.

Since purpose of this document is to provide technical documentation for the data warehouse and to give recommendations for purchasing SQL Server licenses, the rest of this document is dedicated to these two themes.

Recommendations for purchasing SQL Server licenses are covered in the next chapter – *Statistical information system data layer configuration*.

Technical specification of the data warehouse is elaborated through the rest of the document.

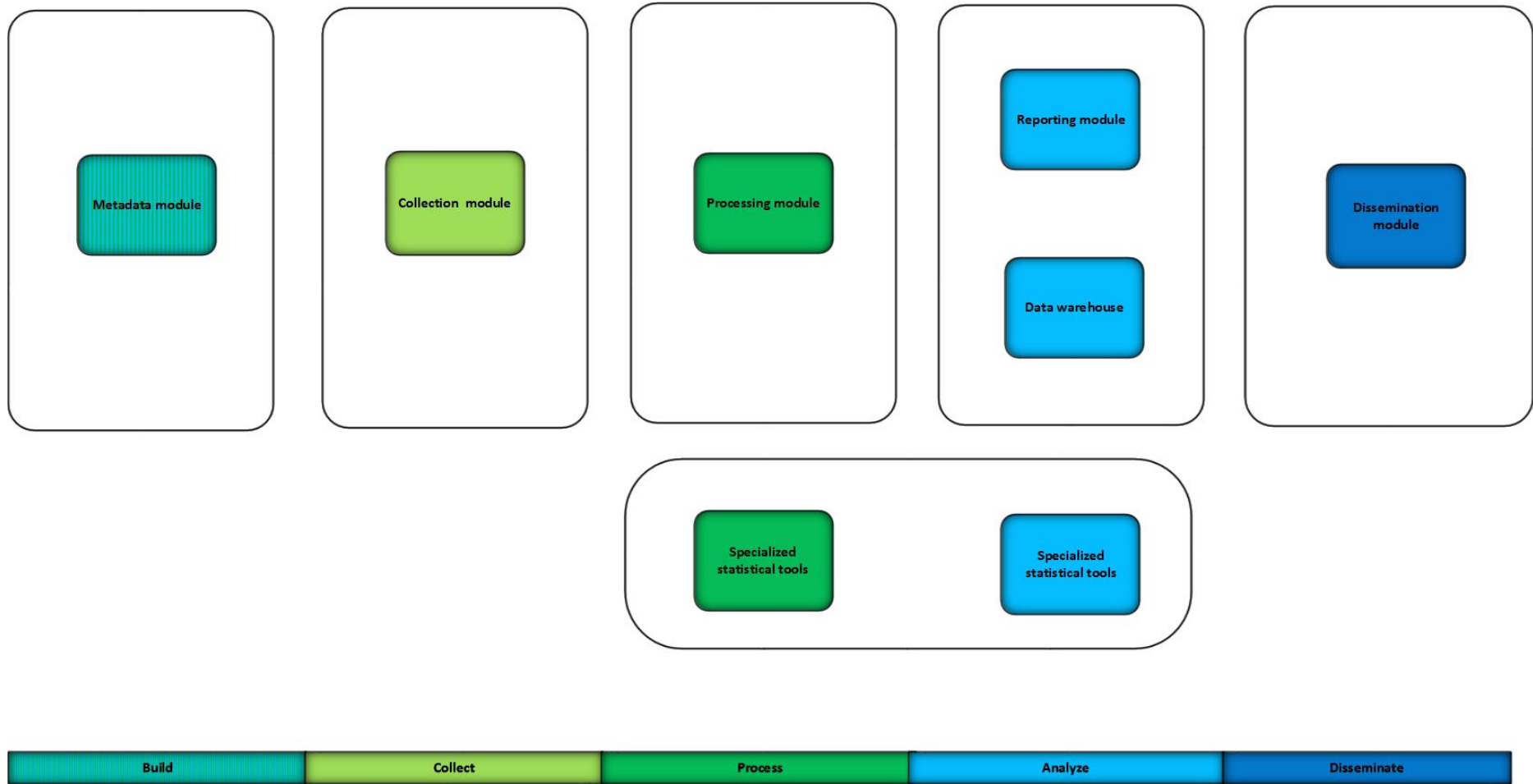


Figure 1: Statistical information system architecture

SYSTEM PREREQUISITES

Certain prerequisites must be satisfied to ensure proper functioning of the future system.

