ENTSOG Cost-Benefit Analysis study (CBA) –

Document for the selection of a harmonised data exchange solution between gas transmission system operators in Europe and with their counterparties

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1 Management summary

The framework guidelines for the network code Interoperability and Data Exchange, issued by ACER on 26 July 2012 define the rules for the harmonisation of the data exchange rules within the European gas transmission networks. Benefits of DE harmonisation include:

- Eliminate barriers to the free flow of gas in Europe
- Streamline practices and facilitate technical, operational and business related communication

ACER requires a Cost-Benefit Analysis in the framework guidelines for the data exchange solution presented in the network code. The components of the data exchange solution are:

- Data network
- Data format
- Data protocol

The framework guideline stated that the CBA must take into account the following considerations:

- Best available technologies, particularly in terms of security and reliability;
- The actual spread (whether the solution considered is widely used) of the solutions considered;
- The volume of data traffic required to transfer information;
- The costs of first introduction and cost of operation;
- The potential for discrimination of small shippers or new market entrants;
- The synergies with current electricity Data Exchange rules;
- The compatibility with counterparties' Data Exchange solutions.

The following three types of data exchange solutions have been identified:

- Document based
- Integrated
- Interactive

The CBA is split into three parts:

- A technical evaluation –
  Leading to the selection of the network, format and protocol of the harmonised data exchange solution for the three types of data exchanges
- A macro-economical evaluation –
  Giving an overview of the spread of the various data exchange solutions in use today and a cost evaluation for the document based data exchange type protocol
- Further conditions –
  Describing data volumes exchanged, discrimination of small shippers and new market entrants, synergies with electricity data exchange rules and compatibility with counterparty solutions

Based on these technical and macro-economical evaluations and further conditions the following DE solutions for the network code are proposed:

Data exchange type	Data network	Data format	Data protocol
Document based	Internet	Edig@s-XML	AS4
Integrated	Internet	Edig@s-XML	HTTP(S)/SOAP
Interactive	Internet	N/A	N/A

Table 1: Data exchange solution for data exchange types

2 Introduction

Today, many local data exchange solutions are in place in the gas industry between TSOs (Transport System Operators) and their counter parties in different EU member states, mainly because of local historical developments to cover data exchange needs on one hand and because of national legislations on the other hand. This resulted in multiple solutions for data exchange in different areas in Europe. Some of these solutions are supported by multiple TSOs where cross-border communication is needed. Figure 1 explains the current situation and also the solution for data exchange harmonisation in Europe.

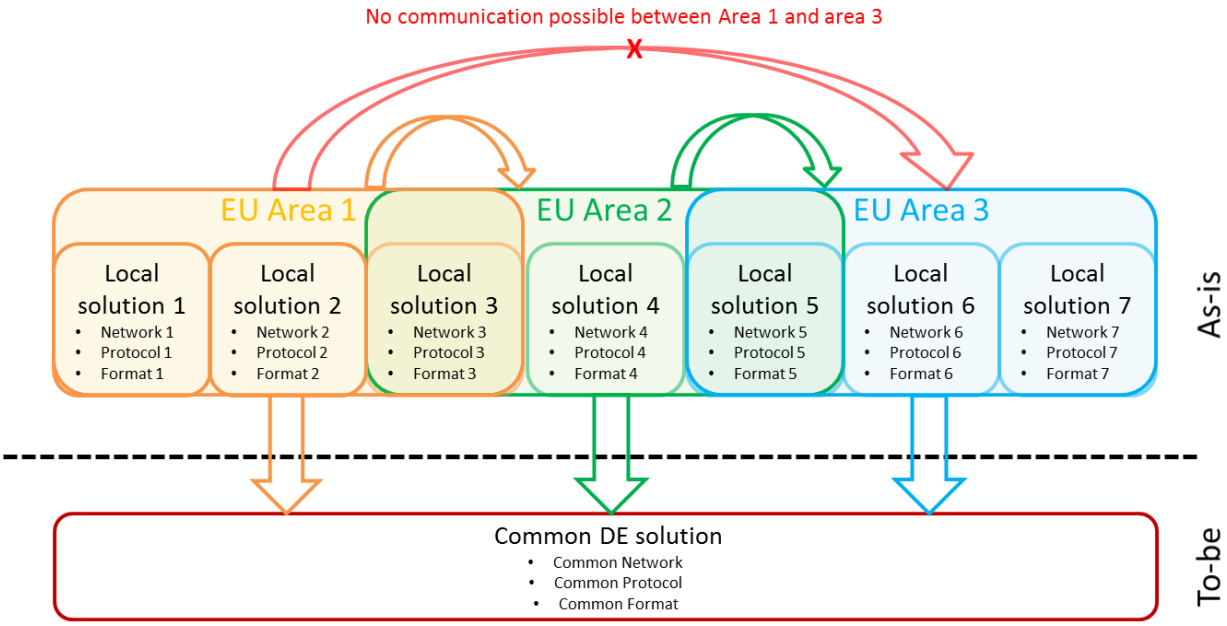

Figure 1: As-is and to be data exchange within Europe

In the example above communication is possible between area 1 and area 2 where they communicate through solution 3. Area 2 and area 3 communicate through solution 5. However, there is no communication possible between area 1 and area 3 as a common local solution for communication is missing.

The bottom part of the diagram presents a common solution for the future. All EU TSOs offering full compatibility for the whole EU gas market will support this solution. The development of the

common solution shall be in line with the implementation of the different EU network codes according to Reg. 715/2009[1].

3 Assumptions and considerations

Identified types of data exchange solutions:

- Document based –
  Document file transfer between IT systems
- Integrated –
  Offers direct exchange of information between applications with flexible query possibilities
- Interactive –
  Exchanges of information through a web browser based on an interactive dialog controlled by the initiator of the communication

These three types of data exchange solutions will be described in the technical selection process below. The integrated and interactive data exchange types were not subjected to a cost-benefit analysis as no technical alternatives are seen for these types of data exchange other than the solutions presented in this document.

4 Supporting documents

This CBA support document repeatedly references to the documents presented in table 2 below. When references are made to these documents they will be presented as follows: [‘short name’].

Short name	Full name	Author	Date
Draft project plan	Draft Project Plan on Interoperability network code Development for Public Consultation INT0161-120711	ENTSOG Interoperability working group	12.09.2012
Workshop data exchange presentation	Presented material Data Exchange WS 23 April 2013 Presentations	ENTSOG /EASEE-gas / Paatz Scholz van der Laan	23.04.2013
Framework guidelines	FG on Interoperability and Data Exchange Rules for European Gas Transmission Networks	ACER	26.07.2012

Table 2: Supporting documents used

[1] Existing local solutions can stay in place with NRA approval

5 Goal and scope of DE harmonisation

One of the main goals of the ACER [framework guidelines] and the subsequent network code interoperability and data exchange rules is to harmonise the data exchange rules within the European gas transmission networks. The harmonisation of the DE rules is twofold:

- To eliminate the barriers to the free flow of gas in Europe
- To streamline practices and facilitate technical, operational and business related communication

The overarching objective of the network code is the harmonisation of rules for the operation of transmission systems in order to encourage and facilitate efficient gas trading and transport across gas transmission systems within the EU, and thereby to move towards greater internal market integration.

