INSPIRE
Infrastructure for Spatial Information in Europe

INSPIRE Network Services Performance Guidelines

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1 Foreword

The document is publicly available as a 'non-paper', as it does not represent an official position of the Commission, and as such can not be invoked in the context of legal procedures.

2 Definition

In this document, minimum performance criteria are understood as the minimal level by which an objective is considered to be attained and it therefore does not mean a minimal set of objectives.

Performance in the Directive is considered synonymous to “Quality of Service” often used in the context of Web Services [1] and is considered to go beyond criteria such as throughput and latency.

When, in the document, a reference to the subsidiarity principle is made, it shall be taken as given by the European Commission Definition[1]:

The principle of subsidiarity is defined in Article 5 of the Treaty establishing the European Community. It is intended to ensure that decisions are taken as closely as possible to the citizen and that constant checks are made as to whether action at Community level is justified in the light of the possibilities available at national, regional or local level. Specifically, it is the principle whereby the Union does not take action (except in the areas which fall within its exclusive competence) unless it is more effective than action taken at national, regional or local level. It is closely bound up with the principles of proportionality and necessity, which require that any action by the Union should not go beyond what is necessary to achieve the objectives of the Treaty.

The Edinburgh European Council of December 1992 issued a declaration on the principle of subsidiarity, which lays down the rules for its application. The Treaty of Amsterdam took up the approach that follows from this declaration in a Protocol on the application of the principles of subsidiarity and proportionality annexed to the EC Treaty. Two of the things this Protocol introduces are the systematic analysis of the impact of legislative proposals on the principle of subsidiarity and the use, where possible, of less binding Community measures.

When a reference to the proportionality principle is made, it shall be taken as given by the European Commission Definition[2]:

Like the principle of subsidiarity, the principle of proportionality regulates the exercise of powers by the European Union, seeking to set within specified bounds the action taken by the institutions of the Union. Under this rule, the institutions' involvement must be limited to what is necessary to achieve the objectives of the Treaties. In other words, the extent of the action must be in keeping with the aim pursued.

This means that when various forms of intervention are available to the Union, it must, where the effect is the same, opt for the approach which leaves the greatest freedom to the Member States and individuals.

The principle of proportionality is clearly laid down in primary law under Article 5, third paragraph, of the Treaty establishing the European Community (TEC). A Protocol on the application of the principles of subsidiarity and proportionality, annexed to the TEC by the Treaty of Amsterdam, sets out the criteria for applying both these principles.

[1] http://europa.eu/scadplus/glossary/subsidiarity_en.htm
[2] http://europa.eu/scadplus/glossary/proportionality_en.htm

3 Overview

Minimum Performance Criteria for INSPIRE Network Services are required in Article 16 of the INSPIRE Directive[3]:

Rules for implementation designed to amend non-essential elements of this Chapter by supplementing it, shall be adopted in accordance with the regulatory procedure with scrutiny referred to in Article 22(3), and shall in particular lay down the following:

*(a) technical specifications for the services referred to in Articles 11 and 12 and **minimum performance criteria for those services**, taking account of existing reporting requirements and recommendations adopted within the framework of Community environmental legislation, existing e-commerce services and technological progress;*

And in Recital 17:

*Network services are necessary for sharing spatial data between the various levels of public authority in the Community. Those network services should make it possible to discover, transform, view and download spatial data and to invoke spatial data and e-commerce services. The services of the network should work in accordance with commonly agreed specifications and **minimum performance criteria** in order to ensure the interoperability of the infrastructures established by the Member States. The network of services should also include the technical possibility to enable public authorities to make their spatial data sets and services available.*

This document addresses these while always keeping in mind the principle of subsidiarity and proportionality.

3.1 Scope

The document provides guidelines for the definition of the performance criteria to be included in each Network Service Implementing Rule. It illustrates the chosen definition of performance and the characteristics of the chosen Quality of Service Attributes.

Even if not all technical specifications of the Network Services are currently available, these guidelines are intended to be applicable to all and be compatible with the Network Services Architecture Document [26].

