7. INVESTMENT AND RESOURCE PLANNING

7.1 INTRODUCTION

The investment and resource planning quantifies (in Euro) the cost of *financial*, *human* and *physical* resources needed to implement the best technical options and solutions for the VIS, as determined in *Chapter 5 – Candidate Architectures*. In principle, it compares the Total Cost of Ownership (TCO) for each of the best technical solutions.

First, separate plans are provided for the two architectures of the so-called **option 1** (a separate VIS based on the structure of the SIS). The *centralised* architecture (solution 1) is reported in section 7.2.1. and the *hybrid* architecture (solution 2) in section 7.2.2.

For each solution of the first option, the planning includes a total bill of expenditure (for investments and operational costs) and its associated cost breakdown (detailed view of the costs). Then the total bill of expenditure is further developed to provide multi-annual bills of expenditure according to the **two** following **implementation scenarios, dates are indicative under the precondition that political, financial and legal aspects allow the launch of the call for tender procedure in 2003**:

1. **A full implementation scenario** where alphanumeric data, photographs and biometrics are implemented in a single step. The supporting documents are introduced at a later stage.

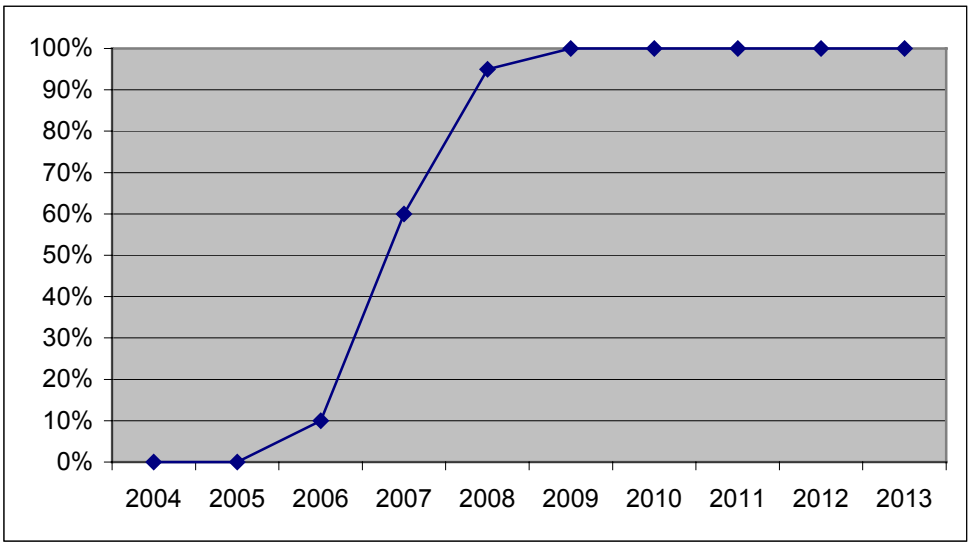
Step 1 (available in 2006)	Step 2 (available in 2009)
Alphanumeric Photographs Biometrics	Supporting Documents

2. **A gradual (step-wise) implementation scenario** with several implementation steps starting with alphanumeric data, adding photographs at a later stage, then incorporating biometrics. The supporting documents are introduced as the last step.

Step 1 (2006)	Step 2 (2007)	Step 3 (2008)	Step 4 (2009)
Alphanumerics	Photographs	Biometrics	Supporting Documents

The implementation scenarios equally apply to the central system (C-VIS) and the national systems (N-VISes). Independently of the implementation scenarios, consulates gradually connect to the VIS by geographic region (one geographic region after the other). We have assumed the following profile for the connection of consulates:

Figure 7-1: Profile for consulates to connect to the VIS.



Business impact of the gradual implementation

The gradual implementation has three significant drawbacks that should be carefully assessed:

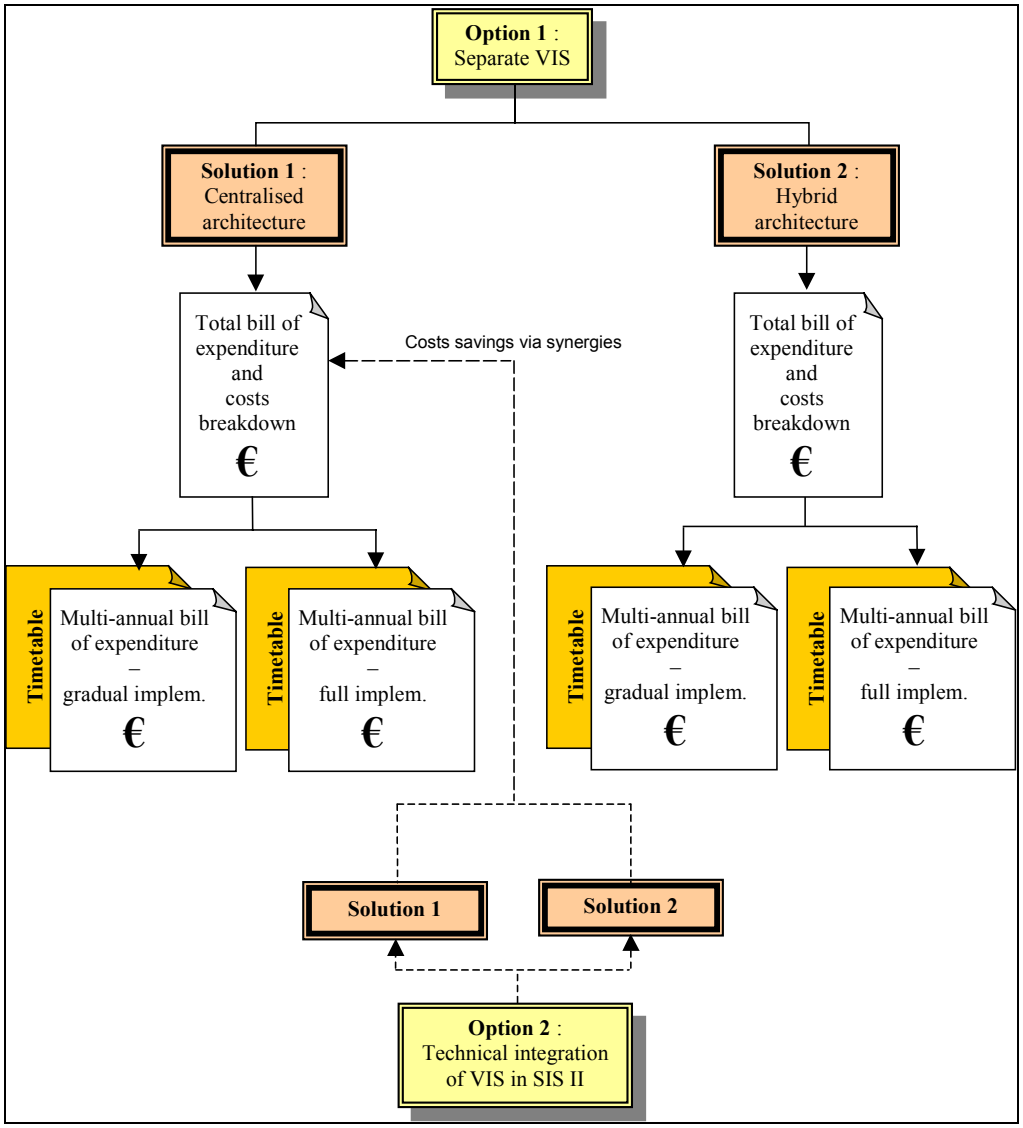
1. It will increase costs, mainly at Member States level. In particular, managing the complexities associated with the gradual implementation scenario will increase the project management costs;

2. The initial implementation steps, which facilitate the sharing among the Member States of alphanumeric data and photographs, are not sufficient to provide highly accurate verification and identification services since biometrics will not be supported;

3. A system that exposes only a reduced set of features could disappoint users and therefore reduce the acceptance rate of the system.

According to the amount of solutions and implementation scenarios, option 1 will be reported along the structure shown in Figure 7-2. This will allow the comparing of the four multi-annual bills of expenditure as well as the two total bills of expenditure.

Figure 7-2: Financial reporting structure.



As regards the so-called **option 2** (the technical integration of the VIS in SIS II), the planning determines the *savings* on financial, human and physical resources as a result of the synergies identified in chapter 5.

7.1.1 Cost breakdown structure

Only the major categories of cost centres, considered along their *investments* and *operational* dimensions, are reported in this chapter. Financial, human and physical resources are further detailed into the following elements, which we briefly explain:

FINANCIAL RESOURCES is comprised of the following main categories:

1. ***Hardware*** costs: This concerns storage, processing, back-up and archiving, security, testing.

   Basis for pricing: For deriving the hardware costs, the study has relied on a comprehensive system-sizing model that translated the business (chapter 2) and technical requirements (chapter 4) to feasible system configurations for the two candidate architectures. Public

price lists from well-established vendors with a 30% discount relative to volumes have been applied to the configurations. The detailed configurations and associated prices are reported in Chapter 9.

2. ***Software*** (licences) costs: This concerns vendors' software necessary to operate the hardware and provide the VIS with an appropriate software development framework. Such costs also include an annual maintenance fee for software updates and upgrades.

   Basis for pricing: Public price lists from well-established vendors with a 30% discount relative to volumes have been applied. The detailed software prices are reported in Chapter 9.

3. ***Application development*** costs: This concerns the whole human effort necessary to develop and test the VIS application (including C-VIS, N-VIS and consulates components) and the VIS interface to be exposed to external systems. Such costs also include an annual maintenance fee for software updates and upgrades.

   Basis for pricing: Common market rates for software development have been applied.

4. ***Telecommunication*** costs: This concerns the set-up and operation of the networks that will interconnect the various VIS-participating locations (C-VIS, N-VISes and consulates). This includes the costs pertaining to the networks' security.

   Basis for pricing: The same system-sizing model has been applied to the networks for deriving the required bandwidths. For interconnecting the C-VIS and the N-VISes, the current SISNET prices have been applied. For interconnecting the consulates and the N-VISes, the same SISNET prices were doubled in order to take into account the expensive nature of very long-distance connections.

HUMAN RESOURCES:

Basis for pricing: The yearly costs of internal resources have been computed according to the standard tables provided by the European Commission for the category of auxiliary staff (grades A, B, C). The yearly costs for internal resources of the Member States have been computed according to the baseline earnings of national experts applied by the European Commission[23].

Table 7-1: Cost of internal resources.

Type of human resources	Cost (€) per year
Auxiliary personnel A	95,576
Auxiliary personnel B	56,760
Auxiliary personnel C	38,592
National Experts	43,000

External resources for system engineering have been computed according to Table 7-2.

[23] The cost of internal resources at national level varies from one country to another and can not be accurately determined. A baseline salary of 43,000€/year for rating the internal resources at national level has been assumed.

Table 7-2: Costs of external resources[24].

Type of human resources	Cost (€) per day
Project Manager	750
Senior Analyst	690
Senior Analyst-Programmer	624
Analyst programmer	564
Programmer	492
Technical support (system maintenance)	432
Administrative support (training and help desk)	432

The following main categories have been assessed:

1. ***System maintenance*** costs: It covers the internal human resources in charge of the VIS (C-VIS and N-VISes) maintenance, monitoring and daily operation;

2. ***Administrative support*** costs: It covers the training that should be provided to Member States staff in charge of the technical, help desk and training support to end users. Administrative support involves at least six auxiliaries category B;

3. ***Co-ordination/supervision*** costs: It covers the internal human resources required to manage technical and administrative staff. It also covers the key task of managing users access rights. Co-ordination and supervision involves a single full-time equivalent for managing the various features of the VIS;

4. ***Project management*** costs: It accounts for the internal human capital costs vested in management activities within the relevant organisation during the project and system life-cycle: tendering, vendor and contractor management, co-ordination with Member States, support to Member States, testing. Technical, legal and financial matters will be covered. Project management resources are not constant over years but require extra staff for setting up and launching the system as shown in Table 7-3. The A and B classes refer to auxiliary personnel of Table 7-1;

Table 7-3: Project management human resources over years.

2004	2005	2006	2007	2008	2009	2010 →
3A + 3B	7A + 7B	8A + 8B	7A + 7B	5A + 5B	4A + 4B	3A + 3B

5. ***System engineering*** costs: It covers the external human resources involved in the system installation, integration and testing as to be provided by the contractor of the VIS project following the call for tender procedure.

PHYSICAL RESOURCES comprise mainly facility management costs to house the VIS system including physical security linked to the facilities.

Basis for pricing: An average rate of 1,000 €/m²/year has been considered.

Due to the small amount of physical resources compared to other expenses, they will not be further considered in this chapter for the sake of clarity.

[24] Figures reflect current market prices (year 2003) but might be subject to re-evaluation.

For each feasible architecture (centralised and hybrid) the cost breakdown is made of a set of six tables that show a detailed view of the costs related to the various items defined above (see Table 7-6 pp 113 as an example). We have the following tables:

- For the C-VIS and N-VISes:
  1. The C-VIS;
  2. The N-VISes;
  3. The telecommunication costs between the C-VIS and the N-VISes;
  4. The human resources at C-VIS and N-VIS levels.
- For the local configurations:
  5. The consulates;
  6. The telecommunication costs for connecting the consulates to the N-VISes.

For the sake of clarity the cost breakdown does NOT include the costs incurred by the business continuity systems. Figures apply to the production systems only. The business continuity systems rely on a complete duplication of the production systems but deployed in remote locations. Accordingly, the investments incurred by the business continuity systems are almost the same as the costs incurred by the production systems. **Nevertheless, they are reported in the total bill of expenditure**.

The tables will also offer a view of the costs incurred by each and every **type of data** participating in the VIS (i.e. alphanumeric data, photographs, biometrics and supplementary documents). In order to be able to isolate such costs we have considered the following path for progressively integrating them in the VIS:

1. First, the set up of the necessary system components (computers, storage and software) and network bandwidth for the alphanumeric data only;
2. Then the addition of the necessary system components and bandwidth increase for accommodating photographs;
3. Then the addition of the necessary system components and bandwidth increase for accommodating biometrics;
4. Finally, the addition of the necessary system components and bandwidth increase for accommodating supplementary documents.

The tables reported in this chapter show the costs pertaining to each and every of these four implementation steps. This means that:

- The costs for a VIS system that includes alphanumeric data and photographs only are obtained by adding the costs reported in the alphanumeric and photographs columns;
- The costs for having alphanumeric data and biometrics only is NOT the sum of the corresponding two columns. Such a scenario has not been foreseen.

7.1.2 Total bill of expenditure

The various tables that overview the cost breakdown of a given architecture are summarised along four synthetic tables that show the total bill of expenditure:

- For the C-VIS and N-VISes:
  1. Investments;
  2. Yearly operational costs.
- For the local configurations:
  3. Investments;
  4. Yearly operational costs.

