

A Comprehensive analysis of XML and JSON web technologies

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Abstract—In this global era, internet plays a vital role to share information all over the world. There are some standard protocols and web technologies to represent the information on internet like HTML, JavaScript, ASP, JSP, XML, JSON etc. All these standards have pros and cons, and also depend on the requirement that which exchange of format more reliable. This research work shows the comparative analysis of XML and JSON using Multi-criteria Decision Support System MCDS, and analyze use of web technology according to the requirement need.

Keywords: Web technology, JSON, XML, MCDS, AJAX

I. INTRODUCTION

Today web technology is on the level that we are talking about synchronous and asynchronous transformation technologies like XML, AJAX, .NET, JSON and so on are in practice. But 15-16 years ago the people was only thinking how to display documents on the internet and for that purpose HTML (Hyper Text Markup Language) had been developed. And then with the time as people get use to with the internet, then the user start demands for new things like to have interactive websites that they can display information as well as can take input from user for that purpose different technologies had been developed that we are using in dynamic websites such that ASP, JSP, PHP, ASP.NET etc. then there was a problem how to transfer data between different platforms so XML has been developed which store plain text base data independent of platform and can easily transfer data between cross platforms.

In the last couple of years AJAX came in to existence which is totally new technology, in the same time JSON has also been introduced, and it is nowadays one of the most debatable topic for developers that “JSON is a fate free alternative to XML?” [10].

In this paper have discussed a little background of the web development starting from HTML, SGML, AJAX, XML and JSON and then XML and JSON is compared in different

aspects and then on the basis of these comparisons conclusion has been derived that which technology is required for whom and for what purpose.

2. Background of XML and JSON

HTML is used and still the people are using it how to display some data or documents, how it will be look like and what will be its layout for that purpose, it uses some different tags like <HTML>, <HEAD>, <TITLE>, and <BODY> etc. to display documents. It was difficult to remember all the tags of HTML but as rapid developments are taking place in this field and now we can have different editors that we can use them how to design a HTML pages but still HTML has some limitations.

When the technology been more developed and the developers started thinking about to store and retrieve data to and from the database so HTML is ok with how to display data and documents but it is not suitable to deal with data structure like some stuff like database and objects hierarchies etc. [11].

2.1. SGML

As we know that HTML as good for displaying documents and their layout but HTML is not suitable for explicit quarries. So if we need to go for a bit different things like how to access and manipulate the data objects instead of documents then HTML is not capable of that, So SGML (Standard Generalized Markup Language). As we know that HTML is one of the applications of SGML. SGML is known as the mother tongue of HTML. So to overcome the limitation of HTML, SGML has the capability to overcome the problems of HTML many organizations had defined their own standards using SGML but SGML is very complex as its specifications are about 500 pages. Due to the very complex structure of SGML it turn the researcher to focus on such a tool which should overcome the limitations of HTML and should be

simple where the user can use in their application on the basis of simple standard and XML came into being [11].

2.2. AJAX (Asynchronous JavaScript and XML)

AJAX is tremendous development on the web which enables web application to look like desktop application means like in the normal WebPages when we need a bit of information we need to reload the whole page, but with AJAX it is now possible to transfer information with out reloading or refreshing the page. For example Google Suggest Lab or yahoo search when we are typing the word to search it give us suggestion with out reloading the page. It means that the AJAX technique enable pages to have the capability to transfer a small amount of data and can retrieve the data from the server in the same page, with out reloading the whole page. Now when we transferring this data we need data transfer format either XML or JSON can be used is data transfer formats. In the next section I am giving an overview to XML and then JSON and then I will come to give detail about which one XML or JSON to use with AJAX [7].

2.3. XML (Extensible Markup Language)

XML is a simple standard that can be used to transform and encode both text and data and it can be processed and transformed across different platforms. XML is more simple and manageable as compared to SGML, it is not a full independent markup language but it is a tool that enables users to define their own markup language, user can define their own tags which are more easy and readable by both machine, as well as user [11].

To take care of compatibility the XML is built to in the way to fit the HTML in the new framework and after some time HTML 4.0 which is a very suitable version that is compatible with XML and there it is named as XHTML, and simply we can say that it is nothing more but a special application of XML.