3.2 Purpose

This document is intended to serve three purposes:

a) Support the discussion and record the consensus reached among the Network Services Drafting team, other Drafting Teams and the Commission.
b) Provide the framework to the Network Services Drafting Team for the detailed definition of criteria and measures to be associated with each Network Service.
c) Help other stakeholders to better understand the framework used for the performance criteria included of the different Network Services Implementing Rules.

[3] http://www.ec-gis.org/inspire/directive/l_10820070425en00010014.pdf

4 Reference Materials

The issue of Quality of Services is often discussed in the variety of sources:

1. By standards organisation such as W3C [2], OASIS [3], [19].
2. On-line software developers portals such as developer.com[4], [5], IBM developersWorks [6] or OpenSourceTutorials.com [7]
3. White papers provided by companies such as Keynote Systems [8] and [9]
4. in Computer Science articles [10], [11], [12]. [13]. [14]. [15], [16]. [17], [18] and [24]

This list, while not trying to be exhaustive, is considered representative of the information coming from a variety of stakeholders, including companies, standards organization, software developers and the Research community.

These references are used extensively in the following and provides the basis for the definition of the guidelines for the INSPIRE Network Services Performance criteria.

5 Context Definition

As demonstrated in figure 1 ([20]), the technical specifications of each Network Service is concentrating on the definition of the interface between the user Computer, the client, and the service provider, the server.

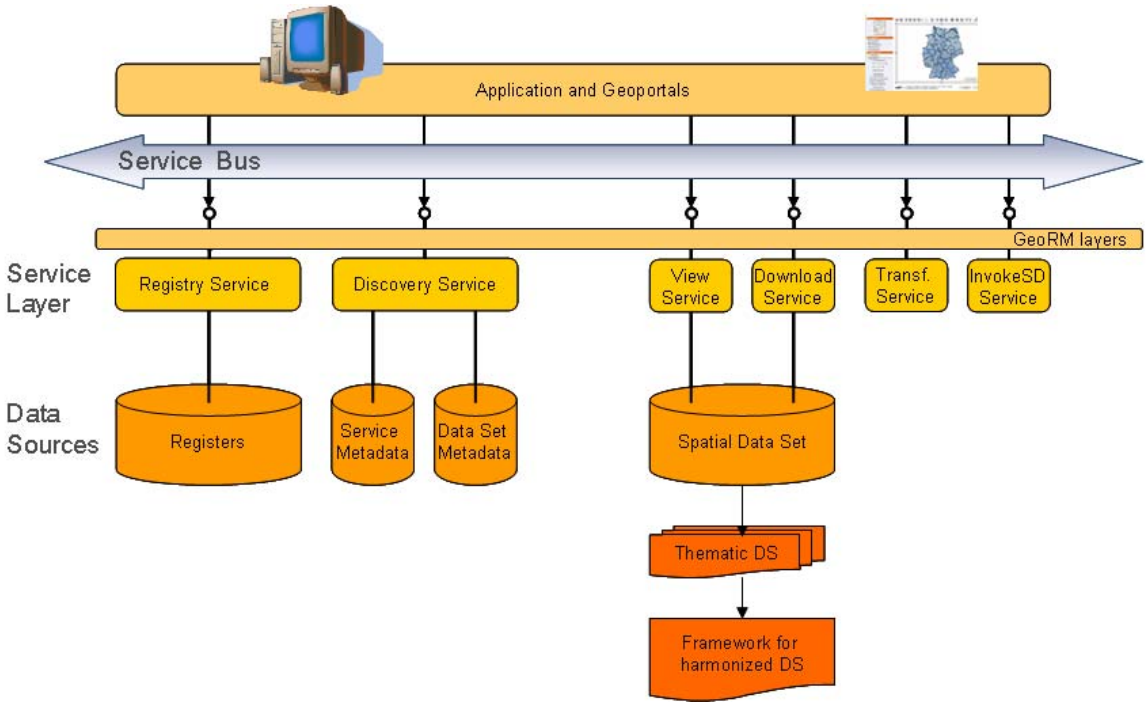

Figure 1: INSPIRE technical architecture overview (from [25])

It already restricts any Quality of Service criteria to the aspects visible to the User and excluding consideration on the internals of the Service (e.g. Software quality, documentation or related to the communication between the service and the data and metadata) in full conformance with the principle of subsidiarity.