The harmonisation of the DE rules applies to:

- All inter-TSO data exchange
- All TSO - counterparty data exchange

arising from Regulation 715/2009

Potential Counterparties are:

- Distribution System Operators (DSO)
- Storage System Operators (SSO)
- LNG System Operators (LSO)
- Network Users (NU)

5.1 Framework guidelines requirement: CBA for selection of DE solution

A Cost-Benefit Analysis is required in the framework guidelines for the data exchange solution presented in the network code. The following components are subjected to a CBA evaluation.

Components of the data exchange solution:

- Data network
- Data format
- Data protocol

The CBA must take into account the following considerations:

- Best available technologies, particularly in terms of security and reliability;
- The actual spread (whether the solution considered is widely used) of the solutions considered;
- The volume of data traffic required to transfer information;
- The costs of first introduction and cost of operation;
- The potential for discrimination of small shippers or new market entrants;
- The synergies with current electricity Data Exchange rules;
- The compatibility with counterparties' Data Exchange solutions.

A public consultation for the CBA has taken place from 16.05.2013 to 10.06.2013. Within this timeframe stakeholders had the possibility to submit their comments on the CBA.

5.2 Timing of the CBA with respect to the network code

Based on the timeline set for the development of the network code interoperability and data exchange rules (please refer to the [draft project plan] for a detailed timeline for the full development process) the following timeline was set to conduct the CBA for selecting the data exchange solution(s).

CBA process steps over time:

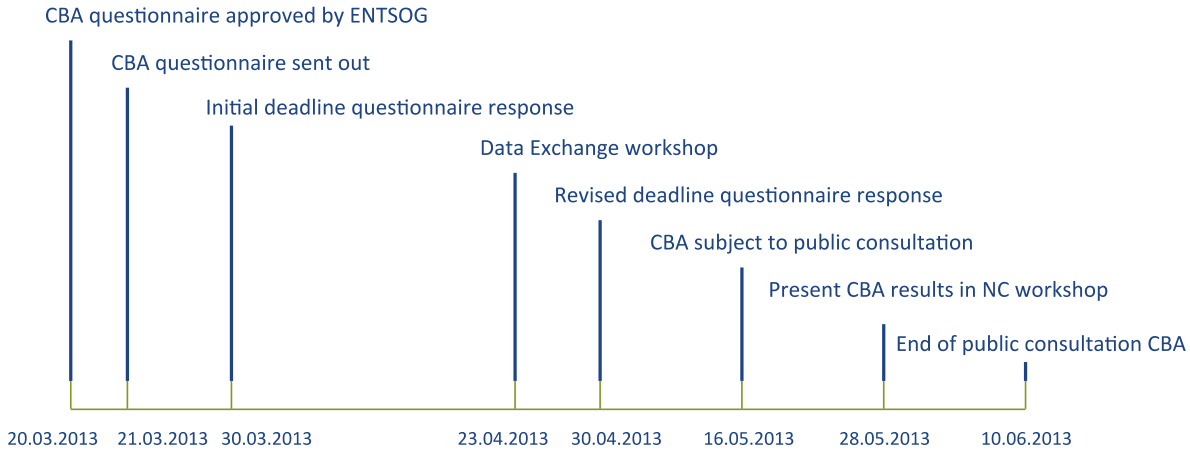

Figure 2: CBA timeline and process steps

- The CBA was performed on the basis of a questionnaire, which was sent on 21.03.2013 (see paragraph 6.1 to whom the questionnaire was sent and the content of the questionnaire).
- The deadline for questionnaire responses was 30.04.2013
- Results from this questionnaire, as well as the methodology used for the CBA were presented to all interested stakeholder during the Data Exchange Workshop at ENTSOG on 23.04.2013.
- The approved CBA was made available for public consultation on 16.05.2013.
- The preliminary conclusions were presented in the network code workshop on 28.05.2013.
- And the final CBA conclusions (after 10.06.2013) will be integrated into the network code before the stakeholder support process (09-07.2013-23.07.2013)

6 CBA execution

The CBA was executed with the help of data exchange experts for selecting the best solution for data exchange network, format and protocol. Furthermore a questionnaire was sent out to gain insights in cost incurred for document based protocols, in the spread of the solutions in use today, in synergies with the electricity DE rules and also to identify possible benefits of DE harmonisation.

6.1 Questionnaire content and responses

The questionnaire used to gain insights in the current gas market data exchange contained questions with regards to:

- Data Network
- Data Format
- Data Protocol
- Further considerations:
    - Data volumes
    - Expected benefits of a common DE solution
    - Synergies & benefits with electricity DE rules

The questionnaire was sent to:

- TSOs
- Participants to the Stakeholder Joint Workgroup Sessions
- EU representative organisations (CEDEC, Eurogas, GIE, OGP, GEODE, EFET, EASEE-gas)

The final deadline for questionnaire feedback was 30.04.2013. A summary of the responses that were received is shown in table 3.

EU state	DSO	LSO	NU	TSO[2]	Other	Total
AT				1/1		2
BE				1/-		1
CZ				-/1		1
DE	4		1	5/2		12
DK				-/1		1
FR				2/-		2
GB				2/-	1	3
GR				-/1		1
HU				1/-		1
IE				1/-		1
IT			1	2/-		3
NL	9	1	1	1/-		12
PL				-/1		1
PT				1/-		1
SE				-/1		1
SI				-/1		1
SK				1/-		1
SP	1		1	1/-		3
Total	**14**	**1**	**4**	**28**	**1**	**48**

Table 3: Questionnaire responses

Furthermore, for the spread evaluation of the data exchange solutions the answers on the ENTSOG members questionnaire on data exchange solutions in the network code were added to get a more complete overview of the EU gas market solutions in place. These numbers are also shown in table 3 in the TSO column.

6.2 Data network evaluation

A data network evaluation and selection was performed based on a technical evaluation and macro-economical spread evaluation.

6.2.1 Data network – technical evaluation

The data network is the electronic communication process used to send and receive data in an organised way. It is the lowest layer of the three needed for data exchange harmonisation as shown in figure 3.

[2] Numbers behind the slashes are the number of responses from the ENTSOG members questionnaire on the network code impact assessment

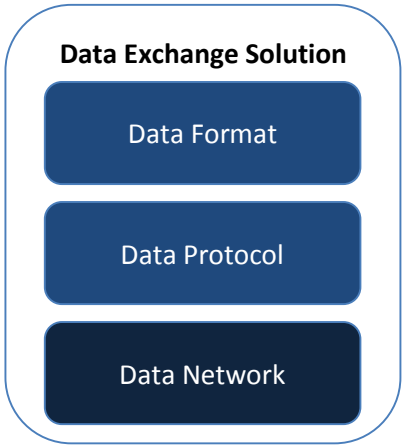

Figure 3: Representation of DE solution layers

Technical alternatives evaluated (short list):

- ISDN (digital telephone lines)
- X25
- Private owned networks
- Internet

Alternatives were scored against the following criteria:

- Accessibility for all parties involved in the international gas business
- Operator independent network connections due to the geographical spread of connected user
- Easy and fast, flexible and worldwide accessibility
- Reliability and up-time of the network

The scoring of each of the alternatives on the four criteria was performed in a quantitative way and visualised in a number, ranking from 1 (poor) or 2 (average) to 3 (good). An explanation per criterion why a specific score is chosen, is provided in the following chapters.