XML is a Meta data and the basic difference between HTML and XML is that, XML allow the user to define their own tags as HTML have a pre defined set of tags but in XML the user can define the tags according to their own use. And the other thing is that, that there are no formal criteria like the HTML have (head, title, body etc), it also take care of contents as well as XML do not defined any contents criteria but as XML is meta language so it allows contents base structuring as well as XLM is functioning different then the level HTML do [11].

So XML will need to be fid with XML based data by the user to get succeed. User can define their own tags according to their own need in their native language. Such that “StartDate”, “TrouserSize”, “EndTime” so XML do not define these tags but actually XML give the way how to define these tags, it means that XML have tags that apply to all documents (XML processing instruction) and also user can define their own criteria that can be stored as a separate documents (DTD) document type definition (Jung 2000). XML provide some grammar rules that apply to all documents, such that

“<identifier>contents</identifier>” then the user can put the contents according to their own use for example <name>khan</khan>. Then everyone can use it according to their own use for instance automobile company can use it <EngineSize>, <ModelOfCar>, <Color> and then can save them in a special schema. The XML capable application can use these definitions directly.

Beside these as XML don’t understand these tags so it means that instead of <StartDate> if say you put <ABC123> XML parser will accept it without any problems it means that it could be anything that is understandable so for this purpose a group of user can be agree on some definitions of tags Document Type Definition (DTDs) can be used then [11].

XML architecture is very flexible documents are written in plain text not in cryptic form so it will be human readable and XML document can be stored, processed and distributed except any special DTD or XML code of the particular author [11].

As XML is flexible so any kind of tags can be defined. But DTD should be use for particular type of data such that real store, Publishing House etc. some of the organization and association already reached on agreement of such type of XML Documents definitions [11].

A simple example of XML data as given below,

```
<teaminfo>
  <players>
    <player>
      <name>Ajmal Khan</name>
      <height>5.8</height>
      <age>24</age>
      <postgrad>true</postgrad>
    </player>
    <player>
      <name>Nadeem shehzad</name>
      <height>5.9</height>
      <age>26</age>
      <postgrad>true</postgrad>
    </player>
    <player>
      <name>Aditya</name>
      <height>6.0</height>
      <age>24</age>
      <postgrad>true</postgrad>
    </player>
  </players>
</teaminfo>
```

The above XML example store information about three players in a team. We can see there are some elements that they are repeating for each piece of information however the actual data is repeated once. And we are interested in the players and their information. The elements <players> and <teaminfo> are not needed but they are just used to define the structure and meaning of the information. Table 1 shows advantages of XML technology over JSON [3].

Table 1. XML strengths over JSON

JSON	XML
There is no grammar support and that's why it is difficult to communicate and enforce interface contracts	While XML have XML schema and Document Type Definition which can be used to define grammar rules
Extensibility is not good as namespaces are not supported	Very strong support for namespaces, schema have more extensibility options
Development tools support is very limited as it is newly introduced	As XML is in the market since long time there for is supported by most of the development tools
JSON is very narrow focused as it is used only for Remote Process Call(RPC), mainly with JavaScript Client	XML is very broad focused, it can be used for Remote Process Call (RPC), Electronic Data Interchange (EDI), Metadata etc.
Very limited support for web services associated stuff (products).	huge hold of web services related products

2.4. JavaScript Object Notation (JSON)

As web services are gaining attractiveness day by day, XML has almost turned into the actual paradigm for data transmission. But still there are different things that people considering that XML is heavy some time it send more bytes through the internet to get the things done which can be done with a much smaller data. To overcome this problem new formats of XML been introduced like binary XML so it means all these solutions are extending XML but still the problem exist when it come to backwards compatibility. Douglas Crockford is software engineer he introduced a new data format which is based on JavaScript called JavaScript Object Notation (JSON) [6].

JSON is simple very lightweight object serialization technique or data format which is based on JavaScript Object initialization syntax, specifically array and object literals. JSON definitions can be incorporated inside JavaScript files and accessed with no further parsing that comes alongside with XML-based languages, because it uses JavaScript syntax. But prior to use JSON, it is essential to know the array and object literals particular JavaScript syntax. JSON the

initialization code is assigned to a string and then is dealt with JavaScript eval() function or JSON parser [6].