The Network Services' Quality of Service could also be dependent on factors that go beyond the technical specifications in the Implementing Rules, such as:

1. Internet Connection Characteristics

2. Service Overall Environment characteristics
3. Measurement Context

5.1 Service Environment Characteristics

A Network Service, as represented in figure 1, is not a stand-alone and a self-contained facility, but it has to be been seen as a part of its environment.

Figure 3 ([5]) introduces a behaviour model of human interaction that identifies the main elements/activities involved in the communication between the user and the service provider that influences the service Quality.

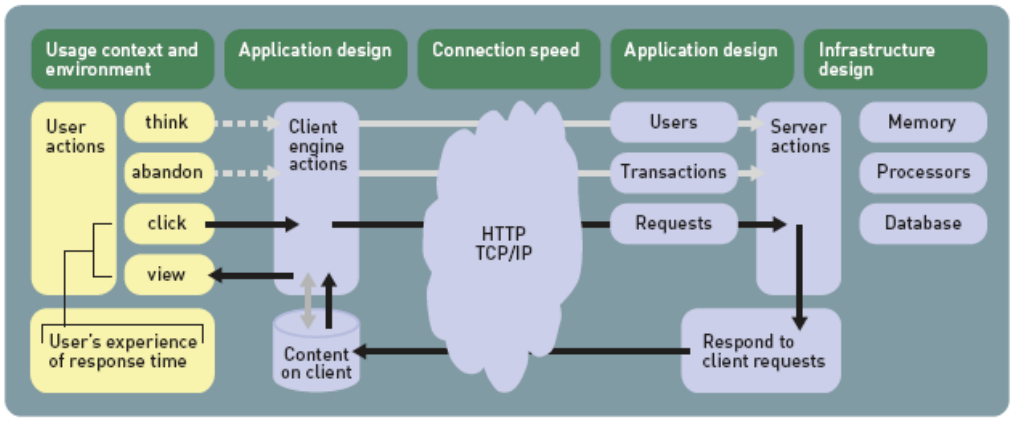

Figure 3: The Rich Internet Application Behaviour Model (from [5])

For what concerns the communication between a service and the service provider, while a lot of specific characteristics have to be taken account, for the purpose of this document, we consider “client” services as a “client” application as depicted in figure 1 or figure 3.

The Network Services Architecture ([26]) do not specify the application design or the National Infrastructure Design that are Member States choices nor does it impose the Geo-portal as a reference, therefore impeding the use of these elements for the definition of performance criteria.

It is therefore recommended that performance criteria are generic enough to be independent from the Member States specific Infrastructure and application design.

5.2 Measurement Context

For the human interaction with the Network Services it is envisioned that the access will be through a browser and will be most surely done through Rich Internet Applications ([8]) as the Rich Internet Application reflects the transition of specialised Web applications from the simple thin-client model of a traditional Web browser to a richer distributed-function model that behaves more like the desktop in a client/server model. Today these richer user experiences are being implemented with technologies such as Flash™, AJAX, and Java™, using standard Internet and Web protocols.

The communication model has evolved, as pictured, in figure 4a and 3b [8], and has the following characteristics:

- information can be fetched from a server in anticipation of the user’s input (e.g. image viewer fetched area bigger than display area) ;

- in response to an input, the screen can be updated incrementally instead of all at once (e.g. image zoom);
- multiple user inputs can be validated and accumulated on the client before being sent to the server (e.g. complex form entry syntax validation);
- responses to some user inputs can be generated without communicating with the server (e.g. choices in hierarchical pre-defined lists);
- Processing previously handled by servers can be offloaded to the client desktop (e.g. image manipulation).