The different data types are still considered here as illustrated in Table 7-14.

7.1.3 Multi-annual bill of expenditure

A multi-annual bill of expenditure for the costs incurred by the C-VIS and N-VISes is presented for each architecture. A single table splits the *investments* and *yearly operational costs* exposed in the total bill of expenditure over the years 2004-2015. Here again the various data types are considered. Nevertheless, only fingerprints have been selected as a biometric identifier.

7.2 INVESTMENT AND RESOURCE PLANNING FOR OPTION 1: SEPARATE SOLUTION FOR VIS

The bills of expenditure for option 1, as illustrated in Figure 7-2, are reported hereunder together with the applicable implementation timetables. Prior to introducing them, the following **reporting principles** should be highlighted, which equally apply to both solutions:

- The costs have been identified and reported with regards to their locations, i.e.:
  - the central system (C-VIS);
  - the national systems (N-VIS);
  - the visa issuing offices (consulates);
  - the communication infrastructure interconnecting the C-VIS and the N-VISes;
  - the communication infrastructure interconnecting the visa issuing offices and the N-VISes.
- Chapter 4 has introduced an N-VIS segmentation that takes account of the large range of visa requests handled by the various Member States. Table 7-4 highlights the three N-VIS standard configurations that have been retained for reporting costs in this chapter;

Table 7-4: Segmentation of N-VISes.

	Category I (small)	Category II (medium)	Category III (large)
# yearly visa requests	100,000	500,000	2,500,000

- Chapter 4 has also emphasised a similar principle for consulates. Table 7-5 underlines the three consulate standard configurations that have been retained for reporting costs in this chapter;

Table 7-5: Segmentation of consulates.

	Category I (small)	Category II (medium)	Category III (large)
# yearly visa requests	500	5,000	50,000

- The costs have been identified and reported for each VIS type of content: alphanumeric data, photographs, biometrics and supplementary documents. Three biometrics are further considered: fingerprints, face and iris.

The system configurations that have been used to price the various categories of N-VISes and consulates are reported in Chapter 9.

The following general **assumptions** have driven the system sizing for which figures are introduced hereafter:

- Volume of visa requests: 20,000,000 per year;
- Data retention: 5 years (70,000,000 persons enrolled);
- Permanent network connections, even for consulates;
- Response time: T_1 (see Chapter 4);
- Average number of supplementary documents per visa request: 6 A4 pages;
- Fingerprints:
  - 10 fingerprints stored in the database;
  - 4 fingerprints used for identification;
  - 2 fingerprints used for verification.
- Iris:
  - 2 irises stored in the database;
  - 2 irises used for identification;
  - 1 iris used for verification.
- Filtering (i.e. sex and age) applied for identification: 10%;
- Identification supported with returned photographs for the ten best candidates;
- Verification supported with returned photograph.

7.2.1 Solution 1: Centralised architecture

This section is divided in four sub-sections:

1. The first sub-section introduces the **cost breakdown**;
2. The second sub-section introduces the **total bill of expenditure**;
3. The third sub-section introduces the multi-annual bill of expenditure for the **full implementation scenario**;

4. The last sub-section introduces the multi-annual bill of expenditure for the **gradual implementation scenario**.

7.2.1.1 Cost breakdown

7.2.1.1.1 C-VIS and N-VIS

Table 7-6: C-VIS.

Cost breakdown in k€	C-VIS					
	Alpha	Photo	Biometric identifier			Documents
			Fingers	*Face*	*Iris*	
Hardware:						
Investment	1 215	146	71 375	370	381	357
Maintenance (annual)	239	30	10 740	40	43	72
Software licenses:						
Investment	2 008	136	271	24 771	49 340	0
Maintenance (annual)	444	28	55	3 730	9 868	0
Application development:						
Investment	761	127	254	254	254	127
Maintenance (annual)	152	25	51	51	51	25
System maintenance (annual)	269	45	90	90	90	45

Table 7-7: N-VIS.

Cost breakdown in k€	N-VIS		
	Cat. I	Cat. II	Cat. III
Hardware:			
Investment	9	9	34
Maintenance (annual)	2	2	7
Software licenses:			
Investment	5	7	49
Maintenance (annual)	1	2	10
System maintenance (annual)	43	43	43

In the centralised architecture the N-VIS is mainly a networking system and the types of data have no impact on it.

Table 7-8: Telecommunication.

Cost breakdown in k€	Telecommunication C-VIS to N-VIS					
	Alpha	Photo	Biometric identifier			Documents
			Fingers	*Face*	*Iris*	
Network C-VIS to N-VIS cat. I (9 sites):						
Investment	21	77	18	18	18	4
Operation (annual)	208	585	117	117	117	21
Network C-VIS to N-VIS cat. II (9 sites):						
Investment	28	117	43	43	43	19
Operation (annual)	224	813	263	263	263	107
Network C-VIS to N-VIS cat. III (9 sites):						
Investment	61	480	158	158	158	108
Operation (annual)	301	2 916	911	911	911	600

Table 7-9: Human resources.

Cost breakdown in k€	Human resources C-VIS and N-VIS					
	Alpha	Photo	Biometric identifier			Documents
			Fingers	*Face*	*Iris*	
Co-ordination and supervision (annual)	57	10	19	19	19	10
Administrative support (annual)	259	43	86	86	86	43
Project management (annual)	529	76	76	76	76	76
System engineering (external)	1 007	144	144	144	144	144

Table 7-9 covers the costs for internal personnel as described in the Human Resources paragraph of section 7.1.1. It incorporates the costs of project management pertaining to an intermediate year, i.e. 2008 (see Table 7-3). System maintenance costs have been reported in Table 7-6 and Table 7-7.

7.2.1.1.2 Local configurations (consulates)

Table 7-10: Local configuration cat. I.

Cost breakdown in k€	Local configuration cat. I					
	Alpha	Photo	Biometric identifier			Documents
			Fingers	*Face*	*Iris*	
Hardware + software:						
Investment	3	1	7	11	10	3
Maintenance (annual)	2	0	2	2	2	1

Local configurations will not need additional budgets to upgrade to supplementary documents since a document scanner is already part of the upgrade for photographs.

Table 7-11: Local configuration cat. II.

Cost breakdown in k€	Local configuration cat. II					
	Alpha	Photo	Biometric identifier			Documents
			Fingers	*Face*	*Iris*	
Hardware + software:						
Investment	3	1	7	11	10	3
Maintenance (annual)	2	0	2	2	2	1

Table 7-12: Local configuration cat. III.

Cost breakdown in k€	Local configuration cat. III					
	Alpha	Photo	Biometric identifier			Documents
			Fingers	*Face*	*Iris*	
Hardware + software:						
Investment	11	7	14	21	19	19
Maintenance (annual)	3	0	3	4	3	4

Table 7-13: Telecommunication.

Cost breakdown in k€	Telecommunication consulates to N-VIS					
	Alpha	Photo	Biometric identifier			Documents
			Fingers	*Face*	*Iris*	
Network consulate cat. I to N-VIS:						
Investment	11	1	0	0	0	0
Operation (annual)	6	4	0	0	0	0
Network consulate cat. II to N-VIS:						
Investment	11	1	0	0	0	0
Operation (annual)	6	5	0	0	0	0
Network consulate cat. III to N-VIS:						
Investment	12	2	0	0	0	1
Operation (annual)	8	17	0	0	0	6

The bandwidth requirements for consulates are driven by the response time constraints, which, for categories I and II, are automatically satisfied for biometrics and documents once the network has been set up for photographs.

7.2.1.2 Total bill of expenditure

7.2.1.2.1 C-VIS and N-VIS

Table 7-14: Investments.

Total bill of expenditure in k€	Total investments C-VIS + N-VIS					
	Alpha	Photo	Biometric identifier			Documents
			Fingers	*Face*	*Iris*	
C-VIS (1 site)	3 984	409	71 900	25 395	49 975	484
N-VIS (9 cat. I + 9 cat. II + 9 cat. III)	1 017					
Network C-VIS to N-VIS (9 cat. I + 9 cat. II + 9 cat. III)	110	674	219	219	219	130
Business Continuity System (all sites and networks)	4 350	956	71 865	25 360	49 940	487
System engineering (external)	1 007	144	144	144	144	144
TOTAL	**10 467**	**2 182**	**144 127**	**51 117**	**100 277**	**1 245**

Table 7-15: Yearly operational costs.

Total bill of expenditure in k€	Total yearly operational costs C-VIS + N-VIS					
	Alpha	Photo	Biometric identifier			Documents
			Fingers	*Face*	*Iris*	
C-VIS (1 site)	1 104	128	10 935	3 910	10 051	142
N-VIS (9 cat. I + 9 cat. II + 9 cat. III)	1 377					
Network C-VIS to N-VIS (9 cat. I + 9 cat. II + 9 cat. III)	733	4 314	1 291	1 291	1 291	729
Business Continuity System (all sites and networks)	2 793	4 372	12 086	5 061	11 202	801
Human resources	844	128	181	181	181	128
TOTAL	**6 851**	**8 943**	**24 493**	**10 443**	**22 725**	**1 799**

7.2.1.2.2 Local configurations (consulates)

Table 7-16: Investments.

Total bill of expenditure in k€	Investments for local configurations					
	Alpha	Photo	Biometric identifier			Documents
			Fingers	*Face*	*Iris*	
Hardware + software cat. I	3	1	7	11	10	3
Hardware + software cat. II	3	1	7	11	10	3
Hardware + software cat. III	11	7	14	21	19	19
Network consulate cat. I to N-VIS:	11	1	0	0	0	0
Network consulate cat. II to N-VIS:	11	1	0	0	0	0
Network consulate cat. III to N-VIS:	12	2	0	0	0	1

Table 7-17: Yearly operational costs.

Total bill of expenditure in k€	Yearly operational costs for local configurations					
	Alpha	Photo	Biometric identifier			Documents
			Fingers	*Face*	*Iris*	
Hardware + software cat. I	2	0	2	2	2	1
Hardware + software cat. II	2	0	2	2	2	1
Hardware + software cat. III	3	0	3	4	3	4
Network consulate cat. I to N-VIS:	6	4	0	0	0	0
Network consulate cat. II to N-VIS:	6	5	0	0	0	0
Network consulate cat. III to N-VIS:	8	17	0	0	0	6

7.2.1.3 Scenario 1: Full implementation

Figure 7-3 details the timetable for implementing solution 1 with regards to the full implementation scenario:

1. The central system (C-VIS) is expected to rollout in **Q4 of 2005** following the software development, hardware sourcing and installation, as well as the integration test;

2. The national systems (N-VIS) are expected to rollout in **Q1 of 2006** (or even earlier) following hardware sourcing and installation as well as the integration tests;

3. Consular posts connect to the VIS by geographic region (starting with Region 1). The first geographic region could be in production in **Q2 2006** followed by the second geographic region in **Q2 2007**;

4. The supporting document infrastructure is planned for **Q1 2009**.

Note: Systems installation, testing and integration cycles are shorter in the centralised solution compared to the decentralised one. This reduces the total rollout time compared to a hybrid solution. The project management risk profile is the least prone to roll-out delays compared to any other implementation scenario.

Table 7-18 provides the multi-annual bill of expenditure for the full implementation scenario.

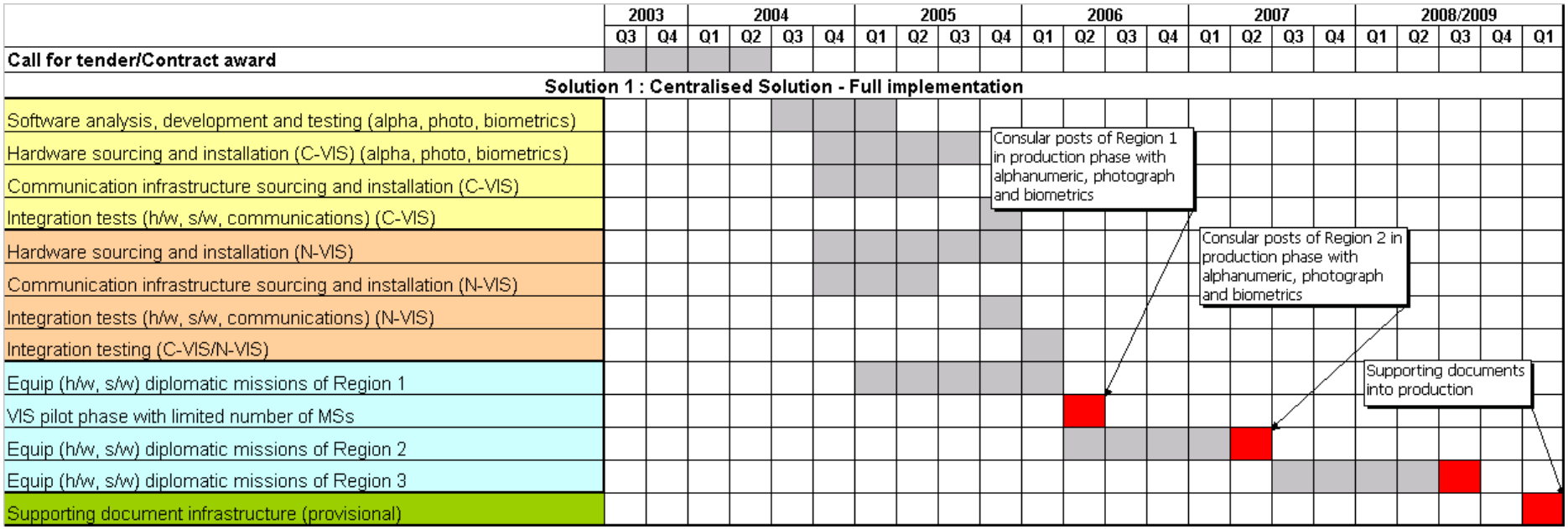
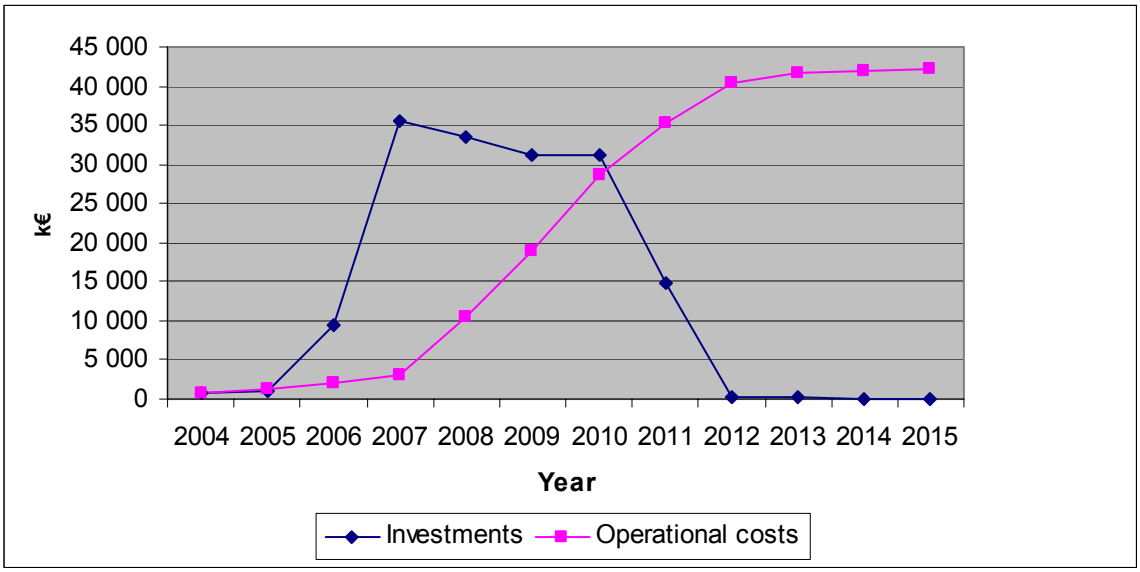


Figure 7-3: Timetable for the full implementation of the centralised architecture.