These are:

- domain controller
 - two domain controllers that hold user accounts in the Active Directory
- network
 - Active network hardware, capable of routing or switching as well as executing some code within active packets
 - Active network hardware used for network separation, DMZ and network control
 - Ethernet with at least 100 Mbit/s, but 1 Gbit/s is recommended
 - DHCP I DNS network services are not mandatory, but are recommended
- VPN server
 - Windows Server 2008-2016 Standard Edition
 - Microsoft RRAS
- remote APP server optionally
- WEB server
 - Windows Server 2008-2016 Standard Edition
 - IIS

Besides system prerequisites, client computers have requirements also. Client computer requirements are the following:

- at least 4GB RAM, but 8 GB is recommended
- Windows 7/8.1/10 64-bit
- CPU – 1 CPU, 2 cores or more
- CPU architecture – x64
- HDD – at least 250GB of free space.



1. MINIMAL SERVER HARDWARE/SOFTWARE PREREQUISITES

Minimal server requirements are as follows:

1. 2 virtual instances with Windows server standard OS (2008 and up)
 - a. HDD – 2TB of free space
 - b. CPU – 2 processors with 8 cores (min. 1.4 GHz).
 - c. RAM – 16GB
2. 2 SQL Server instances (SQL Server 2008 R2 Standard and up)
 - a. One instance to hold main databases
 - b. One for large data storage

SQL instances do not need to be clustered in any way. However, this can be implemented at a later time in order to enhance the system robustness.

Although the functionalities of both Windows Server 2008 and SQL Server 2008 R2 would be enough to accommodate the system, they are both soon reaching end-of-support deadline. Thus we highly recommend later versions, starting with at least 2012 versions.



2. RECOMMENDED SERVER HARDWARE/SOFTWARE PREREQUISITES

1. One physical server instance for each big database + main instance.
 - a. HDD – 3TB of free space– but highly dependent on the data requirements of the institution
 - b. CPU – 2 processors with 8 core x64 (2.0GHz or faster)
 - c. RAM – 24 GB and more, depending on the database size and complexity of data processing – should follow Microsoft practices
 - d. Windows server 2016
2. One SQL instance for each big database + main instance
 - a. SQL Server Standard 2016

2.1 SERVER CONFIGURATION 1. – SIMPLE

| | |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Virtualization | no |
| Cluster | no |
| Server type -example | HPE ProLiant DL380 Gen9 Server (rack) |
| Number | It is recommended that separate servers are purchased for large data bases with demanding queries or that more SQL instances are created on a single server with adequate hardware characteristics. Databases that are not large (not exceed more than ~25GB) and do not have demanding queries can be on a single SQL instance. But, for example, SBR, earnings, external trade etc. should have their own space and other resources not to bother each other. |
| OS | Microsoft 2016 Standard 64bit |
| RAM | Depending on the number and size of databases on server and data processing complexity, RAM should be allocated. On a server that contains almost all not demanding database (in SORS - about 145), 64GB should be enough. Other servers with large amount of data and complex processing should have at least 24GB of RAM each. |
| CPU | 2CPU (each with min. 8 cores) 2.0 GHz or faster |
| CPU type | x64 |
| SQL installation | Depending on the number of necessary SQL server instances, CPU and users, the corresponding number and kind of licenses for SQL2016 64-bit Standard edition should be purchased. (Depending on when it comes to purchasing, it may happen that SQL 2017 is current). The standard version does not support Always-On and Column-Index. For these two functionalities if are needed, a Datacenter version is required, which is much more expensive. |
| HDD | |



| | |
|--|--------------------------------------------------------------------|
| | Depends on the amount of data. Should be estimated. 2TB is minimum |
|--|--------------------------------------------------------------------|

2.2 SERVER CONFIGURATION 2. – CLUSTER

Same as Server configuration 1. – Simple, but doubled.

2.3 SERVER CONFIGURATION 3. – VIRTUAL

Specification for building a Hyper-V cluster with 3-6 hosts on which to build virtual SQL servers.