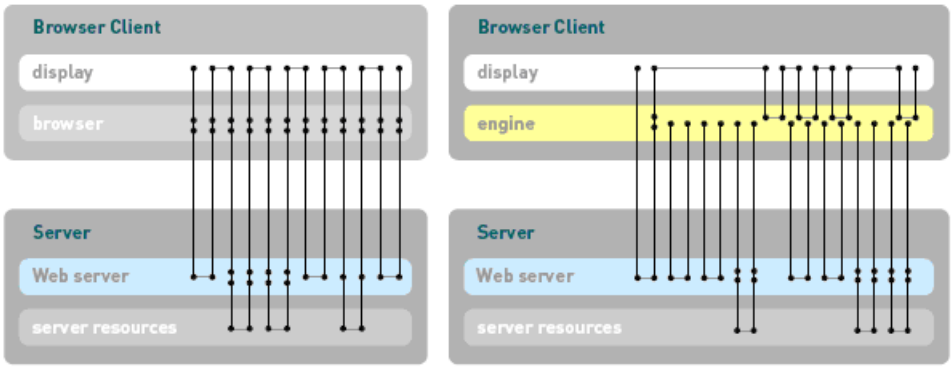

Figure 4a (left): The communication model of a traditional web application (from [8])
Figure 4b (right): The communication of a Rich Internet Application (from [8])

It is therefore recommended to measure performance at the Member State Server level to provide a framework independent of the transport network or the "client" characteristics.

Also taking into account that network services implementing rule specify the lowest level of granularity of the communication between the Network Service and the users in the widest sense:

It is therefore recommended to measure performance of the (request, response) pairs specified in the Network Services Implementing Rules and to refrain to use complex transaction to assess performance.

6 Quality of Service Attributes Relationships

Each Quality of Services Attribute cannot be seen in isolation from the others as a criterion can support another or one criterion can potentially conflict with another. For example [4] indicates that the usability and performance may conflict, as may reliability and capability or performance and capability (see figure 5 for a more complete identification of relationships).

	Capability	Usability	Performance	Reliability	Instability	Maintainability	Documentation	Availability
Capability								
Usability								
Performance	●	●						
Reliability	●	○	●					
Instability		○	○	○				
Maintainability	●	○	●	○				
Documentation	●	○				○		
Availability	●	○	○	○	○	○		

●: Conflict One Another

○: Support One Another

Blank: Not Related

Figure 5: IBM's Measures of User Satisfaction (from [4])

It is out of scope for these guidelines to discuss in detail each attribute and the inter-relationship between them, but to stress the importance of taking into account the relationships between attributes for devising a strong and meaningful **set** of Quality of Service attributes.

It is therefore recommended to explicitly take into account dependencies between Quality of Service Attributes.

7 Existing Sources

There is a wealth of proposals for Quality of Services Attributes, coming from different environments; be it Research, Industry and standards organization.

The following have been selected to represent each one, and are assessed to fairly represent their environment. Namely:

- Standards organization: W3C
- Industry: IBM
- And a technical/scientific article

In the process of putting forward guidelines, the applicability to the INSPIRE context of the W3C Quality of Service attributes is first assessed, and then commonalities with the other sources are identified to finally form the base of the proposed guidelines.

Considering that the Network Services drafting team is proposing the Network Services to be web services [1], it is then natural to take the W3C proposal as the baseline on which the applicability of the Quality of Service attributes to INSPIRE are checked, the other sources being then compared to the W3C and applicability of new emerging Quality of Service attributes checked as well.

7.1 W3C

7.1.1 Proposal

The W3C, in [2], proposes quality aspect of a web service to include performance, reliability, scalability, capacity, robustness, exception handling, accuracy, integrity, accessibility, availability, interoperability, security, and network-related QoS requirements. These quality attributes are defined in [2] as follows[4]:

Performance

The performance of a web service represents how fast a service request can be completed.

Reliability

Web services should be provided with high reliability. Reliability here represents the ability of a web service to perform its required functions under stated conditions for a specified time interval. The reliability is the overall measure of a web service to maintain its service quality.

Scalability

Web services should be provided with high scalability. Scalability represents the capability of increasing the computing capacity of service provider's computer system and system's ability to process more users' requests, operations or transactions in a given time interval.

Capacity

Web services should be provided with the required capacity. Capacity is the limit of the number of simultaneous requests which should be provided with guaranteed performance

Robustness

Web services should be provided with high robustness. Robustness here represents the degree to which a web service can function correctly even in the presence of invalid, incomplete or conflicting inputs.

Exception Handling

Web services should be provided with the functionality of exception handling. Since it is not possible for the service designer to specify all the possible outcomes and alternatives (especially with various special cases and unanticipated possibilities), exceptions should be handled properly.

Accuracy

Web services should be provided with high accuracy. Accuracy here is defined as the error rate generated by the web service.