Table 7-18: Multi-annual bill of expenditure for the full implementation of the centralised architecture.

Multi-annual bill of expenditure in k€	C-VIS + N-VIS												
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	TOTAL
	ALPHANUMERIC (available in 2006)												
Investments	504	636	965	1 797	1 892	1 892	1 892	889	0	0	0	0	**10 467**
Operational costs	529	1 057	1 681	1 323	2 097	3 467	4 837	6 207	6 851	6 851	6 851	**6 851**	
	PHOTOGRAPHS (available in 2006)												
Investments	72	100	208	387	408	408	408	192	0	0	0	0	**2 182**
Operational costs	76	151	227	201	1 037	2 737	4 525	6 314	8 102	8 943	8 943	**8 943**	
	BIOMETRICS - FINGERPRINTS (available in 2006)												
Investments	72	213	8 377	33 338	31 000	28 797	28 797	13 534	0	0	0	0	**144 127**
Operational costs	76	151	251	1 525	7 120	12 393	17 292	22 191	24 493	24 493	24 493	**24 493**	
	SUPPLEMENTARY DOCUMENTS (available in 2009)												
Investments				72	87	112	209	220	220	220	104	0	**1 245**
Operational costs				76	151	252	284	551	911	1 270	1 630	**1 799**	
	ANNUAL TOTAL												
Investments	648	950	9 550	35 594	33 387	31 209	31 306	14 836	220	220	104	0	**158 022**
Operational costs	680	1 359	2 158	3 124	10 405	18 848	28 727	35 262	40 357	41 558	41 917	**42 087**	

Figure 7-4: Multi-annual bill of expenditure.



7.2.1.4 Scenario 2: Gradual system implementation

Figure 7-5 details the timetable for implementing solution 1 with regards to the gradual implementation scenario:

1. The central system (C-VIS) is expected to rollout in **Q2 of 2005 with alphanumeric data** following the software development, hardware sourcing and installation, as well as the integration tests. Photograph sub-systems are integrated a year later during **Q2 2006.** Finally, biometric sub-systems are introduced in **Q2 2007**;

2. The national systems (N-VIS) are expected to rollout in **Q2 of 2005** following hardware sourcing and installation as well as the integration tests with regards to alphanumeric

systems. National systems are upgraded to support photograph and biometric data during **Q2 2006** and **Q2 2007** respectively;

3. Consular posts connect to the VIS by geographic region (starting with Region 1 and Region 2). The first geographic region could be in production in **Q3 2005** followed by the second geographic region in **Q1 2007**;

4. The supporting document infrastructure is planned for **Q1 2009**.

Note: Consulates enter into production at an earlier stage, and as early as **Q3 2005**. This is 6-months earlier compared to the full implementation scenario. However, the management complexities in the gradual implementation could result in delays and increase the overall project management risk profile of the VIS.

Table 7-19 provides the multi-annual bill of expenditure for the gradual implementation scenario.

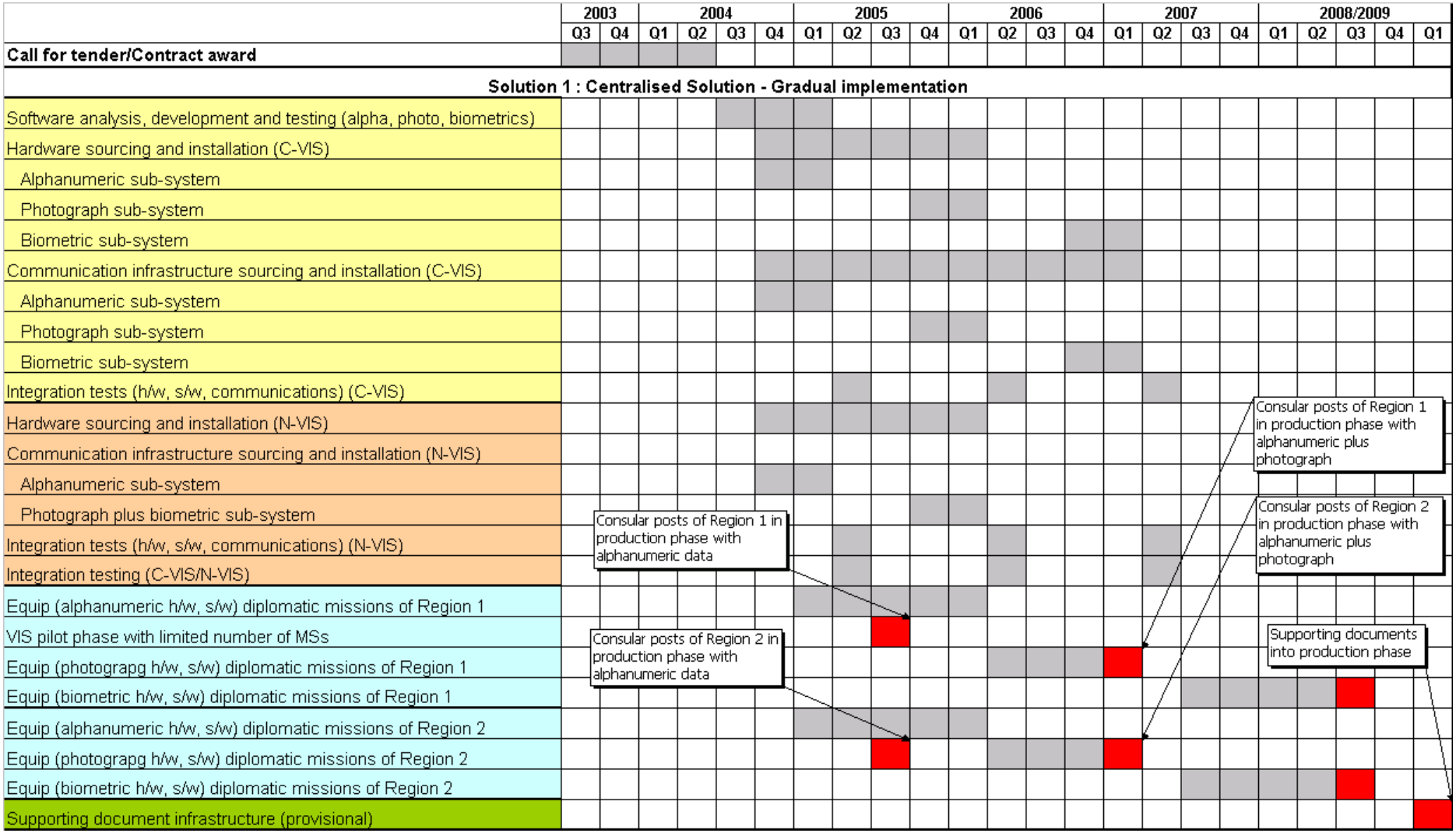
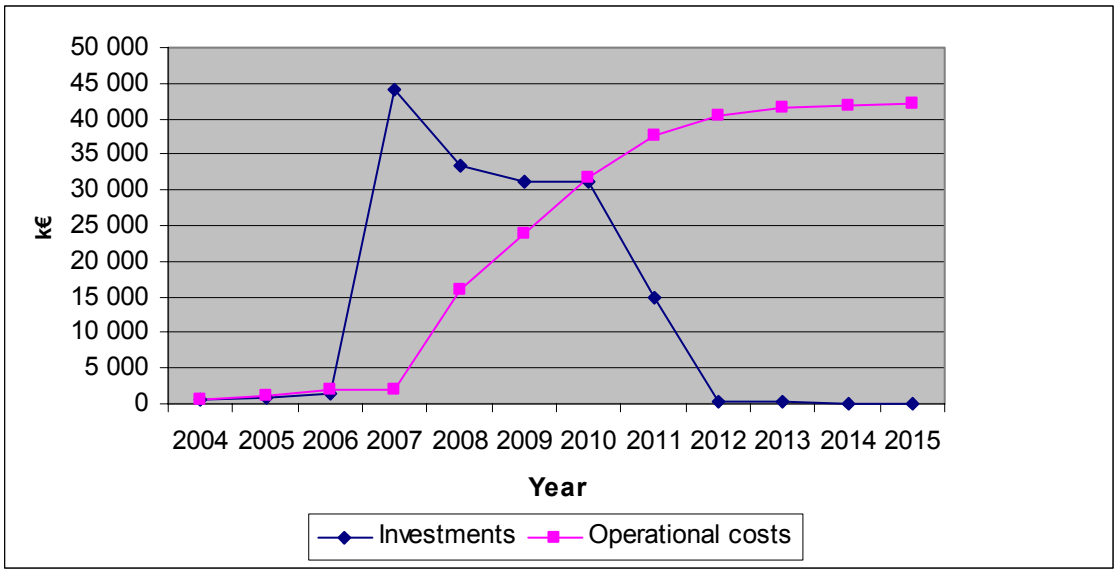


Figure 7-5: Timetable for the gradual implementation of the centralised architecture.

Table 7-19: Multi-annual bill of expenditure for the gradual implementation of the centralised architecture.

Multi-annual bill of expenditure in k€	C-VIS + N-VIS												
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	TOTAL
	ALPHANUMERIC (available in 2006)												
Investments	504	636	965	1 797	1 892	1 892	1 892	889	0	0	0	0	**10 467**
Operational costs	529	1 057	1 681	1 323	2 097	3 467	4 837	6 207	6 851	6 851	6 851	**6 851**	
	PHOTOGRAPHS (available in 2007)												
Investments		72	308	387	408	408	408	192	0	0	0	0	**2 182**
Operational costs		76	151	352	1 113	2 737	4 525	6 314	8 102	8 943	8 943	**8 943**	
	BIOMETRICS - FINGERPRINTS (available in 2008)												
Investments			72	41 928	31 000	28 797	28 797	13 534	0	0	0	0	**144 127**
Operational costs			76	151	12 620	17 368	22 191	24 493	24 493	24 493	24 493	**24 493**	
	SUPPLEMENTARY DOCUMENTS (available in 2009)												
Investments				72	87	112	209	220	220	220	104	0	**1 245**
Operational costs				76	151	252	284	551	911	1 270	1 630	**1 799**	
	ANNUAL TOTAL												
Investments	504	708	1 345	44 184	33 387	31 209	31 306	14 836	220	220	104	0	**158 022**
Operational costs	529	1 133	1 908	1 901	15 980	23 823	31 837	37 565	40 357	41 558	41 917	**42 087**	

Figure 7-6: Multi-annual bill of expenditure.



7.2.2 Solution 2: Hybrid architecture

This section is divided in four sub-sections:

1. The first sub-section introduces the **cost breakdown**;
2. The second sub-section introduces the **total bill of expenditure**;
3. The third sub-section introduces the multi-annual bill of expenditure for the **full implementation scenario**;

4. The last sub-section introduces the multi-annual bill of expenditure for the **gradual implementation scenario**.

7.2.2.1 Cost breakdown

7.2.2.1.1 C-VIS and N-VIS

Table 7-20: C-VIS.

Cost breakdown in k€	C-VIS					
	Alpha	Photo	Biometric identifier			Documents
			Fingers	*Face*	*Iris*	
Hardware:						
Investment	773	0	70 589	297	295	0
Maintenance (annual)	152	0	10 590	33	33	0
Software licenses:						
Investment	1 078	0	271	24 771	49 340	0
Maintenance (annual)	258	0	55	3 730	9 868	0
Application development:						
Investment	819	137	273	273	273	137
Maintenance (annual)	164	27	55	55	55	27
System maintenance (annual)	269	45	90	90	90	45

Table 7-21: N-VISes.

Cost breakdown in k€	N-VIS		
	Cat. I	*Cat. II*	*Cat. III*
Hardware:			
Investment	418	510	550
Maintenance (annual)	85	102	111
Software licenses:			
Investment	110	149	789
Maintenance (annual)	22	30	158
System maintenance (annual)	43	43	43

Table 7-22: Telecommunication.

Cost breakdown in k€	Telecommunication C-VIS to N-VIS					
	Alpha	Photo	Biometric identifier			Documents
			Fingers	*Face*	*Iris*	
Network C-VIS to N-VIS cat. I (9 sites):						
Investment	21	67	0	0	0	0
Operation (annual)	208	528	0	0	0	0
Network C-VIS to N-VIS cat. II (9 sites):						
Investment	28	67	22	22	22	21
Operation (annual)	224	528	156	156	156	138
Network C-VIS to N-VIS cat. III (9 sites):						
Investment	61	213	158	158	158	82
Operation (annual)	301	1 421	649	649	649	474

Table 7-23: Human resources.

Cost breakdown in k€	Human resources C-VIS and N-VIS					
	Alpha	Photo	Biometric identifier			Documents
			Fingers	*Face*	*Iris*	
Co-ordination and supervision (annual)	57	10	19	19	19	10
Administrative support (annual)	259	43	86	86	86	43
Project management (annual)	529	76	76	76	76	76
System engineering (external)	2 650	379	379	379	379	379

Table 7-23 covers the costs for internal personnel as described in the Human Resources paragraph of section 7.1.1. It incorporates the costs of project management pertaining to an intermediate year, i.e. 2008 (see Table 7-3). System maintenance costs have been reported in Table 7-20 and Table 7-21.

7.2.2.1.2 Local configurations (consulates)

As the local configurations do not depend on the architecture of the VIS, the costs are identical to the ones reported in section 7.2.1.2.2 for the centralised architecture.

7.2.2.2 Total bill of expenditure

7.2.2.2.1 C-VIS and N-VIS

Table 7-24: Investments.