Criteria	ISDN score	X25 score	Private network score	Internet score
Accessibility	2	1	1	3
Independent network	1	1	1	3
Fast network	1	1	3	3
Reliable	2	2	2	3
Totals	**6**	**5**	**8**	**12**

Table 4: Data network technical evaluation matrix

6.2.1.1 Accessibility

Each of the alternatives was scored against the accessibility of a data network. Accessibility is the degree to which the data network is available to as many people as possible. Of the alternatives both ISDN and Internet score highest on the accessibility as almost every country has a telecom provider offering ISDN lines (although this technology is getting older and therefore less commonly used) and there are multiple ways to connect to the Internet for each European country, where almost anyone (95%) in the EU has the possibility to utilise a fixed broadband connection[3].

X.25 is an old standard from 1976, now only offered as a legacy service within some EU countries where it can be used over the d-bus of an ISDN line. It therefore scores poor on accessibility.

Private networks are, distinctly from virtual private networks, separated from the internet with a variety of standards offered within the EU. They are mostly used within a country and therefore offer no open solution for the whole European market. It therefore scores poor on accessibility.

6.2.1.2 Operator independent network

Operator independent means that the manner to connect to the network is not being limited by one specific owner (i.e. operator) of the network. ISDN is not operator-independent as only the national telecommunications providers per country offer it. It therefore scores poor on this criterion. The same applies to the private network and X.25. The Internet scores high on this criterion, as there are multiple ways to connect to this network (e.g. analogue phone lines, ISDN, ADSL, VDSL, Cable or fibre) and is therefore operator independent.

6.2.1.3 Easy, fast, flexible and worldwide availability

Based on technical limits:

- X.25 based on ISDN d-channel: 16 kbit/s
- ISDN-2 or 30: 64 kbit/s
- Private network: depends on underlying technology but can be as good as Internet connections
- Internet: Speeds up to 2 mbit/s are available to 91.8% of the EU inhabitants, theoretical speeds over 400 mbit/s can be achieved via cable, and speeds up to 100 terrabits/s can be achieved via fibre[4].

6.2.1.4 Reliability and up-time

This criterion is closely related to the operator independent network criterion. If the operator has problems with the connection and there are no fall-back options available then the network becomes less reliable and up-times are more difficult to keep. Furthermore, ISDN, X.25 and private networks are direct connections, or connections with few nodes. They therefore score average on this criterion, while the Internet has a large backbone with multiple options to connect to the network (redundancy). For example, the Internet backbone AMS-IX (Amsterdam Internet Exchange) offers the option for a 99.99% uptime connection (meaning less than an hour downtime per year) to the Internet.

[3] Source: https://ec.europa.eu/digital-agenda/en/scoreboard

[4] Source: http://www.newscientist.com/article/mg21028095.500-ultrafast-fibre-optics-set-new-speed-record.html

6.2.2 Data network – macro-economical spread evaluation

Based on the answers received on the questionnaire sent by ENTSOG where was asked how communication with other market participants is being done, the respondents answered the following for the use of the data network(s) for their business processes within their company:

Spread of data exchange network (document based DE)										
	Internet		*ISDN*		*VPN*		*PN*		*Others*	
Country										
AT	X									
BE	X						X			
CZ	X									
DE	X		X		X		X			
DK	X									
FR	X		X				X		X	
GB	X		X		X					
GR	X								X	
HU	X									
IE	X									
IT	X		X				X			
NL	X		X							
PT	X									
SE	X									
SI	X								X	
SK	X									
SP	X		X							
	TSO	Non-TSO	TSO	Non-TSO	TSO	Non-TSO	TSO	Non-TSO	TSO	Non-TSO
Used by % of respondents	86%	100%	24%	30%	14%	0%	17%	10%	14%	0%

Table 5: Data network spread for document based DE

Out of the questionnaire respondents (ENTSOG CBA and members questionnaire):

- 29 TSOs use document based DE
- 20 non-TSOs use document based DE

Spread of data exchange network (integrated DE)					
	Internet	*ISDN*	*VPN*	*PN*	*Others*
Country					
AT	X				
BE	X				
DE	X				
DK	X				
FR	X				X
GB			X		
HU	X			X	
IE	X				

IT							X			
NL	X				X					
SI	X									
SP	X									
	TSO	Non-TSO	TSO	Non-TSO	TSO	Non-TSO	TSO	Non-TSO	TSO	Non-TSO
Used by % of respondents	93%	80%			7%	20%	7%	20%	7%	

Table 6: Data network spread for integrated DE

Out of the questionnaire respondents (ENTSOG CBA and members questionnaire):

- 14 TSOs use integrated DE
- 5 non-TSOs use integrated DE

Spread of data exchange network (interactive DE)										
	Internet		*ISDN*		*VPN*		*PN*		*Others*	
Country										
AT	X									
BE	X									
CZ	X									
DE	X						X			
DK	X									
DI	X									
FR	X									
GB					X					
HU	X						X			
IE	X									
IT	X									
NL	X									
PL	X									
PT	X									
SI	X									
SK	X									
SP	X									
	TSO	Non-TSO	TSO	Non-TSO	TSO	Non-TSO	TSO	Non-TSO	TSO	Non-TSO
Used by % of respondents	87%	100%			4%		9%			

Table 7: Data network spread for interactive DE

Out of the questionnaire respondents (ENTSOG CBA and members questionnaire):

- 23 TSOs use interactive DE
- 5 non-TSOs use interactive DE

6.2.3 Data network - recommendation

Based on the technical evaluation of the various alternatives evaluated and the spread of the data network solutions within the EU gas market the following data network solution for the network code is proposed:

Data exchange type	Data network
Document based	Internet
Integrated	Internet
Interactive	Internet

Table 8: Data exchange type data network selection

6.3 Data format evaluation

Data format evaluation and selection was performed through a technical evaluation and macro-economical spread evaluation.

6.3.1 Data format – technical evaluation

The data format is the content and the structure of the document sent over the data network. It is the highest layer of the three required for data exchange harmonisation as shown in figure 4.

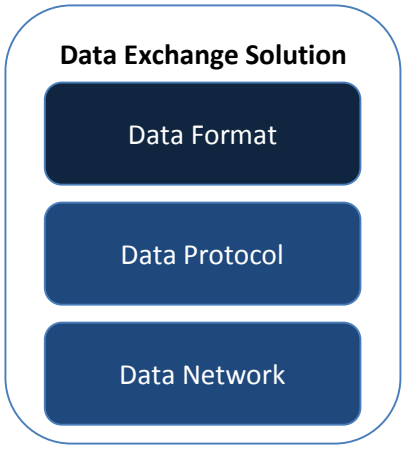

Figure 4: Representation of DE solution layers

Technical alternatives evaluated (short list):

- CSV
- Excel ® [5]
- EDIFACT
- Edig@s-XML[6]

[5] Excel ® - Registered Microsoft trademark

[6] Edig@s-XML is a XML format, harmonised in the gas market and based on the UN/EDIFACT formatting standard.