Integrity

Integrity for web services should be provided so that a system or component can prevent unauthorized access to, or modification of, computer programs or data.

Accessibility

Web services should be provided with high accessibility. Accessibility here represents whether the web service is capable of serving the client's request.

[4] http://www.w3c.or.kr/kr-office/TR/2003/ws-qos/#qos-intro

Availability

The web service should be ready (i.e., available) for immediate consumption. This availability is the probability that the system is up.

Interoperability

Web services should be interoperable between the different development environments used to implement services.

Security

Web services should be provided with the required security.

7.1.2 Preliminary Applicability Analysis

This chapter provides a first analysis of the applicability of the proposed Quality of Service attributes from the INSPIRE directive point of view and based on the subsidiarity principle

QoS Attribute	Definition	Applicability
Performance	The performance of a web service represents how fast a service request can be completed.	Yes
Reliability	Web services should be provided with high reliability. Reliability here represents the ability of a web service to perform its required functions under stated conditions for a specified time interval. The reliability is the overall measure of a web service to maintain its service quality.	Yes
Scalability	Web services should be provided with high scalability. Scalability represents the capability of increasing the computing capacity of service provider's computer system and system's ability to process more users' requests, operations or transactions in a given time interval.	The uptake of the European Spatial Data Infrastructure following the implementation of the INSPIRE directive will most certainly request services to be easily scalable. But as it strongly relates to the internals of a Member State infrastructure. It is proposed not to consider it.
Capacity	Web services should be provided with the required capacity. Capacity is the limit of the number of simultaneous requests which should be provided with guaranteed performance	Yes
Robustness	Web services should be provided with high robustness. Robustness here represents the degree to which a web service can function correctly even in the presence of invalid, incomplete or conflicting inputs.	Yes
Exception Handling	Web services should be provided with the functionality of exception handling. Since it is not possible for the service designer to specify all the possible outcomes and alternatives (especially with various special cases and unanticipated possibilities), exceptions should be handled properly.	Yes

QoS Attribute	Definition	Applicability
Accuracy	Web services should be provided with high accuracy. Accuracy here is defined as the error rate generated by the web service.	Yes
Integrity	Integrity for web services should be provided so that a system or component can prevent unauthorized access to, or modification of, computer programs or data.	Yes
Accessibility	Web services should be provided with high accessibility. Accessibility here represents whether the web service is capable of serving the client's request.	Yes
Availability	The web service should be ready (i.e., available) for immediate consumption. This availability is the probability that the system is up.	Yes
Interoperability	Web services should be interoperable between the different development environments used to implement services	Yes
Security	Web services should be provided with the required security.	Yes

So except for scalability, the W3C proposal is potentially applicable to the INSPIRE Network Services.

7.2 IBM

7.2.1 Proposal

In [6], the major Quality of Service attributes for supporting Quality of Services in Web services are defined as follows:

Availability

Availability is the quality aspect of whether the Web service is present or ready for immediate use. Availability represents the probability that a service is available. Larger values represent that the service is always ready to use while smaller values indicate unpredictability of whether the service will be available at a particular time. Also associated with availability is time-to-repair (TTR). *TTR* represents the time it takes to repair a service that has failed. Ideally smaller values of TTR are desirable.

Accessibility

Accessibility is the quality aspect of a service that represents the degree it is capable of serving a Web service request. It may be expressed as a probability measure denoting the success rate or chance of a successful service instantiation at a point in time. There could be situations when a Web service is available but not accessible. High accessibility of Web services can be achieved by building highly scalable systems. *Scalability* refers to the ability to consistently serve the requests despite variations in the volume of requests.

Integrity

Integrity is the quality aspect of how the Web service maintains the correctness of the interaction in respect to the source. Proper execution of Web service transactions will provide the correctness of interaction. A *transaction* refers to a sequence of activities to be treated as a single unit of work. All the activities have to be completed to make the transaction successful. When a transaction does not complete, all the changes made are rolled back.

Performance

Performance is the quality aspect of Web service, which is measured in terms of throughput and latency. Higher throughput and lower latency values represent good performance of a Web service. *Throughput* represents the number of Web service requests served at a given time period. *Latency* is the round-trip time between sending a request and receiving the response.