Total bill of expenditure in k€	Total investments C-VIS + N-VIS					
	Alpha	Photo	Biometric identifier			Documents
			Fingers	*Face*	*Iris*	
C-VIS (1 site)	2 670	137	71 133	25 341	49 908	137
N-VIS (9 cat. I + 9 cat. II + 9 cat. III)	16 020	6 714	0	0	0	0
Network C-VIS to N-VIS (9 cat. I + 9 cat. II + 9 cat. III)	110	347	180	180	180	103
Business Continuity System (all sites and networks)	17 981	7 061	71 040	25 248	49 815	103
System engineering (external)	2 650	379	379	379	379	379
TOTAL	**39 430**	**14 637**	**142 731**	**51 147**	**100 281**	**721**

Table 7-25: Yearly operational costs.

Total bill of expenditure in k€	Total yearly operational costs C-VIS + N-VIS					
	Alpha	Photo	Biometric identifier			Documents
			Fingers	*Face*	*Iris*	
C-VIS (1 site)	843	72	10 789	3 907	10 045	72
N-VIS (9 cat. I + 9 cat. II + 9 cat. III)	4 374	1 359	0	0	0	0
Network C-VIS to N-VIS (9 cat. I + 9 cat. II + 9 cat. III)	733	2 478	805	805	805	612
Business Continuity System (all sites and networks)	5 517	3 837	11 450	4 568	10 706	612
Human resources	844	128	181	181	181	128
TOTAL	**12 311**	**7 874**	**23 226**	**9 462**	**21 738**	**1 425**

7.2.2.2.2 Local configurations (consulates)

As the local configurations do not depend on the architecture of the VIS, the costs are identical to the ones reported in section 7.2.1.2.2 for the centralised architecture.

7.2.2.3 Scenario 1: Full implementation

Figure 7-7 details the timetable for implementing solution 1 with regards to the full implementation scenario:

1. The central system (C-VIS) is expected to be in production in **Q4 of 2005,** following the software development, hardware sourcing and installation, as well as the integration tests;

2. The national systems (N-VIS) are expected to rollout in **Q2 and Q3 of 2006,** following hardware sourcing and installation as well as the integration tests;

3. Consular posts connect to the VIS by geographic region (starting with Region 1). The first geographic region could be in production in **Q4 2006**, followed by the second region in **Q4 2007**;

4. The supporting document infrastructure is planned for **Q1 2009**.

Note: Development, installation and integration cycles are longer and more complex than when compared to a centralised solution. Having to deal with a large number of complex national systems (N-VIS) has an impact on the time-plan and increases the project management risk profile.

Table 7-26 provides the multi-annual bill of expenditure for this implementation scenario.

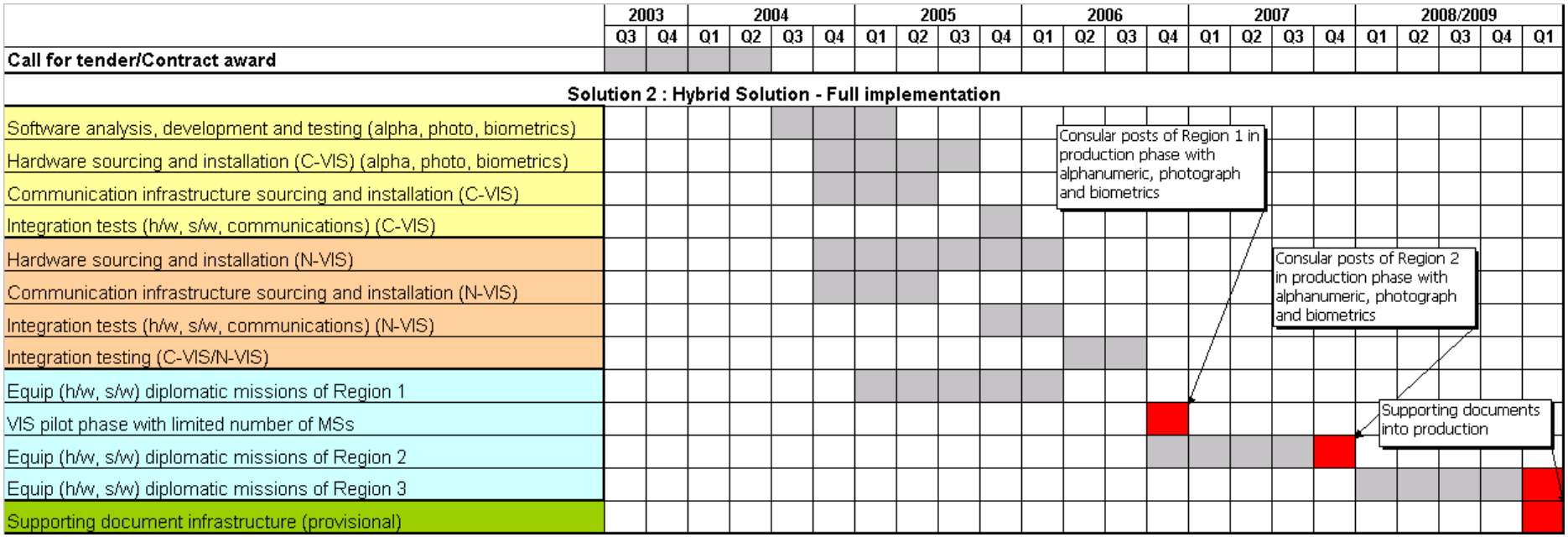
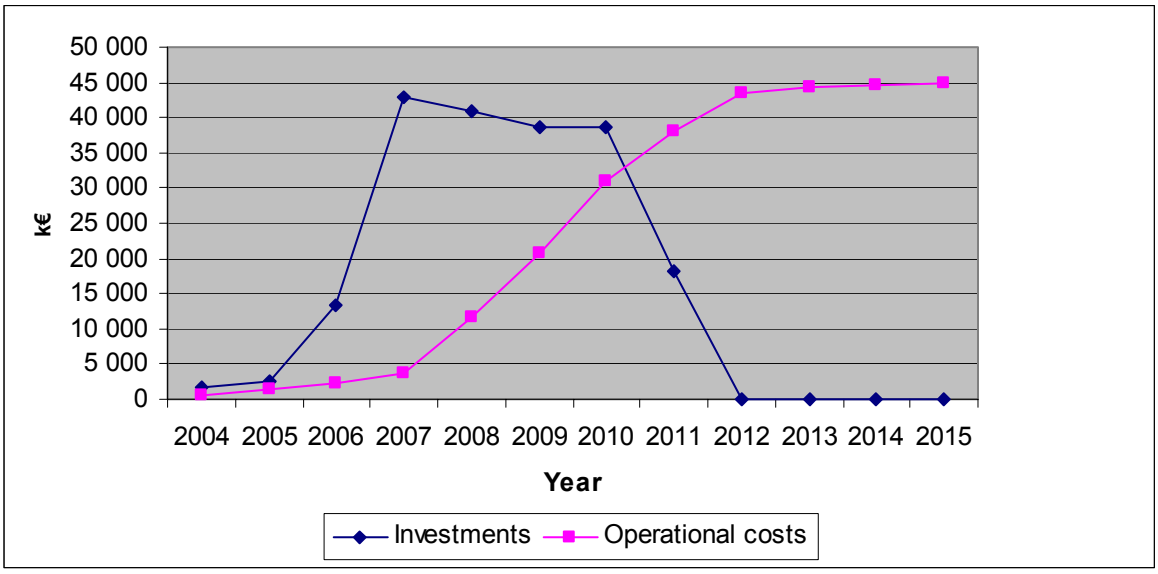


Figure 7-7: Timetable for the full implementation of the hybrid architecture.

Table 7-26: Multi-annual bill of expenditure for the full implementation of the hybrid architecture.

Multi-annual bill of expenditure in k€	C-VIS + N-VIS												
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	TOTAL
	ALPHANUMERIC (available in 2006)												
Investments	1 325	1 840	3 752	6 988	7 356	7 356	7 356	3 457	0	0	0	0	**39 430**
Operational costs	529	1 057	1 758	1 957	3 767	6 229	8 691	11 154	12 311	12 311	12 311	**12 311**	
	PHOTOGRAPHS (available in 2006)												
Investments	189	389	1 454	2 709	2 852	2 852	2 852	1 340	0	0	0	0	**14 637**
Operational costs	76	151	227	186	913	2 409	3 984	5 559	7 134	7 874	7 874	**7 874**	
	BIOMETRICS - FINGERPRINTS (available in 2006)												
Investments	189	329	8 282	32 960	30 649	28 471	28 471	13 381	0	0	0	0	**142 731**
Operational costs	76	151	249	1 450	6 752	11 752	16 397	21 042	23 226	23 226	23 226	**23 226**	
	SUPPLEMENTARY DOCUMENTS (available in 2009)												
Investments				189	194	35	65	68	68	68	32	0	**721**
Operational costs				76	151	246	241	436	721	1 006	1 291	**1 425**	
	ANNUAL TOTAL												
Investments	1 704	2 558	13 488	42 847	41 050	38 713	38 743	18 247	68	68	32	0	**197 519**
Operational costs	680	1 359	2 234	3 667	11 583	20 637	30 888	38 191	43 391	44 416	44 701	**44 835**	

Figure 7-8: Multi-annual bill of expenditure.



7.2.2.4 Scenario 2: Gradual implementation

Figure 7-7 details the timetable for implementing solution 1 with regards to the gradual implementation scenario:

1. The central system (C-VIS) is expected to rollout in **Q2 of 2005 with alphanumeric data** following the software development, hardware sourcing and installation, as well as the integration tests. Photograph sub-systems are integrated a year later during **Q2 2006.** Finally, biometric sub-systems are introduced in **Q2 2007**;

2. The national systems (N-VIS) are expected to rollout in **Q3/Q4 of 2005** following hardware sourcing and installation as well as the integration tests with regards to alphanumeric systems. National systems are upgraded to support photograph and biometric data during **Q3/Q4 2006** and **Q3/Q4 2007** respectively;

3. Consular posts connect to the VIS by geographic region (starting with Region 1 and Region 2). The first geographic region could be in production in **Q1 2006** followed by the second geographic region in **Q1 2007**;

4. The supporting document infrastructure is planned for **Q1 2009**.

Note: Development, installation and integration cycles are longer and more complex compared to a centralised solution. Significant impact falls on the project management risk profile, which has to deal with both complex national systems (N-VIS) and complex management procedures as a result of the gradual implementation.

Table 7-27 provides the multi-annual bill of expenditure for this implementation scenario.

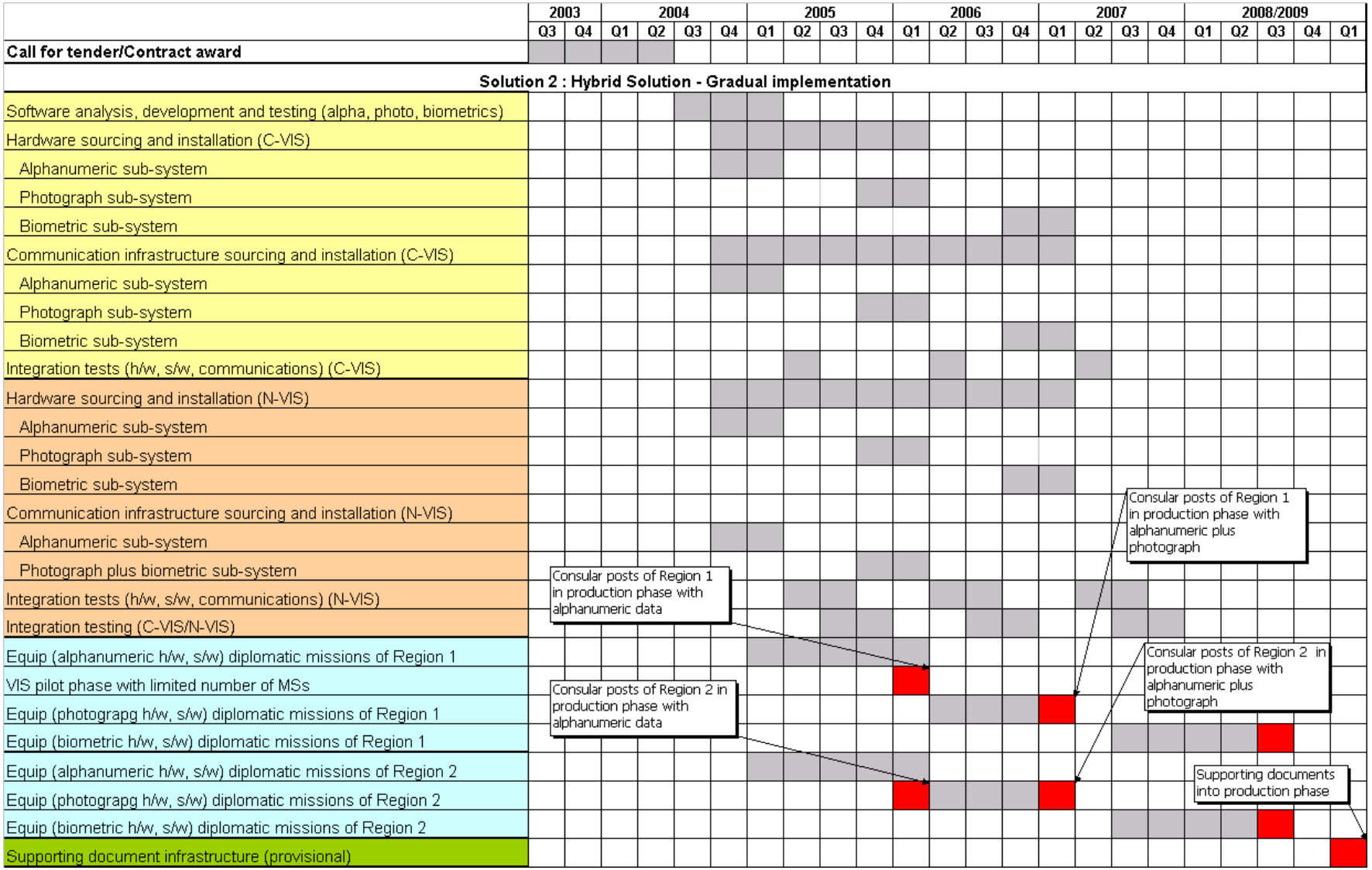
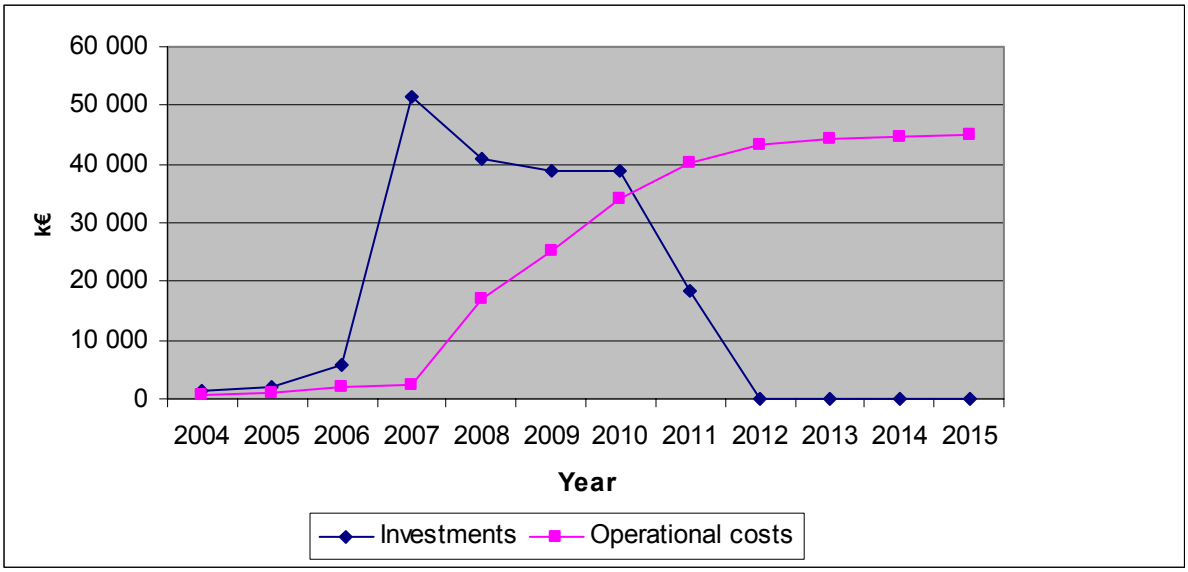


Figure 7-9: Timetable for the gradual implementation of the hybrid architecture.