Alternatives are scored against the following criteria:

- Structure standardisation[7] needs to be possible –
  The format structure must be standardised by a body aimed at harmonising solutions
- The file format must support an open standard[8] –
  Chosen format must support format standard with non-commercial terms
- Overhead of the file format should be kept within boundaries –
  Format overhead is the amount of extra data needed to send the actual payload of a message
- The file format used must be spread throughout the EU gas market –
  The chosen data format must be used within the European gas market to minimise compatibility issues, not only regarding costs but also the ease of implementation
- The file format needs to be readable for human and machine, complexity should therefore be kept at an acceptable level

The scoring of each of the alternatives on the five criteria is done in a qualitative way and visualised in a number, ranking from 1 (poor) or 2 (average) to 3 (good). An explanation of the scoring per criterion is provided in the following paragraphs.

Criteria	CSV score	Excel score	EDIFACT score	Edig@s-XML score
Structure standardisation	1	1	3	3
Open standard	1	1	3	3
Format overhead	3	2	3	2
Spread	2	2	3	3
Complexity	1	3	1	3
Totals	**8**	**9**	**13**	**14**

Table 9: Data format technical evaluation matrix

6.3.1.1 Structure standardisation

The format structure must be harmonised. EDIFACT is standardised by the UNECE with an ISO certification. It therefore scores high on this criterion. Edig@s-XML, based on the UN EDIFACT standard, scores high as it is harmonised in the gas market. CSV and Excel files are only bi-lateral agreed 'standards' between two or more parties and therefore score low on this criterion.

[7] Standardisation is used in a broader context than a legal one, including bodies and solutions not formally recognised as such.
[8] Please see the footnote above.

6.3.1.2 Open standard

Open standard is defined as the use of a format standard on non-commercial terms. All proposed alternatives are available on non-commercial terms[9]. Both EDIFACT and Edig@s are supported and published by independent organisations (UNECE and EASEE-gas respectively) being non-commercial standards for the gas market. As mentioned in 6.3.1.1, CSV and Excel are not formally standardised by any harmonisation body.

6.3.1.3 Format spread

The data format must be used within the European gas market. The scoring is based on the macro-economical spread of the data formats as discussed in chapter 6.3.2.

6.3.1.4 Format overhead

Format overhead is the amount of extra data needed to send the actual payload of a message. Minimising format overhead is important to lower the volume of data transfer needed to send the message from one party to another. CSV and EDIFACT are very compressed data formats (plain text, simple separators between data) and therefore score high on this criterion.

6.3.1.5 Readability of file format (complexity)

Readability of the file format is important as not all data exchange is fully automated. When human interaction is required, the complexity of the format creates a barrier to understand the content of the file. CSV and EDIFACT are very compact formats and are therefore hard to read as a human. In addition, EDIFACT requires translation software to process the messages in order to insert and extract the values, which makes it more expensive. They therefore score low on the complexity. Excel and XML have a more visible structure with explanations what is stored where in the file. They therefore score high on this criterion.

[9] There are no commercial alternatives available for the EU gas market for the time being.

6.3.2 Data format – macro-economical spread evaluation

Based on the answers received on the questionnaire sent by ENTSOG, the following data format(s) are in use in Europe:

Spread of data exchange format (document based DE)												
	XML		*CSV*		*Excel*		*EDIFACT*		*Edig@s XML*		*Kiss-A*	
Country												
AT									X		X	
BE			X				X		X			
CZ									X			
DE	X						X		X		X	
DK	X						X		X			
FR	X		X				X		X			
GB	X								X			
GR					X							
HU					X							
IE	X		X									
IT	X				X		X		X			
NL	X						X		X			
PL			X		X				X			
PT					X							
SE							X					
SK					X				X		X	
SP	X		X		X		X		X			
	TSO	Non-TSO	TSO	Non-TSO	TSO	Non-TSO	TSO	Non-TSO	TSO	Non-TSO	TSO	Non-TSO
Used by % of respondents	38%	65%	24%	0%	28%	5%	34%	45%	48%	30%	17%	10%

Table 10: Data format spread for document based DE

Out of the questionnaire respondents (ENTSOG CBA and members questionnaire):

- 29 TSOs use document based DE
- 20 non-TSOs use document based DE

Spread of data exchange format (integrated DE)												
	XML		*CSV*		*Excel*		*EDIFACT*		*Edig@s XML*		*Kiss-A*	
Country												
BE	X											
DE	X								X			
DK	X											
FR	X											
GB	X											
IE	X											
IT	X											
NL	X		X									
SI	X										X	
SP	X								X			
	TSO	Non-TSO	TSO	Non-TSO	TSO	Non-TSO	TSO	Non-TSO	TSO	Non-TSO	TSO	Non-TSO
Used by % of respondents	92%	80%	8%	20%					8%	20%	8%	

Table 11: Data format spread for integrated DE

Out of the questionnaire respondents (ENTSOG CBA and members questionnaire):

- 13 TSOs use integrated DE
- 5 non-TSOs use integrated DE

One respondent stated another format was used in France for integrated DE, namely TASE2.

Spread of data exchange format (interactive DE):
For interactive DE the data exchange format is not applicable as it is defined as a method of inputting data through a web browser. The technology for sending this data to the responsible system is an internal IT affair and not subject to harmonisation.

6.3.3 Data format - recommendation

Based on the technical evaluation of the various alternatives evaluated and the spread of the data format solutions within the EU gas market, the following data format solution for the network code is proposed:

Data exchange type	Data format
Document based	Edig@s-XML
Integrated	Edig@s-XML
Interactive	N/A

Table 12: Data exchange type data format selection

6.4 Data protocol evaluation

Data protocol evaluation and selection was performed with a technical evaluation, a macro-economical spread evaluation and a cost evaluation.

6.4.1 Data protocol – technical evaluation

The data protocol is a system of digital message format and rules for exchanging those messages in or between computing systems. It is the middle layer of the three layers required for data exchange harmonisation as shown in figure 5.

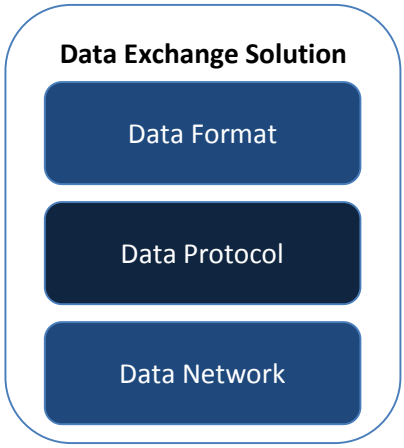

Figure 5: Representation of DE solution layers

For the protocol evaluation, a distinction is made whether DE is used for document based exchange or integrated exchange.