Reliability

Reliability is the quality aspect of a Web service that represents the degree of being capable of maintaining the service and service quality. The number of failures per month or year represents a measure of reliability of a Web service. In another sense, reliability refers to the assured and ordered delivery for messages being sent and received by service requestors and service providers.

Regulatory

Regulatory is the quality aspect of the Web service in conformance with the rules, the law, compliance with standards, and the established service level agreement. Web services use a lot of standards such as SOAP, UDDI, and WSDL. Strict adherence to correct versions of standards (for example, SOAP version 1.2) by service providers is necessary for proper invocation of Web services by service requestors.

Security

Security is the quality aspect of the Web service of providing confidentiality and non-repudiation by authenticating the parties involved, encrypting messages, and providing access control. Security has added importance because Web service invocation occurs over the public Internet. The service provider can have different approaches and levels of providing security depending on the service requestor.

7.2.2 Link with W3C proposal

The following table indicates the matching between IBM Quality of Service attributes and the W3C ones:

IBM'S QoS Attribute	Corresponding W3C QoS Attribute	Comment
Availability	Availability	
Accessibility	Accessibility	
Integrity	Integrity	Different Definitions, the IBM one may not be that relevant in the INSPIRE context considering that [26] advocates stateless interaction as the rule for Network Services.

Performance	Performance	
Reliability	Reliability	
Regulatory	None	
Security	Security	

The additional regulatory requirement is of particular relevance in the INSPIRE context providing for the Network Services a formal requirement of compliance with the future INSPIRE implementing rules.

7.3 *"A Quality of Service Catalog for Software Components"*

This article [11], is one of the few among the identified references proposing a very exhaustive list of Quality of Service attributes, often going beyond the previous proposals, therefore explaining the choice of this article among the abundant literature of which only a sample is provided in 10.

In the context of Component-based Software Development, based on Commercial off the Shelf (COTS) Components coming from a wider variety of source. The authors advocate the use of an objective paradigm for quantifying the quality of service of the components to result in integrated systems with a predictable quality.

7.3.1 Proposal

[11] proposes the following Quality of Services parameters for inclusion in their catalogue:

Dependability

It is a measure of confidence that the component is free from errors.

Security

It is a measure of the ability of the component to resist an intrusion.

Adaptability

It is a measure of the ability of the component to tolerate changes in resources and user requirements.

Maintainability

It is a measure of the ease with which a software system can be maintained.

Portability

It is a measure of the ease with which a component can be migrated to a new environment.

Throughput

It indicates the efficiency or speed of a component.

Capacity

It indicates the maximum number of concurrent requests a component can serve.

Turn-around Time

It is a measure of the time taken by the component to return the result.

Parallelism Constraints

It indicates whether a component can support synchronous or asynchronous invocations.

Availability

It indicates the duration when a component is available to offer a particular service.

Ordering Constraints

It indicates the order of returned results and its significance.

Evolvability

It indicates how easily a component can evolve over a span of time.

Result

Indicates the quality of the results returned.

Achievability

It indicates whether the component can provide a higher degree of service than promised.

Priority

It indicates if a component is capable of providing prioritized service.

Presentation

It indicates the quality of presentation of the results returned by the component.

7.3.2 Link with W3C proposal

The following table indicates the matching between the article Quality of Service attributes and the W3C ones:

Requirement	**Corresponding W3C requirement**	**Comment**
Dependability	Reliability	
Security	Security	
Adaptability	Scalability	
Maintainability	N/A	
Portability	N/A	
Throughput	Performance	To be Considered as a specific example characterising an aspect of performance
Capacity	Capacity	
Turn-around Time	Performance	To be Considered as a specific example characterising an aspect of performance
Parallelism Constraints	N/A	
Availability	Availability	
Ordering Constraints	N/A	
Evolvability	N/A	W3C Scalability is a specific case of evolvability where the evolution criteria is the service use
Result	N/A	Accuracy is a specific case of

Requirement	Corresponding W3C requirement	Comment
		Result
Achievability	N/A	
Priority	N/A	
Presentation	N/A	Could be understood as similar to Accuracy

8 INSPIRE Quality of Service Guidelines

8.1 Attributes Selection

The directive stresses the need to include in the Implementing Rules **Minimum** performance criteria, that, as indicated previously, are minimal from the point of view of the number of criteria and from the point of view of the measure associated to it, both with due consideration of the proportionality principle.