Table 7-27: Multi-annual bill of expenditure for the gradual implementation of the hybrid architecture.

Multi-annual bill of expenditure in k€	C-VIS + N-VIS												
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	TOTAL
	ALPHANUMERIC (available in 2006)												
Investments	1 325	1 840	3 752	6 988	7 356	7 356	7 356	3 457	0	0	0	0	**39 430**
Operational costs	529	1 057	1 758	1 957	3 767	6 229	8 691	11 154	12 311	12 311	12 311	**12 311**	
	PHOTOGRAPHS (available in 2007)												
Investments		189	1 843	2 709	2 852	2 852	2 852	1 340	0	0	0	0	**14 637**
Operational costs		76	151	337	989	2 409	3 984	5 559	7 134	7 874	7 874	**7 874**	
	BIOMETRICS - FINGERPRINTS (available in 2008)												
Investments			189	41 571	30 649	28 471	28 471	13 381	0	0	0	0	**142 731**
Operational costs			76	151	11 979	16 473	21 042	23 226	23 226	23 226	23 226	**23 226**	
	SUPPLEMENTARY DOCUMENTS (available in 2009)												
Investments				189	194	35	65	68	68	68	32	0	**721**
Operational costs				76	151	246	241	436	721	1 006	1 291	**1 425**	
	ANNUAL TOTAL												
Investments	1 325	2 029	5 784	51 458	41 050	38 713	38 743	18 247	68	68	32	0	**197 519**
Operational costs	529	1 133	1 984	2 520	16 886	25 358	33 959	40 374	43 391	44 416	44 701	**44 835**	

Figure 7-10: Multi-annual bill of expenditure.



7.3 INVESTMENT AND RESOURCE PLANNING FOR OPTION 2: INTEGRATION OF VIS AND SIS II

The integration of VIS and SIS II could lead to significant savings as explained in Chapter 5. This section aims at quantifying those savings. This is done for the two solutions of option 2, which are explained in Chapter 5. The first level of synergy consists in:

- Locating the two central systems in the same building and connecting them to the same network through a single access point;
- Using the same technological platform for both systems:

- the same vendor's hardware (including for biometrics, which leads to using the same biometric trait for both systems);
- the same vendor's software as well as
- the same software development framework and software development company.

In addition to solution 1, a second level of synergy has been envisaged:

- The hardware would be shared between the two systems instead of having each system running on its dedicated hardware;
- Application development would be done with a view to integrate the VIS application into the SIS II application.

7.3.1 Solution 1

The savings that could be expected from the first level of synergies applied to the VIS and SIS II are as follows:

- Provided that the same company is in charge of the development of the two applications, some pieces of code, common to both applications, will be developed and tested only once. Similarly, only one software architecture will be developed;
- A single technical team will be able to take charge of the maintenance of the two systems;
- All the requests from the users who are connected to the SIS network (cross-border checkpoints, police departments and immigration departments) will reach the VIS through that network directly, resulting in the following advantages:
  - No bandwidth requirement for the VIS network to support the requests and associated answers;
  - Availability for the VIS network can be reduced from 99.9% down to 99.7% because requests for traveller verification will cross the SIS network only (see Chapter 4).
- Similarly to system maintenance, other human resources can be reduced.

7.3.1.1 Savings breakdown

Table 7-28: C-VIS.

Savings breakdown in k€	C-VIS			
	Alpha	Photo	Biometrics	Documents
			Fingers	
Hardware:				
Investment	0	0	0	0
Maintenance (annual)	0	0	0	0
Software licenses:				
Investment	0	0	0	0
Maintenance (annual)	0	0	0	0
Application development:				
Investment	152	25	51	51
Maintenance (annual)	30	5	10	10
System maintenance (annual)	134	22	45	22

There is no additional discount expected from the synergies since vendors' discounts are negotiated at the EC level and apply equally to all projects.

Table 7-29: Telecommunication.

Savings breakdown in k€	Telecommunication C-VIS to N-VIS			
	Alpha	Photo	Biometrics	Documents
			Fingers	
Network C-VIS to N-VIS cat. I (9 sites):				
Investment	5	38	9	1
Operation (annual)	48	292	63	4
Network C-VIS to N-VIS cat. II (9 sites):				
Investment	6	58	23	2
Operation (annual)	51	406	141	10
Network C-VIS to N-VIS cat. III (9 sites):				
Investment	14	240	85	6
Operation (annual)	69	1 457	490	34

Table 7-30: Human resources.

Savings breakdown in k€	Human resources			
	Alpha	Photo	Biometrics	Documents
			Fingers	
Co-ordination and supervision (annual)	11	2	4	2
Administrative support (annual)	52	9	17	9
Project management (central)	211	30	30	30
System engineering (external)	0	0	0	0

7.3.1.2 Total savings

Table 7-31: Investments savings.

Total savings in k€	On investments			
	Alpha	Photo	Biometrics	Documents
			Fingers	
C-VIS (1 site)	152	25	51	51
Network C-VIS to N-VIS (9 cat. I + 9 cat. II + 9 cat. III)	25	337	118	8
Business Continuity System (C-VIS)	25	337	118	8
System engineering (external)	0	0	0	0
TOTAL	**203**	**698**	**286**	**67**

Table 7-32: Yearly operational savings.

Total savings in k€	On yearly operational costs			
	Alpha	Photo	Biometrics	Documents
			Fingers	
C-VIS (1 site)	165	27	55	33
Network C-VIS to N-VIS (9 cat. I + 9 cat. II + 9 cat. III)	169	2 155	695	48
Business Continuity System (all sites and networks)	169	2 155	695	48
Human resources	275	41	51	41
TOTAL	**777**	**4 378**	**1 495**	**170**

Table 7-33: Total savings.

Total savings in k€	Inv.	Op.
C-VIS (1 site)	279	280
Network C-VIS to N-VIS (9 cat. I + 9 cat. II + 9 cat. III)	488	3 067
Business Continuity System (all sites and networks)	488	3 067
Human resources	0	407
TOTAL	**1 254**	**6 820**

7.3.1.3 Total costs

Table 7-34 shows a summary of the total costs when the synergies of solution 1 are applied to the centralised architecture.

Table 7-34: Centralised VIS integrated with SIS II at technical level (solution 1).

Thousands of €	Alpha	Photo	Biometrics	Documents	Total
Fixed costs	10 265	1 484	143 841	1 178	**156 767**
Operational costs (annual)	5 505	4 477	22 868	1 542	**34 393**
Human resources (annual)	570	87	129	87	**873**

7.3.2 Solution 2

The second level of synergy could allow for the realisation of some additional savings:

- Some hardware and software components (such as processors, biometric hardware and database licenses) can be shared between the two systems;
- Software development effort will be reduced since the two applications will be merged (despite the data remaining separate);
- The external effort required to set up the two systems will be lower due to the lower amount of system components.

7.3.2.1 Savings breakdown

Additional savings to solution 1 are introduced in Table 7-35 and Table 7-36.

Table 7-35: C-VIS.

Savings breakdown in k€	C-VIS			
	Alpha	Photo	Biometrics	Documents
			Fingers	
Hardware:				
Investment	182	22	10 706	54
Maintenance (annual)	36	5	1 611	11
Software licenses:				
Investment	301	20	41	0
Maintenance (annual)	67	4	8	0
Application development:				
Investment	114	19	38	19
Maintenance (annual)	23	4	8	4
System maintenance (annual)	0	0	0	0

Table 7-36: Human resources.

Savings breakdown in k€	Human resources C-VIS + N-VIS			
	Alpha	Photo	Biometrics	Documents
			Fingers	
Co-ordination and supervision (annual)	0	0	0	0
Administrative support (annual)	0	0	0	0
Project management (central)	0	0	0	0
System engineering (external)	151	22	22	22

7.3.2.2 Total savings

Table 7-37: Investments savings.

Total savings in k€	On investments			
	Alpha	Photo	Biometrics	Documents
			Fingers	
C-VIS (1 site)	750	87	10 836	123
Network C-VIS to N-VIS (9 cat. I + 9 cat. II + 9 cat. III)	25	337	118	8
Business Continuity System (C-VIS))	509	379	10 865	62
System engineering (external)	151	22	22	22
TOTAL	**1 435**	**824**	**21 840**	**215**

Table 7-38: Yearly operational savings.

Total savings in k€	On yearly operational costs			
	Alpha	Photo	Biometrics	Documents
			Fingers	
C-VIS (1 site)	290	40	1 682	47
Network C-VIS to N-VIS (9 cat. I + 9 cat. II + 9 cat. III)	169	2 155	695	48
Business Continuity System (all sites and networks)	271	2 164	2 314	59
Human resources	275	41	51	41
TOTAL	**1 004**	**4 399**	**4 741**	**196**

Table 7-39: Total savings.

Total savings in k€	Inv.	Op.
C-VIS (1 site)	11 795	2 059
Network C-VIS to N-VIS (9 cat. I + 9 cat. II + 9 cat. III)	488	3 067
Business Continuity System (all sites and networks)	11 814	4 808
Human resources	216	407
TOTAL	**24 313**	**10 341**

7.3.2.3 Total costs

Table 7-40 shows a summary of the total costs when all the synergies (solution 1) are applied to the centralised architecture.

Table 7-40: Centralised VIS when all the synergies with SIS II are applied (solution 2).

Thousands of €	Alpha	Photo	Biometrics	Documents	Total
Fixed costs	9 033	1 359	122 287	1 030	**133 709**
Operational costs (annual)	5 277	4 456	19 622	1 517	**30 873**
Human resources (annual)	570	87	129	87	**873**

8. COMPARISON OF SOLUTIONS

A number of solutions have been introduced for the two basic options of the VIS. Solutions have been analysed from an *operational*, *functional an, technical perspective*, as well as from a financial and human resources point of view.

With regards to option 1, the separate VIS, the preferred solutions for the VIS architecture are the **centralised** or the **hybrid** architecture.

Option 2, the technical integration between VIS and SIS II, is best realised by two complementary solutions. **VIS and the SIS II could share common technical platforms** (solution 1). Moreover VIS and SIS II could **share common technical platforms and services** (solution 2). In the latter case, VIS and SIS II merge into a single technical and application environment with common application components (and in particular biometric sub-system and functionalities).

In view of the above, the current chapter compares (benchmarks) the solutions for each one of the two options. A top-down methodology has been endorsed. It starts with the introduction of applicable benchmarking criteria. The comparison and substantiation for each of the solutions is developed with these criteria, driving the final conclusions.

The final objective of this chapter is to determine and to make explicitly clear which is the best technical solution for the development of VIS, taking into account the synergies between this new system and SIS II.

8.1 BENCHMARKING CRITERIA

The selection criteria for determining the **best solution** are as follows:

1. Impact on existing **users** operations and procedures thereto;
2. **Functional** requirements;
3. **Technical** requirements;
4. **Operational** requirements including availability, contingency, performance, security, maintenance and systems management;
5. The **financial** impact as determined by the total cost of ownership;
6. **Risk** assessment factors as regards to operational, technological, project management and financial risks[25].

8.2 OPTION 1: SEPARATE VIS – CENTRALISED VS HYBRID

Two competing solutions have been examined as regards to the architecture of the VIS:

1. The **centralised solution**: all the data and functions are exclusively located at the central level (C-VIS);

[25] Refer to Annex A for the definition of the various types of Risks.

2. The **hybrid solution:** a minimal set of data and functions are stored at the central level (C-VIS) (alphanumeric data, indexes and biometric templates) while voluminous data (photographs, biometric and document images) and other functions are stored at national (N-VIS) level.

Impact on existing operations and procedures:

Both architectures appear equal from a user perspective.

Functional requirements:

Both solutions equally support the business context and the objectives of the VIS.

Technical requirements:

Both architectures meet the technical requirements. The hybrid solution is more complex than the centralised one, as is reflected below.

Operational requirement:

Both solutions meet the response time requirements of the business processes, provide the required availability, and business continuity.

In the centralised solution the systems maintenance and management procedures focus on a single physical location that hosts a large data and computing centre, and on its remote business continuity site. In the hybrid solution, additionally to these central systems, 27 national visa information systems (N-VISes) and their business continuity counterparts require maintenance and management. This has an impact on the costs and risks, as reflected in comparison Table 8.2. However, it remains clear that the organisational tasks will be more complex with the hybrid architecture.

While the required level of security can be ensured with both architectures, it is easier to administer the overall security policy and measures in the centralised solution since it implies a single system and physical location.

Financial impact:

From a financial perspective, the implementation of a centralised solution for the VIS is more advantageous than the hybrid one as it results in a lower *total cost per visa*. The cost difference between the two solutions, however, remains inside the error margin of the cost estimation. Thus the study concludes that from a *cost* perspective, both solutions compare.

Table 8-1 compares the two solutions of option 1 from a financial perspective.