6.4.1.1 Data protocol - technical evaluation for document based DE

Technical alternatives evaluated (short list):

- AS2
- ebMS v3
- AS4

Alternatives were scored against the following technical criteria and risk criteria.

1. Technical criteria
   - Timing of protocol (message push / pull)
   - Security of protocol
   - Payload (the actual content of the message)
   - Traceability of protocol (message logging)

Next to technical criteria the maturity of the protocol is also taken into account as a risk criteria, as ebMS v3 and AS4 are relatively new protocols while AS2 is being used since 2005.

2. Risk criteria:
   - Expected life cycle
   - Maturity of protocol
   - Available solutions

The scoring of each of the alternatives on the seven criteria was performed in a quantitative way and visualised in a number, ranking from 1 (poor) or 2 (average) to 3 (good). An explanation of the scoring per criterion is provided in the following paragraphs.

Technology	AS2 score	ebMS v3 score	AS4 score
Timing	2	3	3
Security	2	3	3
Payload	3	3	3
Traceability	2	3	3
Totals	**9**	**12**	**12**

Table 13a: Data protocol technical evaluation matrix

Risk	AS2 score	ebMS v3 score	AS4 score
Life cycle	2	3	3
Maturity	3	1	1
Available solutions	3	1	1
Totals	**8**	**5**	**5**

Table 13b: Data protocol risk evaluation matrix

6.4.1.1.1 Timing of the protocol

AS2 offers the possibility to only push messages to a counterpart. EbMS v3 and AS4 both offer the option to push and pull a message. The alternatives are here scored on their technical capabilities and not the current business requirements. In the current business practices between TSOs and their counter parties, the pull functionality is not required.

6.4.1.1.2 Security of the protocol

AS2 is an older standard supporting encryption and signing of messages. Maximum encryption can be done with 3DES, while signing is done with the PKCS 7 – offering the possibility to sign messages with security certificates. EbMS v3 and AS4 are capable of encrypting with the more up-to-date standard AES and signing messages with security certificates – allowing more flexibility and security for signing messages.

6.4.1.1.3 Payload

Each of the alternatives can send the payload to a counterpart, although ebMS v3 and AS4 do offer the option for larger payloads without any additional extensions to the protocol. Each of the alternatives scores equal on this criterion.

6.4.1.1.4 Traceability of protocol

Each of the alternatives supports message disposition notifications, so an acknowledgment of message delivery/reception can be given to the sender of the message. EbMS v3 and AS4 offer more options in the message header for routing the message within systems.

6.4.1.1.5 Lifecycle

AS2[10] is actively being used since 2005. EbMS v3[11] is an official OASIS standard since 2007 and AS4[12] recently became an official OASIS standard (being based upon the ebMS v3 protocol) in 2013. Data exchange solutions used in the past like X25 and ISDN/FTP have been replaced after 20/25 years by newer solutions. The lifecycle of AS2 is assumed (2005-2030) and for AS4 (2013-2038).

6.4.1.1.6 Maturity

AS2 is actively being maintained, as it is still a dominant data exchange solution in some countries in Europe. EbMS v3 and AS4 are new protocols that have not been extensively tested for interoperability and various vendor talks made clear that these products are still being developed. For these reasons AS2 scores high on this criterion, while ebMS v3 and AS4 score lower.

6.4.1.1.7 Available solutions

For AS2 the following software providers are registered with a Drummond certificate: Axway, Cisco, Cleo, Boomi, DIcentral, Extol, GXS, HP, IBM, Liaison, Nsoftware, Seeburger, Tibco.

Since AS4 is a new emerging protocol, certification is on-going. Today the following software providers are working on an AS4 product in line with the AS4 standard in order to obtain a Drummond certification: Axway, Cleo, Flame, Holodeck, Fujitsu, Oracle, Ponton, Sonnenglanz, Tibco.

Because the certification for AS4 products is not finalized yet, the score for available solutions for AS4 is low.

6.4.1.2 Data protocol - technical evaluation for integrated DE

ENTSOG identified in an early stage of the network code development that integrated DE requires HTTP(S) as the application layer for transport (which is also used for SOAP). Based on the questionnaire, results show that each of the respondents using integrated DE uses HTTP(S)/SOAP as the application layer for transport. Therefore no further analysis is being executed to identify the optimal solution.

10 IETF RFC 4130 published July 2005
11 OASIS publication 1.10.2007
(http://docs.oasis-open.org/ebxml-msg/ebms/v3.0/core/ebms_core-3.0-spec.pdf)
12 OASIS publication 15.02.2013
(https://www.oasis-open.org/news/pr/as4-profile-of-ebms-3-0-becomes-oasis-standard)

6.4.2 Data protocol – macro-economical spread evaluation

Based on the answers received on the questionnaire sent by ENTSOG, the following data protocol(s) are in use in Europe:

Spread of data exchange protocols (document based DE)														
	AS2		*FTP*		*sFTP*		*HTTP*		*HTTPS*		*SOAP*		*SMTP*	
Country														
AT	X				X		X		X				X	
BE	X		X						X		X			
CZ	X										X		X	
DE	X		X				X		X		X		X	
DK	X										X		X	
FR	X		X						X		X			
GB	X		X		X		X		X					
GR													X	
HU					X								X	
IE			X						X				X	
IT	X		X		X		X		X				X	
NL	X		X		X		X		X				X	
PT			X						X				X	
SE													X	
SI													X	
SK	X												X	
SP			X		X		X		X		X		X	
	TSO	Non-TSO	TSO	Non-TSO	TSO	Non-TSO	TSO	Non-TSO	TSO	Non-TSO	TSO	Non-TSO	TSO	Non-TSO
Used by % of respondents	45%	35%	45%	30%	21%	10%	14%	5%	17%	55%	21%	0%	59%	25%

Table 14: Data protocol spread for document based DE

Out of the questionnaire respondents (ENTSOG CBA and members questionnaire):

- 29 TSOs use document based DE
- 20 non-TSOs use document based DE

Spread of data exchange protocols (integrated DE)														
	AS2		*FTP*		*sFTP*		*HTTP*		*HTTPS*		*SOAP*		*SMTP*	
Country														
AT									X					
BE											X			
DE							X		X		X			
DK											X			
FR											X			
GB									X					
HU											X			
IE											X			
IT									X					
NL							X		X		X			
SI											X			
SP											X			
	TSO	Non-TSO	TSO	Non-TSO	TSO	Non-TSO	TSO	Non-TSO	TSO	Non-TSO	TSO	Non-TSO	TSO	Non-TSO
Used by % of respondents								40%	36%	20%	64%	40%		

Table 15: Data protocol spread for integrated DE

Out of the questionnaire respondents (ENTSOG CBA and members questionnaire):

- 14 TSOs use integrated DE
- 5 non-TSOs use integrated DE

Spread of data exchange protocols (interactive DE):
ENTSOG identified that interactive DE requires no protocol as information is presented through a website and is therefore not evaluated in the analysis.