The following table provides the synthesis of the quality attributes proposed previously:

W3C Quality of Service attributes	In IBM proposal	Article Proposal
Performance	**X**	**X**
Reliability	**X**	**X**
Scalability		**X**
Capacity	**X**	**X**
Robustness		
Exception Handling		
Accuracy		**X**
Integrity	**X**	
Accessibility	**X**	
Availability	**X**	**X**
Interoperability		
Security	**X**	**X**

So assuming that the 3 proposals are representative of the current status for Quality of Service for Web Services, understanding that commonalities between these 3 different approaches are an indication of convergence/consensus and remembering that the Directive asks for minimum

performance criteria, therefore not requesting full coverage of what Quality of Service may be characterised by:

It is recommended to use the Quality of Service attributes common to the 3 proposals; performance, reliability, capacity, availability and security as guidelines for the definition of the minimum performance criteria of the Network Services.

To this list and considering the INSPIRE legal characteristic:

It is recommended to add the attribute regulatory to the list of Quality of Service recommended attributes that should provide the necessary means for assessing the conformity of the Network Service with the applicable Implementing Rule.

Finally, and considering the importance of interoperability in the INSPIRE Directive (see for example recital (17)):

It is recommended to add the attribute interoperability to the list of Quality of Service recommended attributes.

To summarize the quality of Service attributes proposed to guide the definition of minimum performance criteria for the INSPIRE Network Services is provided in the following table

Quality of Service Attributes for the INSPIRE Network Services
Performance
Reliability
Capacity
Availability
Security
Regulatory
Interoperability

The following section recalls the definition of each Quality of Service attribute with examples of criteria and best practices taken from the literature. For more information on limitation and best practices in the context of service orchestration, see [27].

8.2 Performance

8.2.1 Definition

The performance of a web service represents how fast a service request can be completed. [2]

8.2.2 Example Criteria

[2] proposes a set of them:

- Throughput is the number of web service requests served in a given time interval.

- Response time is the time required to complete a web service request.
- Latency is the round-trip delay (RTD) between sending a request and receiving the response.
- Execution time is the time taken by a web service to process its sequence of activities.
- transaction time represents the time that passes while the web service is completing one complete transaction. This transaction time may depend on the definition of web service transaction.

In general, high quality web services should provide higher throughput, faster response time, lower latency, lower execution time, and faster transaction time.

8.3 Reliability

8.3.1 Definition

Web services should be provided with high reliability. Reliability here represents the ability of a web service to perform its required functions under stated conditions for a specified time interval. The reliability is the overall measure of a web service to maintain its service quality [2].

8.3.2 Example Criteria

For this particular requirement, whether it is proposed to measure the time to failure, time intervals between failures, cumulative failures in a given time period, or failures experienced in a given time interval, the basic metric of reliability is *time* [4].

8.4 Capacity

8.4.1 Definition

Web services should be provided with the required capacity. Capacity is the limit of the number of simultaneous requests which should be provided with guaranteed performance [2].

8.4.2 Example Criteria

Maximum number of simultaneous requests with the performance criteria defined above

8.5 Availability

8.5.1 Definition

The web service should be ready (i.e., available) for immediate consumption. This availability is the probability that the system is up. [2]

8.5.2 Example Criteria

Percentage of time the system is up

8.6 Security

8.6.1 Definition

Security is the quality aspect of the Web service of providing confidentiality and non-repudiation by authenticating the parties involved, encrypting messages, and providing access control. [6]

8.6.2 Example Criteria

Security can be assesses through a set of different characteristics:

- Authentication: Users (or other services) who can access service and data should be authenticated Whenever applicable
- Authorisation: Users (or other services) should be authorised so that they only can access the protected services whenever applicable
- Confidentiality: Data should be treated properly so that only authorised users (or other services) can access or modify the data whenever applicable
- Accountability: The supplier can be hold accountable for their services.
- Traceability and Auditability: It should be possible to trace the history of a service when a request was serviced.
- Data encryption: Data should be encrypted whenever required
- Non-Repudiation: A user cannot deny requesting a service or data after the fact.