Table 8-1: Comparison of costs for Option 1, the separate VIS.

k€	Investments	Yearly operational costs	Total Cost of Ownership (TCO)
Option 1: separate VIS			
Solution 1: centralised architecture	158 022	42 087	**368 457**
Solution 2: hybrid architecture	197 519	44 835	**421 694**

Legend: TCO is computed as investment costs (fixed) plus 5 year of operating costs.

Risk assessment:

The technological risks are higher for the hybrid solution as a result of having to keep 28 communicating systems (27 N-VISes and 1 C-VIS) updated.

The project management risk is much higher with the hybrid solution as a result of the large amount of systems having to be set up as well as the increased complexity of the VIS software architecture. Delays in the delivery of the system are very likely if one opts for the hybrid architecture.

Financial risks are higher in the hybrid solution as a more complex solution makes precise estimates of costs more difficult. Therefore cost overruns are more likely if we opt for the hybrid solution.

The operational risks increase with the hybrid solution as the number of systems increases.

8.2.1 Conclusions

Table 8-2 provides a high level benchmarking of the solutions with regards to the common set of selection criteria. In the light of this table and the previous comparison, the centralised solution evidently presents several advantages over the hybrid one. As fewer systems have to be installed and since software development, testing and integration cycles will be shorter in the centralised solution, the risk to slow down the release of the VIS system is minimised. When adding to this the lower Total Cost of Ownership (TCO), the centralised solution becomes the preferred solution.

Table 8-2: Comparison of the solutions for the separate VIS – Centralised vs Hybrid.

Selection criteria	Centralised solution	Hybrid solution
Business context, operations, procedures	Supports the VIS BPs	Supports the VIS BPs[26]
Technical Requirements		
Biometrics	Less complex to manage	More complex to manage
Storage	High (1*DSR in one location)	High (1*DSR over 27 locations)
Communication	High impact on bandwidth and cost	Low impact on bandwidth and cost
Operational requirements		
Availability	Conforms to table 4-1	Conforms to table 4-1
Contingency (planning)	Complex	Very Complex
Performance	Conforms to table 4-2	Conforms to table 4-2
Security	Less difficult to administrate	More difficult to administrate
Technical support requirements		
Maintenance and management	Complex	Very Complex
Cost Profile		
Development, testing and integration costs	Less capital intensive	More capital intensive
Investment costs	Lower	Higher

[26] The major drawback of the hybrid solution relates to the management of the visa history dossier of a visa applicant. This is distributed in several national (N-VIS) systems, making the tracking of visa history a cumbersome process.

Selection criteria	Centralised solution	Hybrid solution
Operational costs	Lower	Higher
Total Cost of ownership (TCO)	Lower	Higher
Risk assessment factors		
Strategic risks	Moderate	High
Operational risks	Moderate	High
Technology risks	Moderate	High
Project Management risks	Moderate	High
Financial risks	Moderate	High

Legend:
BP refers to the VIS business process as determined in chapter 2.
DSR refers to the logical storage requirements as determined in Table 5.3.

8.3 OPTION 2 : TECHNICAL INTEGRATION OF VIS AND SIS II

Two complementary solutions have been examined as regards to the integration between the VIS and SIS II:

1. In the first solution, **common technical platforms**, the VIS and the SIS II could share a common technical environment, co-house an infrastructure at central level (C-VIS and CS-SIS II), as well as share a common management organisation;

2. In the second solution (which is complementary to the first one), **common technical platforms and services**, VIS and SIS II could integrate at system and application level.

Impact on existing operations and procedures thereto:

Sharing of a common technical infrastructure, as well as development environments and methodologies, facilitates interoperability between the C-VIS and the core system of the SIS II (CS-SIS II). This introduces operational efficiency as the visa and traveller verification and person identification processes are performed via the future SIS II infrastructure.

Impact on operational requirements:

Synergies between the two systems have an impact on the availability of the communication infrastructure connecting N-VIS to the C-VIS. The VIS infrastructure will streamline the less critical process of visa issue. Thus the required network availability drops from 99.9% to 99.7%. The critical process of visa and traveller verification (with a strict requirement of 99.9 availability) is implemented via the SIS infrastructure.

Financial impact:

A common software development architecture, test and integration plan could be endorsed by the two systems if a single software development and integration vendor is selected. Maintenance costs are lower having a common system management and administration team shared by the two systems (solution 1).

Availability for the VIS network can be reduced from 99.9% down to 99.7% as the most critical process of visa and traveller verification will be performed through the SIS II infrastructure. This could have a significant impact on the telecommunication costs (solution 1).

Software development costs will be lower if the two applications are merged (despite the data remaining separated). Both systems can share a common biometric infrastructure (hardware and software). Moreover, common biometric-related functionalities could be developed and shared by the two systems. Some hardware and software components (such as processors, hardware and database licenses) can be shared between the two systems (solution 2).

Table 8-3 compares the two solutions of option 2 from a financial perspective.

Table 8-3: Comparison of costs for Option 2, VIS integrated with SIS II.

k€	Investments	Yearly operational costs	Total Cost of Ownership (TCO)
Option 2: centralised VIS integrated with SIS II			
Solution 1: common technical platform	156 767	35 267	**333 102**
Solution 2: common technical platform and services	133 709	31 746	**292 439**

Legend: TCO is computed as investment costs (fixed) plus 5 years of operating costs.

Risk assessment:

Application of synergies will not change the risks analysed for option 1 except for the project management risk. If solution 2 is selected (a single system for both applications), there is an increased risk of encountering extra delays for the roll-out of the systems due to the increased complexity of the common project.

Table 8-4: Comparison of the solutions for the technical integration of VIS with SIS.

Selection criteria	Common technical platform	Common technical platform and services
Application development	Less complex as application separated	Complex to merge applications (services)
Operational Responsibilities	Separated	Merged
Technical Responsibilities	Merged	Merged
Functional Responsibilities	Separated	Merged
Cost savings	Less cost savings	More cost savings

8.4 CONCLUSIONS

All options and solutions to support the VIS processes are feasible from an operational and technical perspective. The differences lie in operational and investment costs as well as in the implementation planning of each of the solutions.

For Option 1, the recommended solution for the VIS architecture, as a separate system, is the centralised one. This solution meets the technical, functional and operational requirements of the VIS. It provides a preferred cost profile compared to the hybrid solution and entails less complexity from a technology and systems management perspective. Moreover, it entails moderate project management and financial risks with regards to having the VIS in production by 2006.

For Option 2, the technical integration between VIS and SIS II, it is recommended that solution 1 or solution 2 be implemented in order to maximise the benefits derived from the synergies between the VIS and SIS II. Solution 2 entails significant cost-savings, as both VIS and SIS use a common biometric infrastructure and services. However, this solution does introduce

additional complexities as regards to responsibilities. **It is therefore recommended to opt for option 2 solution 1, in which VIS and the SIS II share common technical platforms and infrastructure at central level (C-VIS and CS-SIS II) as well as sharing a common management organisation.**

9. POSSIBLE SYSTEM SPECIFICATIONS

This chapter determines the technical specifications of the VIS. It defines the hardware and the software components and configurations that support the VIS business context and meet the requirements of chapter 4.

The system specifications will be provided for (refer to Figure 9-1):

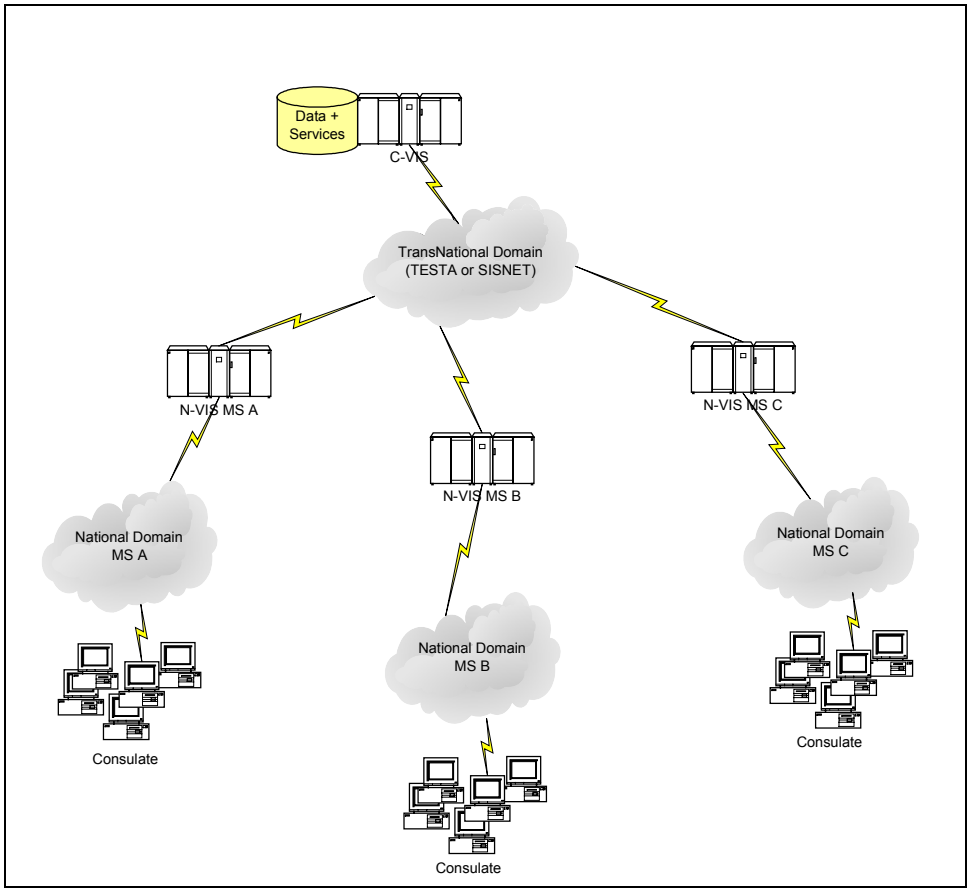
- The **C-VIS**;
- The **N-VIS** (each category will be considered);
- A standard configuration for **consulates** (each category will be considered).

Specifications will also be provided for the test environment and the business continuity system.

The system specifications are provided separately the **centralised** and **hybrid** solutions of option 1, the separate VIS.

Note: The chapter contains a number of tables with the technical characteristics of the various systems (hardware and software) that comprise the VIS. They are only indicative, i.e. are based on a typical example of a possible configuration and are thus provided solely to facilitate the pricing of the VIS.

Figure 9-1: Global architecture and VIS sub-systems.



9.1 CONFIGURATIONS FOR THE C-VIS AND N-VIS

Table 9-1 provides an overview of the hardware components needed for each solution of the VIS, the *centralised* and the *hybrid* ones.

Table 9-1: Global view of the hardware components.

Hardware component	Purpose	CENTRALISED ARCHITECTURE		HYBRID ARCHITECTURE	
		C-VIS	N-VIS	C-VIS	N-VIS
Application server	Runs the VIS EBPs	✓		✓	✓
Database server	Manages the alphanumeric data and indexes	✓		✓	
Images server	Manages the photographs, biometric samples and supplementary documents	✓			✓
SAN (Storage Area Network)	Stores all the data	✓		✓	✓
Backup server	Carries out backups of data	✓		✓	✓
Tape Library	Stores backups on tapes for archiving	✓		✓	✓
Mail server	Stores requests from users and forward answers to users mailboxes.	✓	✓		✓
Web server	Provides a web interface to some users	✓			✓
Authentication server	Authenticates requests and their senders	✓		✓	
Monitoring server	Monitors all the components for performance tuning, failure detection and transactions logging	✓	✓	✓	✓
Biometric server	Stores the biometric templates and manages the biometric matching engine	✓		✓	
Biometric matching engine	Performs templates matches	✓		✓	
Ethernet switch	Interconnects components	✓		✓	✓
Router	Interconnects a site to a wide area network	✓	✓	✓	✓
Crypto box and network termination device	Enciphers/deciphers data and interfaces with a telco network	✓	✓	✓	✓

The following sections will specify each component in order to comply with the VIS requirements in matters of **size** and **performance**. The costs of each component (hardware and software) has been documented in chapter 7, using public price lists from vendors and applying uniformly a 30% discount to take account of economics of scale. We first study the centralised architecture and then the hybrid one.

The following principles have been used when defining the system configurations of the C-VIS and N-VIS:

1. Cryptographic devices and network termination devices are part of a telecommunication service and therefore are not documented. The costs of these devices are included in the telecommunications costs;

2. To ensure the highest possible availability and to ease the system maintenance procedures, redundancy has been applied to avoid a single point of failure. To this end:

   - Dual connections of local networks have been introduced;

   - Clusters (at least two identical machines) are used to implement every single component.

3. Where possible several logical components share the same hardware in order to introduce cost savings;

4. The same configuration is valid either for response time T_1 or T_2 (a response time is the sum of the network transmission time and the system processing time).