3. MODULES

All modules are based on windows OS and MS SQL Server database.

| Modules by recommended order of implementation | Description of module |
|------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Basic module - single location | Data entry Data edit Batch logical control Advanced search Tabulating, reports 2 surveys by choice This module includes capacity building and ability to carry out an activity |
| Basic module - multiple location | Basic + VPN support for distant locations |
| CAPI | Basic + Synchronization component with free localDB |
| CATI | Basic + CATI component open source solutions (Linux, Asterisk, Zoiper) in order to support internet phoning |
| CAWI | CAWI component – generation full app for web *web portal, if not exists - NOT MODULE OF SOLUTION, additional costs |

Important notices:

| | |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| *Solution with free DB | All modules are capable to work with MS SQL Server Express edition, with is free, so there is no need to buy additional licenses. However, this solution has certain limitations regarding to the speed and back end system jobs. |
| Module independence | All modules are dependt only on basic module, additional modules are independent of each other, i.e. they can be implemented according to needs |

3.1 BASIC MODULE

Single location

| Min infrastructure | Recommended infrastructure |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Software and services</p> <ul style="list-style-type: none">• Active directory• Windows clients: Win 7, 8.1• Windows server: OS 2008 R2 Standard• Solution with free DB – MS SQL Server Express• Solution with no free DB - MS SQL Server 2008 R2• MS Office 2003 | <p>Software and services</p> <ul style="list-style-type: none">• Active directory, DHCP, DNS• Windows clients: Win 10• Windows server: OS 2016 Standard• MS SQL 2016 Standard• MS Office 2016 |
| <p>Hardware</p> <ul style="list-style-type: none">• Local network (LAN) min 100 Mbit/s• SQL server and file server. They can be on the same machine | <p>Hardware</p> <ul style="list-style-type: none">• Local network (LAN) 1Gbit/s• SQL server and file server. Different machines. |

Multiple location

| min infrastructure | recommended infrastructure |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Software</p> <ul style="list-style-type: none">• min requirements for basic module single location | <p>Software</p> <ul style="list-style-type: none">• recommended requirements for basic module single location |
| <p>Hardware</p> <ul style="list-style-type: none">• min requirements for basic module, single location• WAN connection, min 4 Mbit/s• DMZ: Public VPN server built for users comes clean from Internet and is not connected to the central server by another link (leased lines, L3VPN, etc.)• Active networking equipment <p>NOTE: In the event that there are only remote locations connected through the services of a telecommunications provider, a solution can be implemented without DMZ</p> | <p>Hardware</p> <ul style="list-style-type: none">• recommended requirements for basic module, single location• WAN connection, min 10 Mbit/s• DMZ: Public VPN server that is built up for customers comes clean from Internet and is not connected to another central link (leased lines, L3VPN etc.)• Active networking equipment |

Important notice:

MS SQL Server Express Edition limitations:

- Constrained to a single CPU (in 2012, this limitation has been changed to "The lesser of one socket or four cores", so multi-threading is possible)



- 1GB RAM (Same in 2008/2012)
- 4GB database size (raised to 10GB in SQL 2008 R2 and SQL 2012) per database
- no Smart Backups, Encrypted Backups (jobs cannot be made - <http://www.fmsinc.com/microsoftaccess/SQLServerUpsizing/express/index.html>)

There are no limits to the number of databases that can be attached to the server. However, as mentioned in the comments and above, the database size limit was raised to 10GB in 2008 R2 and 2012. Also, this 10GB limit only applies to relational data, and Filestream data does not count towards this limit (<http://msdn.microsoft.com/en-us/library/bb895334.aspx>).

End-of-support

Functionalities of both Windows Server 2008 R2 and SQL Server 2008 R2 would be enough to accommodate the system, they are both soon reaching end-of-support deadline. Thus we highly recommend later versions, starting with 2012 versions.

SQL cluster

SQL instances do not need to be clustered in any way. However, this can be implemented at a later time in order to enhance the system robustness.

Number of SQL servers

It is recommended that you have separate SQL server for each big database (as Census, statistical business register, etc.) + main instance for rest of databases that do not consume a lot of resources.

Storage capacity

Storage capacity depends on customer data and should be estimated.