8.7 Regulatory

8.7.1 Definition

Regulatory is the quality aspect of the Web service in conformance with the rules, the law, compliance with standards, and the established service level agreement. [6]

8.7.2 Example Criteria

The directive mandates two items to be included in a Network Service Implementing Rule, namely Technical Specifications and minimum performance criteria

For the performance criteria the conformance will be reached with the compliance with the limits or measures included in each service Implementing Rules.

For what concerns Compliance of a service with the technical specifications, [22] provides an inventory of currently available methods and tools while [23] provides an example of a tool to test conformance of services with a set of OGC Implementations specifications.

8.8 Interoperability

8.8.1 Definition

Web services should be interoperable between the different development's environments used to implement services.

8.8.2 Example Criteria

Developers using those services do not have to think about which programming language or operating system the services are hosted on.

9 Towards Criteria and Measurement

The process to put forward criteria and corresponding value for each Network Service is identical to what is used for the technical specifications of the Network Services. More precisely the Consolidation Team provided the Detailed definitions on the INSPIRE Network Services Document [20] as input to the Drafting of the Implementing Rules by the Network Services Drafting Team.

Analogously, this document is provided by the Consolidation Team as input to the Drafting of the Implementing Rules by the Network Services Drafting Team (figure 6 recalls the process)

In particular the definition of specific criteria for each Network service and the corresponding measure is proposed to be put forward by the Network Services Drafting Team where the technical expertise and experience lies.

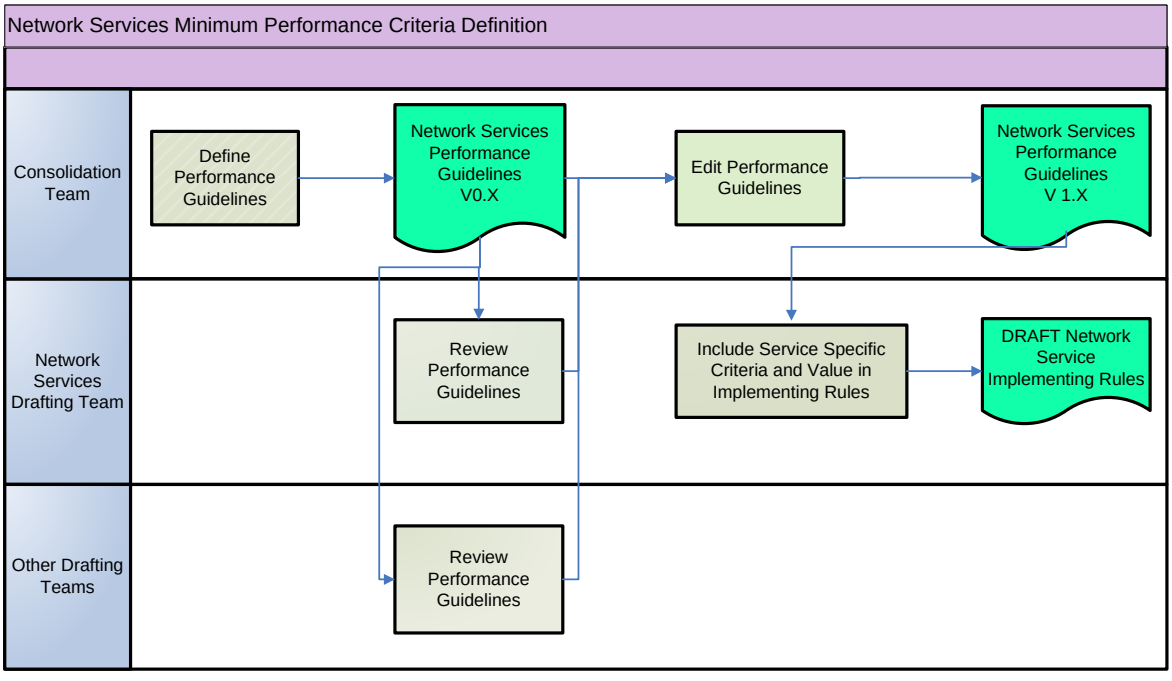

Figure 6: Performance Criteria Definition Process

10 References

[1] W3C. Web Services Architecture. http://www.w3.org/TR/ws-arch/
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