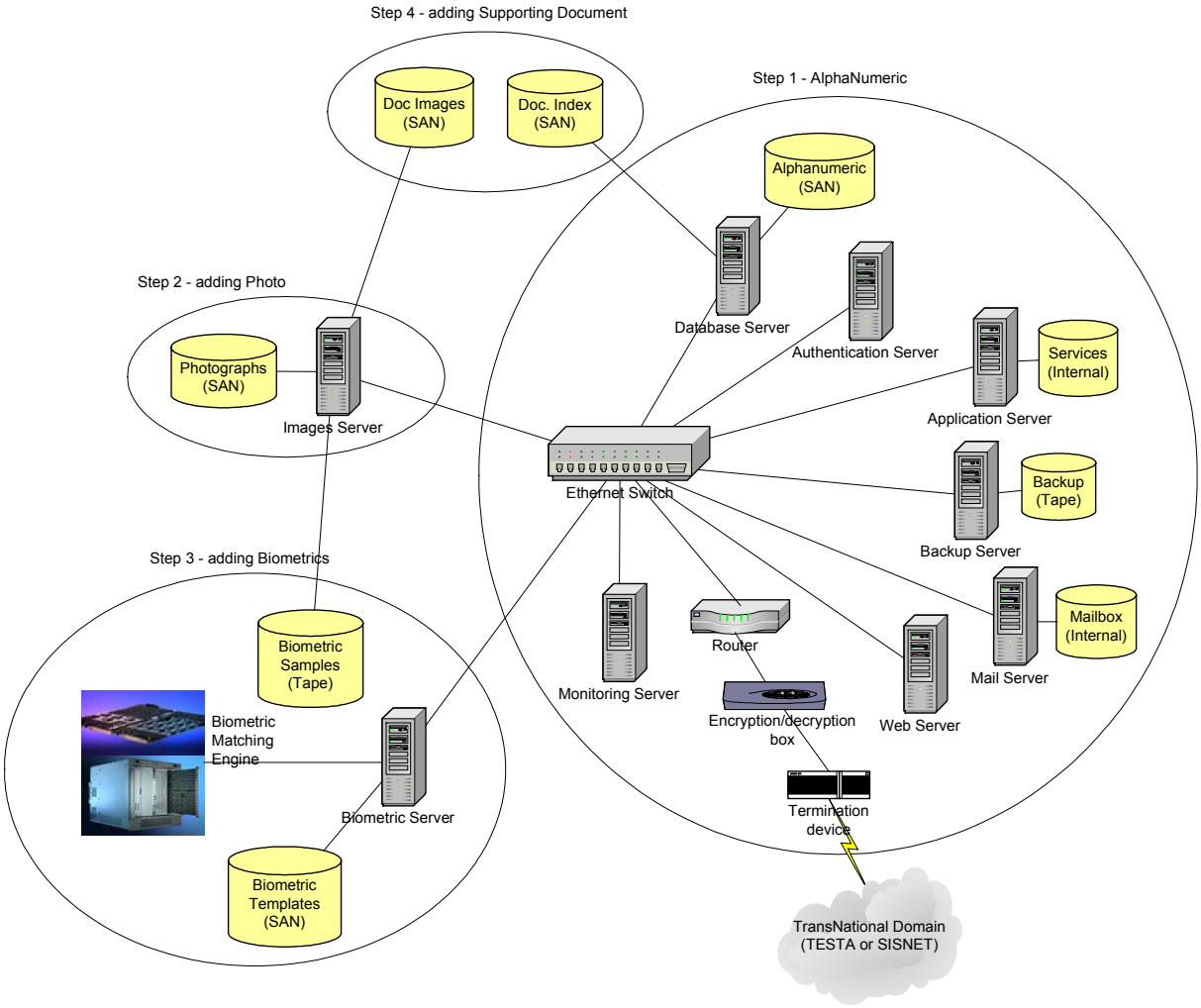
9.1.1 Centralised architecture

The centralised architecture is presented in section 5.5.1.

9.1.1.1 Configuration of the central system (C-VIS)

Figure 9-2 shows a logical view of the various components of the C-VIS for a centralised architecture.

Figure 9-2: C-VIS components - centralised architecture.



The physical configuration chosen to implement the C-VIS components is described in Table 9-2. The software required for each machine is listed in Table 9-3. The numbers that appear between parenthesis refer to the specific machines on which the software will run.

Table 9-2: Hardware configuration: C-VIS - centralised architecture.

Hardware	Configuration	Units	Unit price (€)	Total price (€)
Application server	12 CPU at 900 MHz, 8 Mb cache each, 24 Gb memory	2	192 500	385 000
Database server	8 CPU at 900 MHz, 8 Mb cache each, 16 Gb memory	2	140 200	280 400
SAN (Storage Area Network)	Step 1: 1321 Gb (18x73.4Gb)	1	121 600	121 600
	Step 2: 3240 Gb (18x181Gb)	1	164 000	164 000
	Step 3: 12960 Gb (72x181Gb)	2	508 800	1 017 600
	Step 4: 12960 Gb (72x181Gb)	1	508 800	508 800
Authentication server	2 CPU at 1,015 GHz, 8 Mb cache each, 2 Gb DRAM	2	21 600	43 200
Authentication repository	2 CPU at 1,015 GHz, 8 Mb cache each, 2 Gb RAM	2	21 000	42 000
Backup server	2 CPU at 1,015 GHz, 8 Mb cache each, 2 Gb DRAM	1	21 600	21 600
Tape Library	StorEdge L700	1	83 900	83 900
	6 drives SDLT-320	6	13 800	82 800
	StarterKit Media	1	12 600	12 600
Mail server	2 CPU at 1,015 GHz, 8 Mb cache each, 2 Gb DRAM	2	21 600	43 200
Web Server	2 CPU at 1,015 GHz, 8 Mb cache each, 2 Gb DRAM	2	21 600	43 200
Monitoring server	CPU at 650 MHz, 512 Mb cache, 512 Mb DRAM	1	4 050	4 050
Images server	2 CPU at 1,015 GHz, 8 Mb cache each, 2 Gb DRAM	2	21 600	43 200
Biometric server (management)	2 CPU at 1,015 GHz, 8 Mb cache each, 2 Gb DRAM	2	21 600	43 200
Router	2600 MX	2	3 000	6 000
Ethernet Switch (Gigabits)	Catalyst 3xxx	2	10 000	20 000
Crypto box management PC		1	1 500	1 500
Other	Rack 900	5	6 550	32 750
Biometric features extraction FP	PIII 900Mhz, 512k cache, 512Mb RAM extensible to 1Gb, 40Gb harddisk, network@100Mbps	42	2 500	105 000
Biometric features extraction iris	PIII 900Mhz, 512k cache, 512Mb RAM extensible to 1Gb, 40Gb harddisk, network@100Mbps	42	2 500	105 000
Biometric features extraction face	PIII 900Mhz, 512k cache, 512Mb RAM extensible to 1Gb, 40Gb harddisk, network@100Mbps	42	2 500	105 000
Biometric matching engine FP	1,000,000 matches/sec.	101	1 000 000	101 000 000
Biometric matching engine iris	PIII 900Mhz, 512k cache, 512Mb RAM extensible to 1Gb, 40Gb harddisk, network@100Mbps	152	2 500	380 000
Biometric matching engine Face	PIII 900Mhz, 512k cache, 512Mb RAM extensible to 1Gb, 40Gb harddisk, network@100Mbps	152	2 500	380 000

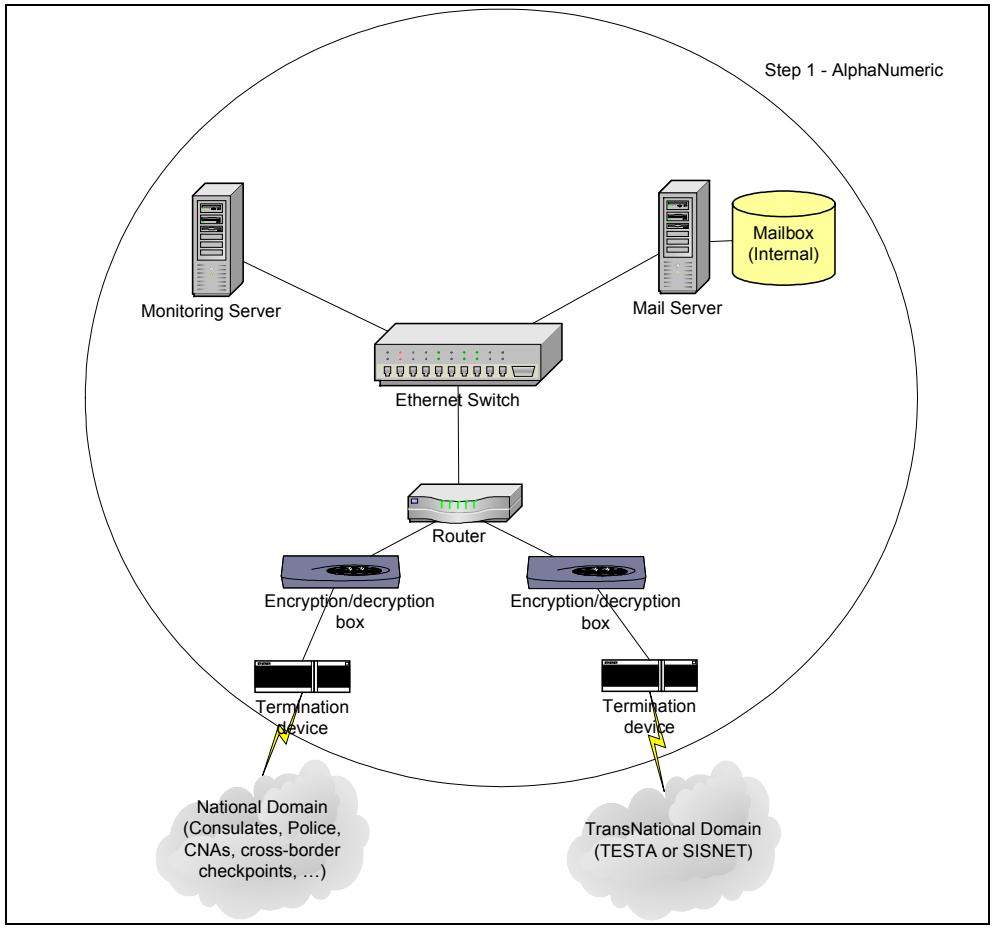
Table 9-3: Software configuration: C-VIS - centralised architecture.

Software	Configuration	Units	Unit price (€)	Total price (€)
Application Server (1)	Application Server Enterprise	24	21 720	521 280
Database Management System (2,3,10,11)	Server Enterprise Edition	24	43 440	1 042 560
	Real Application Clusters	24	21 720	521 280
	Management Packs	24	9 774	234 576
	Advanced Security	24	10 860	260 640
	Label Security	24	10 860	260 640
Identity Manager (5)	ONE Directory Server	40 000	2.2	88 000
Authentication server (4)	ONE identity server	40 000	8.8	352 000
Backup/Archive manager (6,7)	Horizon Monitoring for Sun StorEdge L700	1	4 000	4 000
	Solstice Backup	1	21 400	21 400
Mail server (8)	ONE Messaging Server (only 1 mailbox)	1	22	22
Web Server (9)	ONE Web Server	1	1 650	1 650
System Management (10)	Management Center 3.0 Advanced Systems Monitoring	1	3 250	3 250
Biometric matching iris (12)	Know-who	70 000 000	1.0	70 000 000
Biometric matching iris (14)	SQL server single user license	152	650	98 800
Biometric matching face (14)	FaceExplorer	2 100 000	0.5	1 050 000
Biometric matching face (14)	Server Enterprise Edition	2	43 440	86 880

9.1.1.2 Configuration of the national systems (N-VIS)

Figure 9-3 shows a logical view of the various components of an N-VIS for a centralised architecture.

Figure 9-3: N-VIS components - centralised architecture.



The hardware and software configurations chosen to implement the N-VIS components are described in Table 9-4, Table 9-5 and Table 9-6 for each N-VIS category. The numbers that appear between parenthesis refer to the specific machines on which the software will run.

Table 9-4: Hardware and Software configuration: N-VIS cat. III - centralised architecture.

Hardware	Configuration	Units	Unit price (€)	Total price (€)
Mail server	2 CPU at 1,015 GHz, 8 Mb cache each, 2 Gb DRAM	2	21,600	43,200
Monitoring server	CPU at 650 MHz, 512 Mb cache, 512 Mb DRAM	1	4,050	4,050
Router	2600 MX	2	3,000	6,000
Hub		2	100	200
Crypto box management PC		1	1,500	1,500
Other	Rack 900	1	6,550	6,550
Software	*Configuration*	*Units*	*Unit price (€)*	*Total price (€)*
Mail server (1)	ONE Messaging Server (150 post * 20 users)	3,000	22	66,000
System Management (2)	Management Center 3.0 Advanced Systems Monitoring	1	3,250	3,250

Table 9-5: Hardware and software configuration: N-VIS cat. II - centralised architecture.

Hardware	Configuration	Units	Unit price (€)	Total price (€)
Mail server	CPU at 650 MHz, 512 Mb cache, 512 Mb DRAM	2	4,050	8,100
Monitoring server	CPU at 650 MHz, 512 Mb cache, 512 Mb DRAM	1	4,050	4,050
Router	2600 MX	2	3,000	6,000
Hub		2	100	200
Crypto box management PC		1	1,500	1,500
Other	Rack 900	1	6,550	6,550
Software	*Configuration*	*Units*	*Unit price (€)*	*Total price (€)*
Mail server (1)	ONE Messaging Server (150 post * 2 users)	300	22	6,600
System Management (2)	Management Center 3.0 Advanced Systems Monitoring	1	3,250	3,250

Table 9-6: Hardware and software configuration: N-VIS cat. I - centralised architecture.

Hardware	Configuration	Units	Unit price (€)	Total price (€)
Mail server	CPU at 650 MHz, 512 Mb cache, 512 Mb DRAM	2	4,050	8,100
Monitoring server	CPU at 650 MHz, 512 Mb cache, 512 Mb DRAM	1	4,050	4,050
Router	2600 MX	2	3,000	6,000
Hub		2	100	200
Crypto box management PC		1	1,500	1,500
Other	Rack 900	1	6,550	6,550
Software	*Configuration*	*Units*	*Unit price (€)*	*Total price (€)*
Mail server (1)	ONE Messaging Server (150 post * 1 user)	150	22	3,300
System Management (2)	Management Center 3.0 Advanced Systems Monitoring	1	3,250	3,250

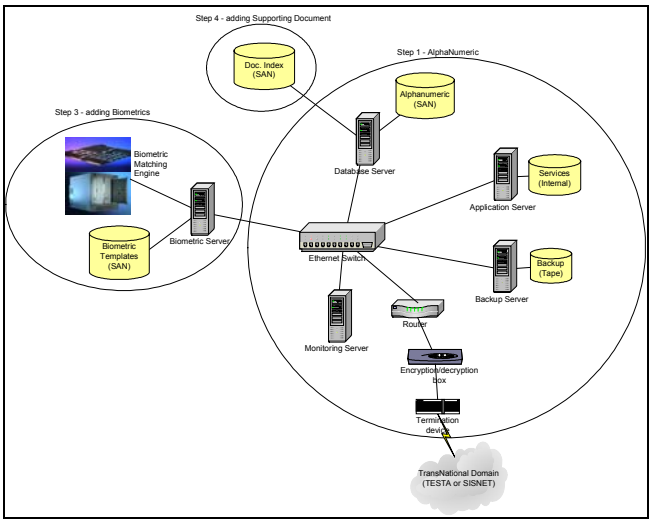
9.1.2 Hybrid architecture

The hybrid architecture is described in section 5.5.2.

9.1.2.1 Configuration of the central system (C-VIS)

Figure 9-4 shows a logical view of the various components of the C-VIS for the hybrid architecture.

Figure 9-4: C-VIS components - hybrid architecture.



The physical configuration chosen to implement the C-VIS components is described in Table 9-8. The software required for each machine is listed in Table 9-7. The numbers that appear between parenthesis refer to the specific machines on which the software will run.