The JSON parser is very light weight. JSON is mainly used with different AJAX tools kits and frameworks and provide easy serialization for remote calls. JSON is supported by GWT and DOJO. JSON and web 2.0 technologies must be considered very seriously by Service Oriented Architecture (SOA) (Alexander 2007).

Most of the server languages do not contain JavaScript interpreters there for they wouldn't able to process the JavaScript code and lets suppose that they can evaluate it, but still the developer wouldn't allow the arbitrary code to b run on the server because it can generate a serious security problem. But both of these problems been solved by JSON which is the literal Syntax for JavaScript, as JSON can be run using eval() function of the JavaScript side. JSON allows any JavaScript data types to be transferred and would be faster than the XML-based solutions because the compact encoding allows for much smaller data to be transferred. On server side small parser to be built to serialize the native data types into JSON and also to create native data types from JSON [7]. The following sample describes how to represent JSON data.

```
{ "teaminfo" :
  {
    "players" : [
      {
        "name" : "Ajmal Khan",
        "height" : 5.7,
        "age" : 24,
        "postgrad" : true
      },
      {
        "name" : "nadeem shehzad",
        "height" : 5.8,
        "age" : 26,
        "postgrad" : true
      },
      {
        "name" : "Aditya",
        "height" : 6.0,
        "age" : 23,
        "postgrad" : false
      }
    ]
  }
}
```

We can observe that a lot of redundant information is not present as compare to the XML one; no closing tags are required to match opening tags this will reduce the number of bytes to be send out for same information of to great extent. In the above example excluding spaces the JSON data is 249 bytes while the XML data is 378 bytes so it save more than 120 bytes in this much data. That is the reason why Crockford, JSON inventor said that “JSON is a fat free alternative to XML”.

The draw back of the JSON format is that it is a bit hard to read as compare to XML as XML one is easier to read by a layperson as it is clearer and meaning full but JSON format is reduced by its shorthanded notations and due to that it will be difficult to read it with nicked eye. But no it can be disagreement that why we need to view the data exchange format with naked eye if we can use tools for parsing the data passing back and forth but still the question arising that are such tools available so there are some tools available but still this can be a limitation some where (EICHORN 2006). JSON have some pros over XML as shown in table 2 [3].

Table 2. JSON strengths over XML

JSON	XML
Completely programmed technique for de-serializing and serializing JavaScript objects, with very little coding.	JavaScript code will be written by developer to serialize and de-serialize to and form XML
Most of the browsers have enough support of JSON.	All new browsers have built-in XML parser but it could be a bit tricky when it come to cross-browser XML parsing.
The format is very concise due to having name/value pair-based approach.	Because of tags and namespaces the format is very lengthy.
de-serialization is very speedy in JavaScript	De-serialization is slower in JavaScript
Most of JavaScript libraries and AJAX toolkits have good support of JSON	AJAX toolkits don't have strong support for it.
Having simple API for JS and more other languages	The APIs are very complicated

3. Related work

Data interchange format have significant consequences on data transferring rates and performance, data interchange format generate from mark-up to further support for structural attribute of information using encoding of meta-data. XML and JSON are data interchange format that can be use in different aspects with unique purpose. XML primary uses are

object serialization for transfer of data between application and Remote Procedure Calls RPC [13]. To analyze the impact of management of energy and cost of processing for transferring data in mobile devices of proposed formats of XML, JSON and Protocol Buffer [5]. These two form of data interchangeable using data serialization approach which allows for better communication between applications. Data transmission of web application more secure, powerful in the XML serialization approach and with JSON serialization approach fast and convenient [17].

XML is more complex than JSON in web services of web programming, some time programmer doesn't need to use namespace and mixed content documents. The developers focus on to use simple data structure, compact and exchange format. XML is great in problem domain, namespace, well-formed and mixed content document [15].

The Analytic Hierarchy Process is a method of measurement for formulating and analyzing decisions. AHP is a decision support tool which can be used to solve complex decision problems considering tangible and intangible aspects. Therefore, it supports decision makers to make decisions involving their experience, knowledge and intuition [2],[9].

4. Comparative analysis

In this research work comparison between JSON and XML carried out by using the Make it Rational MCDM tool. MCDM is decision making tool based on comparative analysis and defined steps. For decision making system these are the main steps to be evaluate goal, alternative, criteria, preferences, sub criteria and final result [1].