6.4.3 Data protocol – recommendation

Based on the technical evaluation of the various alternatives and the spread of the data protocol solutions within the EU gas market the following data protocol solution for the network code is proposed:

Data exchange type	Data protocol
Document based	See explanation below
Integrated	HTTP(S)/SOAP
Interactive	N/A

Table 16: Data exchange type data protocol selection

As show in table 13 all solutions have the same global score. From a technical point of view, AS4 is using ebMS as a basis for its communication protocol. However AS4 restrict options as opposed to ebMS guaranteeing a quicker implementation. Therefore the ebMS v3 will not be taken further into

account for this evaluation. The recommendation for the protocol for document based DE will be based on the cost evaluation that is described in the next chapter.

6.5 Further qualitative analysis

Based on input given in the questionnaires, considerations are be made for the following items:

- Data volumes in the EU gas market
- Benefits of DE harmonisation
- Synergies with electricity DE rules

6.5.1 Data volumes

Data volumes are split into two overviews. A distinction was made between an intensive market where more than 4000 messages per day are sent and a non-intensive market where less than 4000 messages per day are sent. The average data volume is based on answers from respondents of the questionnaire. To get a better understanding of these averages the minimum and maximum values are also given.

Intensive market - average data volume sent daily:

To / From	TSO	Non-TSO
TSO	3300 (0-20000)	13000 (4100-40000)
Non-TSO	3600 (100-15200)	13900 (4000-15500)

Table 17: Average number of daily messages sent (intensive market)

Non-intensive market - average data volume sent daily:

To / From	TSO	Non-TSO
TSO	300 (0-800)	1200 (500-2800)
Non-TSO	400 (0-1000)	800 (100-2300)

Table 18: Average number of daily messages sent (non-intensive market)

Based on the average number of messages sent on a daily basis today, an overview of the total volume (in gigabyte) can be given for the EU market. This estimated volume is based upon the responses given in the questionnaire. An average message size of 10 kilobyte was used for the calculation.

From	Annual data volume sent in GB
TSO	622
Non-TSO	48000

Table 19: Annual data volume sent in GB

The figures presented in the tables above have been used during the technical evaluation to confirm the ability of the different protocols to handle these amounts of data. All proposed protocols in combination with the proposed network are meeting the technical requirements.

Remark:
Newer solutions usually have a negative impact on the size of the messages. In the case of AS4, the more elaborated message header, and optionally when a stronger encryption is used for the messages, the size of a message may increase. However the increased data volume for a message is largely compensated by the technological evolutions through increased bandwidths that are available for internet connections.

6.5.2 Synergies with electricity DE rules

The framework guidelines requested to investigate the possibility of synergies with the electricity DE rules. In the questionnaire sent we asked the respondent: "Do you gain benefits from integration with the electricity data exchange solution?" 91% of questionnaire respondents, of the 22 answers given, say no benefits are gained when harmonising gas and electricity DE rules. 2 respondents (non-TSOs) answered maybe, of which one respondent answered that a distinction between retail and wholesale needs to be made (although benefits remain unclear).

Further considerations on synergies with the electricity DE rules are being discussed in chapter 8.2.

6.5.3 Benefits of DE harmonisation

Based on responses given in the questionnaire the following qualitative benefits were identified when harmonising the DE solutions:

- Harmonised gas-market DE will remove cross-border trade barriers
- Fewer communication solutions (for each platform or business process) to maintain will lead to reduced costs
- Less time effort in preparing and establishing new connections with partners
- Higher communication reliability with fewer DE solutions in place
- Less expensive transactions due to more intensive use of harmonised data exchanges

7 Scenario analysis for Document Based Data Exchange protocols

This chapter will give insight into the costs incurred when selecting one of the protocol alternatives discussed in chapter 6. EbMS is not taken into consideration as described in chapter 6.4.3.

7.1 Cost calculation parameters

The cost calculation was performed with a discounted cash flow analysis to determine the net present value (NPV) of the alternatives under evaluation. In order to calculate the outcomes some criteria are set and assumptions are made.

According to the efforts required to implement a new protocol, the selected protocol should stay in place for a minimum of 10 years after its introduction. Data exchange solutions used in the past like X25 and ISDN/FTP have been replaced after 20/25 years by newer solutions because they were not supported anymore or because they did not meet the imposed higher security standards. Based on the assumed lifecycle of 25 years for protocols it is expected that the remaining lifetime for AS2 is 15 years (2015 – 2030) and for AS4 is 23 years (2015 – 2038) as explained in section 6.4.1.1.5 (lifecycle). Both evaluated protocols fulfil the minimum 10-year operation time.

- Investment decision is made in 2013
- Minimum time of usage for the harmonised solution when NC enters into force is 10 years
- Benefits are kept at €0 – (for the comparison of two solutions the financial benefits are set equally to zero)
- Discount rate is set at 7% –
  The annual effective discount rate is the annual interest divided by the capital including that interest, which is the interest rate divided by 100% plus the interest rate
- Cost of set up and maintenance are based on answers from questionnaire respondents:

Data protocol	Average set up cost	Average maintenance cost
AS2	€ 157.000 (35.000-500.000)	€ 91.000 (4.000-500.000)
AS4	€ 137.000 (10.000-435.000[13])	€ 108.000 (4.000-500.000)

Average rounded cost are given with minimum and maximum values between brackets

Table 20: Estimated average implantation costs based on questionnaire responses

Additional statistical information is available in appendix A.

Discussion on the questionnaire responses (table 20):

The CBA questionnaire responses show that the expected average set up cost is higher than the actual average set up cost. A possible explanation is the uncertainty that is involved when estimating the set up cost for a protocol implementation - to cover the risk.

Differences between the two alternatives in terms of maintenance cost can exist due to the risk that is involved when introducing a new solution (AS4) for IT-service providers. The higher maintenance cost may decrease over time due to learning curve effects. This is taken into account in the NPV calculation. A discount for the maintenance costs is set at 3% per year for the next 10 years.

13 One respondent mentioned a set up cost of 1.7 million Euros. This figure could not be validated and has been removed from the sample.

The questionnaire responses have a high spread and standard deviation (see appendix A). An explanation could be the different size of the system and what each respondent included in the cost in detail. However based on experience and input received from external experts the average values are a plausible guideline for a general cost estimation.