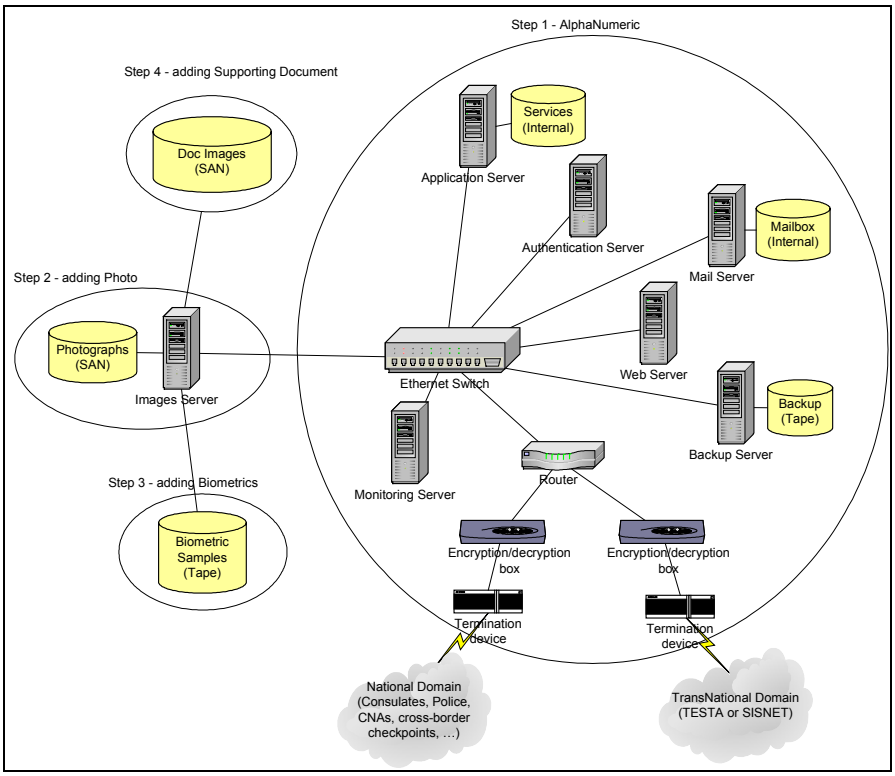
Table 9-7: Software configuration: C-VIS - hybrid architecture.

Software	Configuration	Units	Unit price (€)	Total price (€)
Application Server (1)	Application Server Enterprise	16	21 720	347 520
	ONE Message Queue	16	4 000	64 000
Database Management System (2,7)	Server Enterprise Edition	12	43 440	521 280
	Real Application Clusters	12	21 720	260 640
	Management Packs	12	9 774	117 288
	Advanced Security	12	10 860	130 320
	Label Security	12	10 860	130 320
Backup/Archive manager (4)	Solstice Backup	1	21 400	21 400
System Management (6)	Management Center 3.0 Advanced Systems Monitoring	1	3 250	3 250
Biometric matching iris (8)	Know-Who	70 000 000	1.0	70 000 000
Biometric matching iris (8)	SQL server single user	152	650	98 800
Biometric matching face (13)	FaceExplorer	2 100 000	0.5	1 050 000
Biometric matching face (13)	Server Enterprise Edition	2	43 440	86 880

9.1.2.2 Configuration of the national systems (N-VIS)

Figure 9-5 shows a logical view of the various components of an N-VIS for the hybrid architecture of the VIS.

Figure 9-5: N-VIS components - hybrid architecture.



The physical configuration chosen to implement the N-VIS components are described in Table 9-9, Table 9-11 and Table 9-13 for each N-VIS category. The software required for each machine is listed in Table 9-12 and Table 9-14. The numbers that appear between parenthesis refer to the specific machines on which the software will run.

Table 9-8: Hardware configuration: C-VIS - hybrid architecture.

Hardware	*Configuration*	*Units*	*Unit price (€)*	*Total price (€)*
Application server	8 CPU at 900 MHz, 8 Mb cache each, 24 Gb memory	2	140 200	280 400
Database server	4 CPU at 900 MHz, 8 Mb cache each, 8 Gb DRAM	2	52 800	105 600
SAN (Storage Area Network)	StorEdge 3960, 1321 Gb (18x73.4Gb)	1	121 600	121 600
Backup server	CPU at 650 MHz, 512 Mb cache, 512 Mb DRAM	1	4 050	4 050
Tape Library	StorEdge L25	1	8 700	8 700
	2 drives HVD DLT8000	2	8 000	16 000
	StarterKit Media	1	920	920
Monitoring server	CPU at 650 MHz, 512 Mb cache, 512 Mb DRAM	1	4 050	4 050
Biometric server (management)	2 CPU at 1,015 GHz, 8 Mb cache each, 2 Gb DRAM	2	21 600	43 200
Ethernet Switch (Gigabits)	Catalyst 3xxx	2	10 000	20 000
Router	2600 MX	2	3 000	6 000
Crypto box management PC		1	1 500	1 500
Others	Rack 900	3	6 550	19 650
Biometric matching engine FP	1,000,000 matches/sec.	101	1 000 000	101 000 000
Biometric matching engine iris	PIII 900Mhz, 512k cache, 512Mb RAM extensible to 1Gb, 40Gb harddisk, network@100Mbps	152	2 500	380 000
Biometric matching engine Face	PIII 900Mhz, 512k cache, 512Mb RAM extensible to 1Gb, 40Gb harddisk, network@100Mbps	152	2 500	380 000

Table 9-9: Hardware and software configuration: N-VIS cat. III - hybrid architecture.

Hardware	Configuration	Units	Unit price (€)	Total price (€)
Application/Web server	4 CPU at 900 MHz, 8 Mb cache each, 8 Gb DRAM	2	52,800	105,600
Images server	2 CPU at 1,015 GHz, 8 Mb cache each, 2 Gb DRAM	2	21,600	43,200
SAN(Storage Area Network)	Step 2: 1x 3240 Gb (18x181Gb)	1	164,000	164,000
	Step 3/4: 1x 3240 Gb (18x181Gb)	1	164,000	164,000
Backup server	CPU at 650 MHz, 512 Mb cache, 512 Mb DRAM	1	4,050	4,050
Tape Library	StorEdge L100	1	29,400	29,400
	2 drives HVD DLT8000	2	8,000	16,000
	StarterKit Media	1	920	920
Mail/Authentication server	2 CPU at 1,015 GHz, 8 Mb cache each, 2 Gb DRAM	2	21,600	43,200
Authentication repository	2 CPU at 1,015 GHz, 8 Mb cache each, 2 Gb RAM	2	21,000	42,000
Monitoring server	CPU at 650 MHz, 512 Mb cache, 512 Mb DRAM	1	4,050	4,050
Ethernet Switch (Gigabits)	Catalyst 3xxx	2	10,000	20,000
Router	2600 MX	2	3,000	6,000
Crypto box management PC		1	1,500	1,500
Others	Rack 900	2	6,550	13,100
Biometric features extraction FP	PIII 900Mhz, 512k cache, 512Mb RAM extensible to 1Gb, 40Gb harddisk, network@100Mbps	5	2,500	13,125
Biometric features extraction iris	PIII 900Mhz, 512k cache, 512Mb RAM extensible to 1Gb, 40Gb harddisk, network@100Mbps	5	2,500	13,125
Biometric features extraction face	PIII 900Mhz, 512k cache, 512Mb RAM extensible to 1Gb, 40Gb harddisk, network@100Mbps	5	2,500	13,125

Table 9-10: Software configuration: N-VIS cat III - hybrid architecture.

Software	Configuration	Units	Unit price (€)	Total price (€)
Application Server (1)	Application Server Enterprise	8	21,720	173,760
	ONE Message Queue	8	4,000	32,000
Database Management System (2)	Server Enterprise Edition	4	43,440	173,760
	Real Application Clusters	4	21,720	86,880
	Management Packs	4	9,774	39,096
	Advanced Security	4	10,860	43,440
	Label Security	4	10,860	43,440
Archive/Backup manager (4)	Solstice Backup	1	21,400	21,400
Mail server (6)	ONE Messaging Server (150 posts * 20 users)	3,000	22	66,000
Identity Manager (7)	ONE Directory Server	3,000	2	6,000
Authentication server (6)	ONE identity server	3,000	9	26,400
System Management (8)	Management Center 3.0 Advanced Systems Monitoring	1	3,250	3,250

Table 9-11: Hardware configuration: N-VIS cat. II - hybrid architecture.

Hardware	Configuration	Units	Unit price (€)	Total price (€)
Application/Web server	2 CPU at 1,015 GHz, 8 Mb cache each, 2 Gb DRAM	2	21,600	43,200
Images server	2 CPU at 1,015 GHz, 8 Mb cache each, 2 Gb DRAM	2	21,600	43,200
SAN (Storage Area Network)	1321 Gb (18x73.4Gb)	1	85,200	85,200
Backup server	CPU at 650 MHz, 512 Mb cache, 512 Mb DRAM	1	4,050	4,050
Tape Library	StorEdge L8	1	9,900	9,900
Mail/Authentication server	2 CPU at 1,015 GHz, 8 Mb cache each, 2 Gb DRAM	2	21,600	43,200
Authentication repository	2 CPU at 1,015 GHz, 8 Mb cache each, 2 Gb RAM	2	21,000	42,000
Monitoring server	CPU at 650 MHz, 512 Mb cache, 512 Mb DRAM	1	4,050	4,050
Ethernet Switch (Gigabits)	Catalyst 3xxx	2	10,000	20,000
Router	2600 MX	2	3,000	6,000
Crypto box management PC		1	1,500	1,500
Others	Rack 900	2	6,550	13,100
Biometric features extraction FP	PIII 900Mhz, 512k cache, 512Mb RAM extensible to 1Gb, 40Gb harddisk, network@100Mbps	2	2,500	5,000
Biometric features extraction iris	PIII 900Mhz, 512k cache, 512Mb RAM extensible to 1Gb, 40Gb harddisk, network@100Mbps	2	2,500	5,000
Biometric features extraction face	PIII 900Mhz, 512k cache, 512Mb RAM extensible to 1Gb, 40Gb harddisk, network@100Mbps	2	2,500	5,000

Table 9-12: Software configuration: N-VIS cat. II - hybrid architecture.

Software	Configuration	Units	Unit price (€)	Total price (€)
Application Server (1)	Application Server Enterprise	4	21,720	86,880
	ONE Message Queue	4	4,000	16,000
Database Management System (2)	Server Enterprise Edition	4	43,440	173,760
	Real Application Clusters	4	21,720	86,880
	Management Packs	4	9,774	39,096
	Advanced Security	4	10,860	43,440
	Label Security	4	10,860	43,440
Archive/Backup manager (4)	Solstice Backup	1	21,400	21,400
Mail server (6)	ONE Messaging Server (150 posts * 2 users)	300	22	6,600
Identity Manager (7)	ONE Directory Server	300	2	600
Authentication server (6)	ONE identity server	300	9	2,640
System Management (8)	Management Center 3.0 Advanced Systems Monitoring	1	3,250	3,250

Table 9-13: Hardware configuration: N-VIS cat. I - hybrid architecture.

Hardware	Configuration	Units	Unit price (€)	Total price (€)
Application/Images/Web server	CPU UltraSPARC IIi at 650 MHz, 512 Mb cache, 512 Mb DRAM	2	4,050	8,100
SAN (Storage Area Network)	655 Gb (18x36.4Gb)	1	69,600	69,600
Mail/Authentication server	CPU at 650 MHz, 512 Mb cache, 512 Mb DRAM	2	4,050	8,100
Authentication repository	2 CPU at 1,015 GHz, 8 Mb cache each, 2 Gb RAM	2	21,000	42,000
Backup Server	CPU at 650 MHz, 512 Mb cache, 512 Mb DRAM	1	4,050	4,050
Tape Library	StorEdge L7	1	7,500	7,500
Monitoring server	CPU at 650 MHz, 512 Mb cache, 512 Mb DRAM	1	4,050	4,050
Router	2600 MX	2	3,000	6,000
Ethernet Switch (Gigabits)	Catalyst 3xxx	2	10,000	20,000
Crypto box management PC		1	1,500	1,500
Others	Rack 900	1	6,550	6,550
Biometric features extraction FP	PIII 900Mhz, 512k cache, 512Mb RAM extensible to 1Gb, 40Gb harddisk, network@100Mbps	2	2,500	5,000
Biometric features extraction iris	PIII 900Mhz, 512k cache, 512Mb RAM extensible to 1Gb, 40Gb harddisk, network@100Mbps	2	2,500	5,000
Biometric features extraction face	PIII 900Mhz, 512k cache, 512Mb RAM extensible to 1Gb, 40Gb harddisk, network@100Mbps	2	2,500	5,000

Table 9-14: Software configuration: N-VIS cat. I - hybrid architecture.

Software	Configuration	Units	Unit price (€)	Total price (€)
Application Server (1)	Application Server Enterprise	2	21,720	43,440
	ONE Message Queue	2	4,000	8,000
Database Management System (1)	Server Enterprise Edition	2	43,440	86,880
	Real Application Clusters	2	21,720	43,440
	Management Packs	2	9,774	19,548
	Advanced Security	2	10,860	21,720
	Label Security	2	10,860	21,720
Backup/Archive manager (5)	Solstice Backup	1	21,400	21,400
Mail server (3)	ONE Messaging Server (150 posts * 1 user)	150	22	3,300
Identity Manager (4)	ONE Directory Server	150	2	300
Authentication server (3)	ONE identity server	150	9	1,320
System Management (7)	Management Center 3.0 Advanced Systems Monitoring	1	3,250	3,250

9.2 CONFIGURATION FOR THE TEST SYSTEM

A test system has been foreseen as located in the C-VIS site. Its purpose is to test updates and upgrades of the system components before modifying the production system. The physical configuration chosen to implement the test system is described in Table 9-15. The software required for each machine is listed in Table 9-16. The numbers that appear between parenthesis refer to the specific machines on which the software will run.

Table 9-15: Hardware configuration: test system.

Hardware	Configuration	Units	Unit price (€)	Total price (€)
Application/Mail/Web server	2 CPU at 1,015 GHz, 8 Mb cache each, 2 Gb DRAM	1	21,600	21,600
Database/Biometric server	2 CPU at 1,015 GHz, 8 Mb cache each, 2 Gb DRAM	1	21,600	21,600
Authentication/Backup server	CPU at 650 MHz, 512 Mb cache, 512 Mb DRAM	1	4,050	4,050
Tape Library	StorEdge L7	1	7,500	7,500
Monitoring server	CPU at 650 MHz, 512 Mb cache, 512 Mb DRAM	1	4,050	4,050
Biometric server (management)	2 CPU at 1,015 GHz, 8 Mb cache each, 2 Gb DRAM	1	21,600	21,600
Other	Rack 900	1	6,550	6,550
Biometric matching engine FP	1,000,000 matches/sec.	1	2,500	2,500
Biometric matching engine iris/face	PIII 900Mhz, 512k cache, 512Mb RAM extensible to 1Gb, 40Gb harddisk, network@100Mbps	1	2,500	2,500
Biometric enrolment station		1	10,000	10,000