4.1. Goal

Main goal for this work to be analyzed are JSON and XML technologies based on criteria and sub criteria. This work will help developer to choose proper web technology in certain condition [12].

4.2. Alternatives

There are many web development technologies, this research work focus on alternatives of JSON and XML.

4.3. Main criteria

Hierarchy view show top down approach for alternatives, criteria's and sub criteria's, as shown in Figure 1, in our case main criteria's are Format of Exchange, Validity, Readability, Efficiency, Debugging and Troubleshooting, and sub criteria's are Machine and Human Readability.

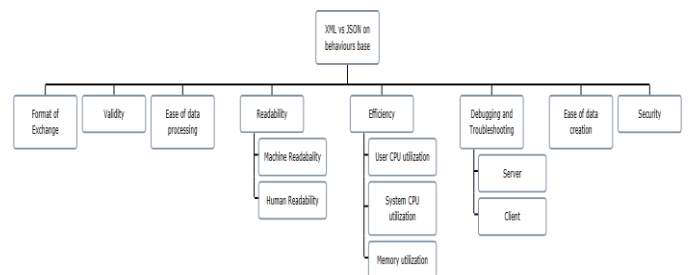


Figure 1: Hierarchy view of XML and JSON

4.3.1. Format of Exchange

JSON format is always smaller than XML, in fact the more tag involves in XML format increase size of XML exchange format. JSON specification excluding unnecessary tag and syntax produce small size of exchange format comparatively to XML. AJAX application can use XML or JSON as transformation format. Now it is an important issue how to select transformation format. XML is more composite structure and could be able to transfer any type of data however JSON is simple data structure that will be all we need to transfer AJAX data, and it is useful enough to use JSON with AJAX such that, JSON is subset of JavaScript, so using eval() method of JavaScript JSON text can be simply changed into JavaScript Object and then we can extract data using JavaScript. So if someone know JavaScript will be easy for them to use.

JSON is subset of JavaScript so it have the JavaScript Data types but it is not same for XML we can define it for XML using XML schema or DTD to define XML structure.

JSON can be parsed as JavaScript, for more security we can use the JSON parser to convert. But if we use to get the as XML it means that we will need to parse it. For that Dom method will be needed which is very comple [16].

4.3.2. Validity

XML content rules conforms the data to be valid documents. These rules describe document organizational structure and accurate data values. Valid XML documents match defined schema, constrains on the structure and content of the document articulated in schema. JSON validator is a program that verifies JSON data with provided schema which contains define validation, documentation, interaction control of JSON data and hyperlink navigation. Research analysis shows that XML validation bit stronger than JSON.

4.3.3. Ease of Data processing

The simple data structure and data standard of XML provide very easy process. But it is same in JSON as it having very simpler structure [10].

4.3.4. Efficiency

XML document includes statements, handling instruction, elements and rich tags. Also composed of root node, the root node contains a root element, nested child element also include chilled element and properties which increase size of the XML documents. Data format of JSON is very simple that can be transmitted with a single array, variable of number or Boolean type or also string type. JSON exchanging data by object while object are tagged by unordered which contains a series of key values and pair key value [14]. Analysis and t-

test observation indicated that XML appears to use less user CPU utilization than JSON, XML use more system CPU utilization than JSON, and memory utilization of the JSON and XML encoded transmissions nearly the same on server [13].

4.3.5. Debugging and Troubleshooting

XML server checks data being sent to client well formed and valid. XML document verify with XML schema, as an alternative to XML, JSON manually involves verification that the response object has the right attributes. On client side it is difficult to spot error in either format; browser would fail to parse XML into the response XML. For small data relatively easy to detect error in JSON but with large data it is difficult to relate the error message to the data.

4.3.6. Ease of Data creation

XML data-binding APIs to create XML in more than a few programming languages, XML APIs have been around for years and may be deal with complex application. JSON APIs are new to create JSON responses but not so far behind than XML. There are so many ways to create XML alternative to JSON [4]. Security

XML language specifications ensure that the form of serialization data of XML has strong security; labels stored all data in the tag closed strictly with the data index. AJAX lightweight application demanding for low security while have high demanding for efficiency, so JSON have good support as an alternative to XML [17].