7.2 Individual cost calculation

The individual NPV calculation is done with the parameters described in chapter 7.1. This leads to the following individual costs over a 10-year period:

Data protocol	NPV
AS2	€ 686.000-
AS4	€ 702.000-

Table 21: Individual NPV calculation (10 years)

Based on the expected lifetime of the protocols evaluated an average individual annual cost (NPV for the remaining lifecycles of 15 respectively 23 year divided by the remaining lifecycle) gives the following outcome:

Data protocol	Average annual cost
AS2 (15 years)	€ 56.800
AS4 (23 years)	€ 44.600

Table 22: Average individual annual cost (remaining lifecycle)

Based on the individual cost calculation (table 21) two scenarios are being discussed in the next paragraphs:

1. Cost calculation for one solution for the whole gas market
2. Cost calculation for a common solution for a selection of gas market participants

7.3 Scenario I: Full market implementation

When taking the AS2 market spread into account, the total market cost can be calculated per protocol alternative. This calculation is based on the assumptions that:

- 45% of the TSOs already have AS2 implemented
- 15% of the non-TSOs already have AS2 implemented
- All market parties will change their protocol in 2015
- The selected protocol will be used at least for 10 years
- The market consists of around 3800 market parties[14], of which:
  - 43 TSOs
  - 2200 DSOs
  - 1500 NUs
  - 45 SSOs/LSOs

Data protocol	TSO market cost	Non-TSO market cost	Total market cost
AS2	€ 16.824.000	€ 2.187.943.000	€ 2.204.767.000
AS4	€ 30.165.000	€ 2.630.728.000	€ 2.660.893.000

Table 23: Total market cost per protocol implementation for document based DE

Based on the existing solutions in place for document based data exchange within the EU gas market, an AS2 implementation presents lower total market cost.

7.4 Scenario II: Common solution market implementation

The figures in table 23 show that the cost required to harmonise the data exchange solutions for non-TSOs is 90 to 120 times the total cost required for the TSOs. Impose a full market harmonisation for data exchange for all parties is unrealistic, taking into account that the majority of the non-TSOs are only interested in local (national) data exchange, since there is no financial, commercial or operational benefit to do so. Therefor it is reasonable to keep the existing data exchange solutions in place as long as they are meeting the requirements of the business processes they have to cover.

In order to eliminate barriers for free flow of gas in Europe with respect to data exchanges, the most cost efficient way to reach this objective is that TSOs shall make the common data exchange solution available for all counterparties (i.e. network users that communicate over interconnection points), in line with the timelines imposed by the corresponding network codes. In this way the cost for harmonisation can be based on the costs involved for TSOs and a subset of the number of NUs to offer the common data exchange solution as presented in the following table, based on the cost calculation for the TSOs and affected NUs for the next 10 years.

The number of network users taken into account is assumed to be 15% (253) of the total network users, based on the information given by the TSOs.

The calculation is based on the assumptions that:

- 45% of the TSOs already have AS2 implemented
- 15% of the NUs already have AS2 implemented

[14] Total estimated number of market parties. Not all market parties are currently involved in cross-border communication; this depends on various factors including future network code developments.

- 253 NUs are communicating over interconnection points

Data protocol	TSO market cost	NU market cost	Total market cost
AS2	€ 16.824.000	€ 147.613.000	€ 164.437.000
AS4	€ 30.165.000	€ 177.486.000	€ 207.651.000

Table 24: Overview TSO and NU cost calculation (10 years)

7.5 Scenario analysis – recommendation

In order to remove potential barriers for the free flow of gas in Europe with respect to data exchange, all TSOs shall implement and offer the possibility to use the common data exchange solution for data exchanges with their counter parties.

To minimise the cost for the selected counter parties where existing data exchange solutions are in place that are compatible with the business and technical requirement of the concerned business processes, a different implementation schedule can be agreed, subject to national regulatory authority approval. This approach permits a longer migration period for the network users and allows them to make the investment at the moment they have to replace or upgrade their IT systems.

8 Further considerations

The criteria of the framework guidelines referred also to take into consideration potential discrimination of small shippers and new market entrants and synergies with the electricity DE rules for the selection of a data exchange solution. Input for these criteria was taken from the questionnaire and from stakeholders during the SJWS.

8.1 Discrimination of small shippers and new market entrants

The harmonisation of DE solutions will lead to investments in the harmonised DE solution proposed by the network code. For larger companies the investment will be relatively small, as they will have an extensive IT-infrastructure and higher IT-budgets. For smaller companies the investment will be high compared to the relatively low use their data exchange system.

To mitigate the impact of harmonisation of data exchange solutions for small users and new market entrants the following alternatives are considered:

1. Keep existing DE solutions in place

During workshops and stakeholder joint workgroup sessions (SJWS) for interoperability and data exchange, stakeholders expressed their concerns regarding the impact and the costs related to the harmonisation of the DE solutions for the whole gas market for all existing business processes and upcoming business processes (in new network codes). The network code allows that existing DE solutions can stay in place as long as they are compliant with the business requirements with approval of the NRAs.

2. Service providers

When smaller companies, or new market entrants need to communicate via the harmonised DE solution there are options to 'reroute' communications via service providers. The service provider transforms these files into the required DE format and sends them via the harmonised network and protocol as stated in the network code. This avoids big investments in IT for setting up data exchange solutions for small users.

3. Interactive DE solutions

Depending on the application, TSOs or parties operation on behalf of TSOs can offer interactive data exchange solutions in addition to document based data exchanges. This way the TSO's counter party can send in business process data via a web browser by entering these values directly on screen, thus avoiding document based data exchanges. This lowers the need for IT-investments, but requires more manual labour (data entry on screen).

8.2 Synergies with electricity DE rules and other market participants

Based on the proposed harmonised DE solution the following characteristics are shared with the electricity DE market solutions MADES and EFET:

- Data network used: Internet
- Data format used: XML

Differences:

- Data protocol used: ebXML (ebMS v2) for EFET and a specific third party platform (hosted solution) for MADES
- Not all electricity TSOs support MADES as a common solution
- EFET has specific business practices for traders

Although some business activities are similar for electricity and gas, it is expected that the cost and the effort to harmonise both energy sectors are much higher than the potential benefits. Only a small percentage of the respondents to the questionnaire mentioned a potential added value. For TSOs and network users the additional cost for maintenance and the risk for data exchange failures due to changed data message formats are much higher without any financial benefit.

For these reasons, it is not recommend harmonising data exchanges with other markets.

9 Recapitulation of framework guideline considerations

The considerations that needed to be taken into consideration as stated in the framework guidelines are recapitulated in the paragraphs below.

9.1 Best available technologies, particularly in terms of security and reliability

Based on the technical evaluation, as described in chapter 6, the following technical alternatives were selected for the three types of data exchange identified:

Data exchange component	Alternatives
Network	Internet, X25, ISDN and Private Network
Format	CSV, Excel, EDIFACT and Edig@s-XML
Protocol	AS2, ebMS v3 and AS4

Table 25: Selected alternatives for data exchange components

9.2 The actual spread of the solutions considered

The spread (whether the solution considered is widely used) was identified with the use of the ENTSOG and EC impact assessment questionnaires. These numbers, as shown in chapter 6, were the following for the alternatives proposed / selected for the three data exchange types:

- Document based:

Component	Possible alternative	Spread TSO	Spread non-TSO
Network	Internet	86%	100%
Format	Edig@s-XML	48%	30%
Protocol	AS2 / AS4	45% / 0 %	35% / 0%

Table 26: Spread of document based data exchange components for chosen alternative

- Integrated:

Component	Chosen alternative	Spread TSO	Spread non-TSO
Network	Internet	93%	80%
Format	Edig@s-XML	8%	20%
Protocol	HTTP(S)/SOAP	36%/64%	20%/40%

Table 27: Spread of integrated data exchange components for chosen alternative

- Interactive:

Component	Chosen alternative	Spread TSO	Spread non-TSO
Network	Internet	87%	100%

Table 28: Spread of interactive data exchange component for chosen alternative

9.3 The volume of data traffic required to transfer information

The figures presented in the tables below have been used during the technical evaluation to confirm the ability of the different protocols to handle these amounts of data. All proposed protocols in combination with the proposed network are meeting the technical requirements.