Hardware specification:

On the end of these document



3.2 CAPI

| min infrastructure | recommended infrastructure |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| basic module | basic module |
| Software <ul style="list-style-type: none"> • min requirements for basic module - multiple location | Software <ul style="list-style-type: none"> • recommended requirements for basic module - multiple location |
| Hardware <ul style="list-style-type: none"> • min requirements for basic module - multiple location • Internet connection of the central location for access of the interviewers from the terrain for receiving and sending data min 4Mbit / s • Each interviewer must be able to access the Internet for receiving and sending data. No access to the Internet is required for field entry • DMZ zone • Public VPN server to which respondents will access. • Within the DMZ zone can be the SQL Server to which the data is transferred or the WEB service through which access to the SQL server in the LAN • Servers in the configuration (do not have to be separate machines): VPN, SQL, file server. • On the client side of the application to support the work of the interviewer (receiving and sending the material and launching the input program) • An application support solution on the central site page • An appropriate number of Laptop computers | Hardware <ul style="list-style-type: none"> • recommended requirements for basic module - multiple location • • 2 Internet connections. One for production and user access, and the other for surfing. The reason is avoiding production jamming. The production connection should be min 10 Mbit / s • Each interviewer must be able to access the Internet for receiving and sending • DMZ zone • Public VPN server to which respondents will access. • Within the DMZ zone can be the SQL Server to which the data is transferred or the WEB service through which access to the SQL server in the LAN • Servers in Configuration (VPN Separate Machine): VPN, SQL, File Server. • On the client side of the application to support the work of the interviewer (receiving and sending the material and launching the input program) • An application support solution on the central site page • Application for Installing an Initial Environment on Clients (Framework, Local DB, etc.) • An appropriate number of Laptop computers |



Suggestion for laptop specifications:

- RAM: minimum 2GB (recommended 4GB)
- Platform: Windows 7, 8.1, 10 or later
- Disk space: minimum 120GB (amount of space needed by the OS plus 20GB)
- Network: Ethernet adapter (optionally Wi-Fi)
- .NET framework (proper version requested by IST) installed
- MS SQL Local DB or Express edition

Important notice: 11.6 'laptops, in this moment, on market, are offered with 32GB eMMC HDDs and only 14' (which are a bit big for the filed) goes with a ~ 500GB hard drive.



3.3 CATI

| min infrastructure | recommended infrastructure |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| basic module | basic module |
| <p>Software</p> <ul style="list-style-type: none"> min requirements for basic module | <p>Software</p> <ul style="list-style-type: none"> desired requirements for basic module *software to support internet phoning **script for recording and compressing conversations <p>Important notices: * It can be open source software (Asterisk and Free VoIP SIP softphone dialer with voice, video and instant messaging) in order to support internet phoning Asterisk PBX on Linux server Zoiper softphone</p> <p>** open source script</p> |
| <p>Hardware</p> <ul style="list-style-type: none"> min requirements for basic module Outgoing telephone lines - the appropriate number of direct telephone lines for interviewers (SORS has 30). With this configuration, there is no possibility to call the phone through an application and record a conversation | <p>Hardware</p> <ul style="list-style-type: none"> recommended requirements for basic module outgoing telephone lines Headphones with a microphone For software dialing: <ul style="list-style-type: none"> SIP trunks with adequate number of lines SIP trunk, VoIP A server where the conversations are stored |
| <p>Additional Adapted and equipped room / office for telephone data collection</p> | <p>Additional Adapted and equipped room / office for telephone data collection</p> |

3.4 CAWI

| min infrastructure | recommended infrastructure |
|-----------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Min basic module | Recommended basic module |
| <p>Software</p> <ul style="list-style-type: none"> min requirements for basic module web server web services | <p>Software</p> <ul style="list-style-type: none"> recommended requirements for basic module web server web services existing web portal |
| <p>Hardware</p> <ul style="list-style-type: none"> min requirements for basic module DMZ zone | <p>Hardware</p> <ul style="list-style-type: none"> recommended requirements for basic module DMZ zone |