4.3.7. Extensible

Extensibility reduces the coupling between the producer and the consumer of the data. XML is extensible while JSON is not but there is no need for that because it is not document mark-up language so there is no need for new tags as already store data so there is no need to have tags to store data about data [10].

4.3.8. Reusability of software

As XML claim that the there are plenty of software code is available that developer can use that code and there is no need for recoding but JSON is simpler and there is no need for more programming/ additional software only JSON simple code is enough [10].

4.3.9. Adoptability by the industry

XML is adopted by the wide range of computer industry. Hover JSON is just newly known to the industry and because of it simplicity and it is easy to convert JSON from XML, due to these properties JSON becoming more adoptable [10].

4.4. Preferences

Preference is concerned with the priorities based on importance of criteria/sub-criteria, as assigned priorities are shown in the table 3.

Table 3. Preference based on priorities

Intensity	Importance	Intensity	Importance
1	Equal Importance	6	Strong Importance plus
2	Weak Importance	7	Very Strong Importance
3	Moderate Importance	8	Very Strong Importance plus
4	Moderate Importance plus	9	Extreme Importance
5	Strong Importance		

Each criteria assigned priority value shown in the given table 4.

Table 4. Criteria priority scale based on importance

Criteria	Ratio	Criteria	Ratio
Ease of data processing vs. Format of Exchange	1:1	Efficiency vs. Ease of data creation	3:1
Validity vs. Readability	3:1	Format of Exchange vs. Ease of data creation	2:1
Format of Exchange vs. Security	1:1	Security vs. Efficiency	1:1
Efficiency vs. Readability	2:1	Ease of data processing vs. Ease of data creation	2:1
Ease of data processing vs. Readability	2:1	Ease of data processing vs. Efficiency	1:1
Validity vs. Ease of data creation	3:1	Debugging and Troubleshooting vs. Efficiency	1:1
Security vs. Ease of data creation	2:1	Ease of data creation vs. Readability	1:1
Format of Exchange vs. Debugging and Troubleshooting	1:1	Security vs. Debugging and Troubleshooting	1:1
Debugging and Troubleshooting vs. Ease of data creation	2:1	Validity vs. Security	2:1
Validity vs. Efficiency	2:1	Format of Exchange vs. Efficiency	1:1

Debugging and Troubleshooting vs. Readability	3:1	Ease of data processing vs. Security	1:1
Format of Exchange vs. Readability	2:1	Validity vs. Ease of data processing	2:1
Ease of data processing vs. Debugging and Troubleshooting	1:1	Security vs. Readability	2:1
Validity vs. Format of Exchange	2:1	Validity vs. Debugging and Troubleshooting	2:1

4.5. Result and analysis

4.5.1. Ranking graph

Figure 2 shows rank graph for each criteria of XML and JSON, i.e. format of the exchange rank graph for JSON contribute more than XML, while the validity of an XML value higher than JSON.

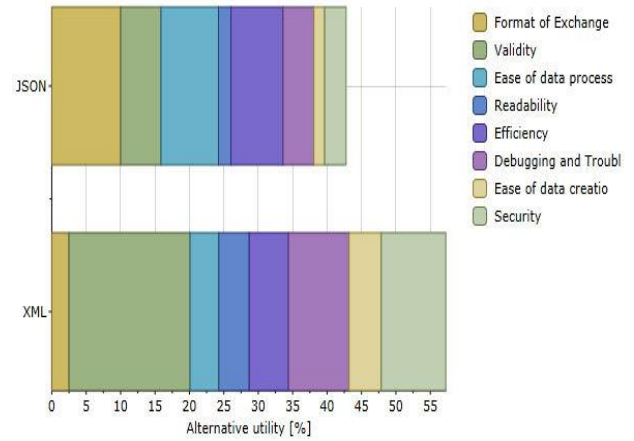


Figure 2: XML and JSON Attributes ranking graph

4.5.2. Values allocation table

Values assign to criteria's in alternatives of XML and JSON as shown in Table 3, i.e. format of exchange 2.5 value for XML and 10.01 value of JSON for same criteria.

Table 3: Values allocation to criteria of XML and JSON

Criteria	XML	JSON
Format of Exchange	2.5	10.01
Validity	17.6	5.87
Ease of data process	4.17	8.34
Readability	4.41	1.81

Efficiency	5.51	7.57
Debugging and Troubleshooting	8.8	4.48
Ease of data creation	4.67	1.56
Security	9.38	3.13
Total	57.23	42.77

4.5.3. Weight Chart

Criteria's Weight distribution shown in Figure 3, Validity has the highest value and lowest value for Ease of data creation.