- Intensive market - average data volume sent daily:

To / From	TSO	Non-TSO
TSO	3300 (0-20000)	13000 (4100-40000)
Non-TSO	3600 (100-15200)	13900 (4000-15500)

Table 29: Average number of daily messages sent (intensive market)

- Non-intensive market - average data volume sent daily:

To / From	TSO	Non-TSO
TSO	300 (0-800)	1200 (500-2800)
Non-TSO	400 (0-1000)	800 (100-2300)

Table 30: Average number of daily messages sent (non-intensive market)

9.4 The costs of first introduction and cost of operation

Cost of set up and maintenance for document based data exchange are based on answers from questionnaire respondents:

Data protocol	Average set up cost	Average maintenance cost
AS2	€ 157.000 (35.000-500.000)	€ 91.000 (4.000-500.000)
AS4	€ 137.000 (10.000-435.000)	€ 108.000 (4.000-500.000)

Table 31: Average cost are given with minimum and maximum values between brackets

Based on the expected lifetime of the protocols evaluated an average individual annual cost (NPV for the remaining lifecycles of 15 respectively 23 year divided by the remaining lifecycle) gives the following outcome:

Data protocol	Average annual cost
AS2 (15 years)	€ 56.800
AS4 (23 years)	€ 44.600

Table 32: Average individual annual cost (remaining lifecycle)

Market costs for a common solution for TSOs and network users that communicate over interconnection points were calculated:

Data protocol	TSO market cost	NU market cost	Total market cost
AS2	€ 16.824.000	€ 147.613.000	€ 164.437.000
AS4	€ 30.165.000	€ 177.486.000	€ 207.651.000

Table 33: Overview TSO and NU cost calculation (10 years)

Taking into account the discussion in paragraph 7.1 it is expected that AS4, based on a more recent technology will last longer than AS2. Selecting AS4 would be more cost efficient over the protocol lifetime (paragraph 7.2 – table 22). In addition, AS4 scores higher on the technical evaluation (table 13a).

9.5 The potential for discrimination of small shippers or new market entrants

To mitigate the impact of harmonisation of data exchange solutions for small users and new market entrants the following alternatives are considered:

1. Keep existing DE solutions in place
2. Service providers
3. Interactive DE solutions

9.6 The synergies with current electricity Data Exchange rules

Although some business activities are similar for electricity and gas, it is expected that the cost and the effort to harmonise both energy sectors are much higher than the potential benefits. Only a small percentage of the respondents to the questionnaire mentioned a potential added value. For TSOs and network users the additional cost for maintenance and the risk for data exchange failures due to changed data message formats are much higher without any financial benefit.

For these reasons, it is not recommend harmonising data exchanges with other markets.

9.7 The compatibility with counterparties' Data Exchange solutions

None of both solutions for document based data exchange (using AS2 / AS4 protocol) are technically compatible with other solutions in place today (see table 14). The network code allows that existing DE solutions can stay in place as long as they are compliant with the business requirements with approval of the NRAs. This ensures maximum compatibility with counterparties' existing DE solutions.

10 Conclusion – Document based data exchange protocols

In the previous chapters a detailed evaluation was done for the selection of a common data exchange solution. The document based DE solution has two possible protocol alternatives; in order to make a decision on the final selection an overview of the benefits for each alternative is given in the table below.

Benefits	AS2	AS4
Technical	• Proven technology (based on HTTP)	• Based on SOAP (web services) • Security (stronger encryption) • Routing possibilities • Pull functionality
Risk Control	• Maturity & spread in gas sector (standardised in 2005)	• Based on proven technology in other sectors

Table 34: Overview - Benefit for the evaluated document based Data Exchange protocols

Cost	AS2	AS4
Cost	• NPV (10 year): € 686.000- • Market cost € 164.437.000 • Average annual cost over lifecycle € 56.800	• NPV (10 year): € 702.000- • Market cost € 207.651.000 • Average annual cost over lifecycle € 44.600

Table 35: Overview - Cost for the evaluated document based Data Exchange protocols

For document based data exchange, from a technical and a long term perspective, AS4 is the recommended solution.

11 Proposed common solutions

Taking into consideration the technical, risk and macro-economical evaluations described in this document, and following the criteria defined in the framework guidelines, the following DE solutions are proposed to be included in the network code "Interoperability and Data Exchange":

Data exchange type	Data network	Data format	Data protocol
Document based	Internet	Edig@s-XML	AS4
Integrated	Internet	Edig@s-XML	HTTP(S)/SOAP
Interactive	Internet	N/A	N/A

Table 36: data exchange solution overview for data exchange types

Although AS4 is based on existing and already used technology (ebMS v3), the configuration and setup of the AS4 communication needs to be defined for the gas TSOs, based on their specific communication needs.

AS4 task force:

As indicated in table 13b the risk for AS4 is higher than for AS2 related to the maturity and available solutions. Therefore, ENTSOG is willing to collaborate with the stakeholders in order to eliminate the risk related to this new technology by the creation of a task force to define all required AS4 specific parameters and to setup a proof of concept.

Proposed implementation plan:

In order to remove potential barriers for the free flow of gas in Europe with respect to data exchange, all TSOs shall implement and offer the possibility to use the common data exchange solution for data exchanges with their counter parties.

To **minimise the cost** for the selected counter parties where **existing data exchange solutions** are in place that are compatible with the business and technical requirement of the concerned business processes, a **different implementation schedule** can be agreed, subject to national regulatory authority approval.

This approach permits a longer migration period for the network users and allows them to make the investment at the moment they have to replace or upgrade their IT systems.

12 Appendix A: Statistical information

For the cost calculation from chapter 7 the following additional statistical information is available. Discussion on the questionnaire responses given is described in paragraph 7.1.

Statistic	AS2 – set up	AS2 - maintenance	AS4 – set up	AS4 - maintenance
Population	22		33	
Average	€ 156.850	€ 90.842	€ 136.898	€ 108.285
Median	€ 160.000	€ 12.000	€ 137.500	€ 20.000
Mode	€ 160.000	€ 10.000	€ 160.000	€ 10.000
Min	€ 35.000	€ 4.000	€ 10.000	€ 4.000
Max	€ 500.000	€ 500.000	€ 435.000	€ 500.000
1st quartile	€ 100.000	€ 10.000	€ 50.000	€ 10.000
3rd quartile	€ 160.000	€ 67.500	€ 160.000	€ 42.500
Std. dev	€ 98.957	€ 140.753	€ 107.858	€ 175.497
Avg. dev	€ 56.095	€ 109.119	€ 76.231	€ 133.849

Table 37: Statistical information questionnaire responses for cost evaluation