| | |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none">• DMZ: public VPN server to which the interviewers will access• DMZ: public WEB server• Internet connection of central location for user access to the WEB server min 4Mbit / s <p>NOTE: In case the WEB application is not enabled directly with the SQL database, the solution is made with the web services</p> | <ul style="list-style-type: none">• DMZ: public VPN server to which the interviewers will access• Within the DMZ zone, they can have a SQL Server to which data is transferred or a WEB service through which the SQL server will be fed into the LAN• DMZ: public WEB server• 2 Internet/WAN connections - one for production and accessing of the users and the other for surfing. It depends on policy of statistical office. Generally, if all goes through the same link, office should have a very good traffic filter so that they do not interfere with the streaming.<ul style="list-style-type: none">○ A symmetric link variant (the same upload and download) It can start from 10Mbit \ s○ Internet connection of central location for user access to the WEB server min 10 Mbit / s <p>NOTE: In case the WEB application is not enabled directly with the SQL database, the solution is made with the web services</p> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|



4. DETAILED TECHNICAL SPECIFICATION LAN

- Local computer network at a minimum speed of 100mbit / s, preferably 1Gbit / s.
- When designing a LAN, account must be taken of the number, physical layout of users and their needs.
- Equipment:
 - Active network equipment: Central switch (preferably L3 for more than ~ 60), floor-to-floor switches
 - Passive network equipment: Cables, etc.
- Network Services:
 - Active Directory on two domain controllers that hold user accounts
 - About DHCP and DNS

4.1 WAN

- Connection to the Internet and participating users - regional offices. It can also be implemented in a variety of ways and in that sense it is necessary, apart from the number, physical layout of the users and their needs, to be aligned with the capabilities of the telecommunication environment. The minimum speed is 4Mbit / s, preferably 10 Mbit / s.
- Equipment:
 - Active network equipment: the device for connecting to the telecommunications network is defined depending on the type of service provided by the service provider, most often requires additional switch and sometimes a router
 - Physical or Software Firewall. In the case of a software firewall, it is necessary to provide the appropriate server machine and software.

4.2 DMZ

- Networked segments of networks where public IP addresses are accessed by external users through a WAN network (VPN, WEB, Mail)
- Equipment:
 - Active network equipment that allows segmenting of the computer network (router, firewall). They can be software and hardware. Server software and software are required for software implementation.

4.3 PROTECTION

- Antivirus software on clients and servers
- ACL on active network equipment
- Authorization at the level of the domain order

4.4 TELEPHONE SWITCHBOARD

For CATI, it is desirable to provide a PBX with the ability to connect to the SIP TRUNK service of a telecommunications provider. In the event that the physical controller does not have this capability, a software solution with the Asterisk server on the Linux platform can be made. It's the only non-Windows server.



Softphone Zoiper is used for communication.

Open source software (Asterisk and Free VoIP SIP softphone dialer with voice, video and instant messaging) in order to support internet phoning. Establish SIP trunk service.

Adequate SIP trunks to cover the need for CATI center in this moment. It is vital to project a system in a way that it will be easy for SORS to expand the capacity of lines.

4.5 BACKUP

Regular backup:

- SQL database
- a server file
- Domain controller
- Setting up on active network equipment



5. ANNEX 1: ABBREVIATIONS AND ACRONYMS

List of abbreviations and acronyms, included in the report.

GSBPM - Generic Statistical Business Process Model: A flexible tool to describe and define the set of business processes needed to produce official statistics.

INSTAT - Institute of Statistics of Albania

- type 1 – overwrites the old value with the new one
- type 2 – inserts a new record (with new value) into dimension table
- type 3 – adds a column to dimension table that is used to keep the new value

OLAP – Online Analytical Processing. Technologies that use multidimensional data structures to enable efficient data analysis.



6. ANNEX 2: REFERENCES

SQL Server Database Engine:

[https://msdn.microsoft.com/en-us/library/ms187875\(v=sql.120\).aspx](https://msdn.microsoft.com/en-us/library/ms187875(v=sql.120).aspx)

SQL Server Integration Services:

[https://msdn.microsoft.com/en-us/library/ms141026\(v=sql.120\).aspx](https://msdn.microsoft.com/en-us/library/ms141026(v=sql.120).aspx)

Features supported by editions of SQL Server 2016:

[https://msdn.microsoft.com/en-us/library/cc645993\(v=sql.120\).aspx](https://msdn.microsoft.com/en-us/library/cc645993(v=sql.120).aspx)