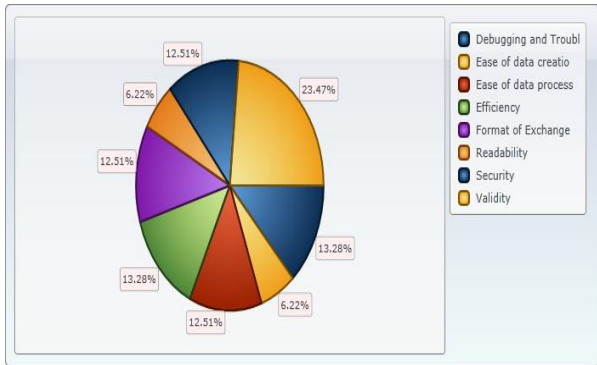


Figure 3: Weight chart of XML and JSON attributes

4.5.4. Alternative Chart of XML and JSON

In readability, security, validity and debugging and troubleshooting XML have edge over JSON, while JSON better in format of exchange, efficiency and ease of data processing than XML as shown in Figure 4.

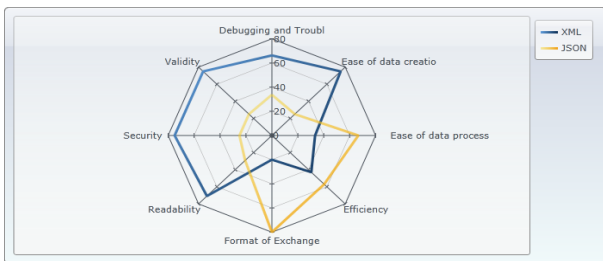


Figure 4: Alternatives chart of XML and JSON

4.5.5. Efficiency ranking graph

For each criterion in alternatives have ranking graph, as figure 5 show graph for efficiency further extended to sub criteria's of user CPU utilization, system CPU utilization and memory utilization. The graph shows that JSON best in user CPU utilization than XML, while in system CPU utilization XML perform well than JSON.

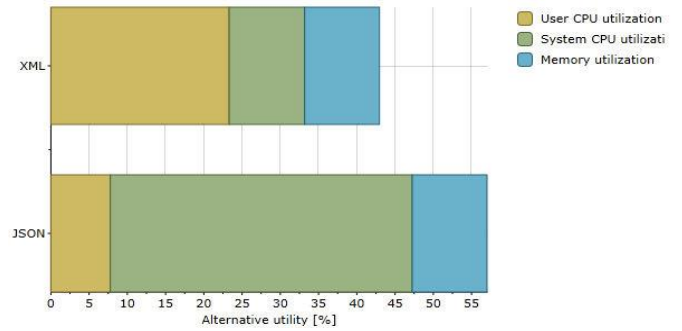


Figure 5: ranking graph for efficiency of XML and JSON

4.5.6. Efficiency Alternation chart

Alternative chart for efficiency in figure 6 shows that system CPU utilized well by alternative JSON, XML efficiently use user CPU and in memory utilization both alternative are same.

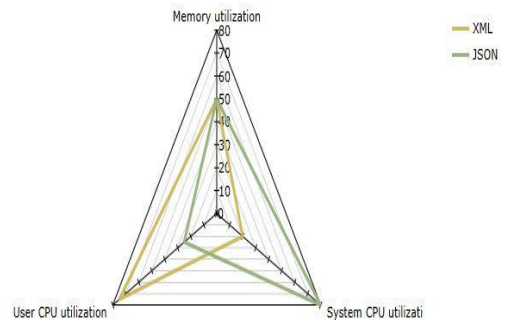


Figure 6: Alternative chart for attribute of XML and JSON Efficiency

5. Conclusion

From the above comparison it is clear that both technologies JSON and XML have their own advantages and drawbacks and it is also clear that both can be use according to the need of the system. The research study, understanding and facts from the above graphs and results conclude that XML have a bit edge over JSON for web technologies. According to my experience and above description I will advice that combination of both should be used depending on the requirement and demand. Both technologies have good properties for different situation as discussed above.

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