Above is the text of the document in a readable format. It appears to be a review report on semantic web service composition using Petri nets. The document includes an abstract and an introduction, followed by a review of literature, and concludes with a section for summaries and future work. The authors discuss the use of Petri nets for modeling semantic web service composition, including the role of OWL-S language in supporting control constructs for each phase of semantic web services. They also mention the composition of web services using different control constructs represented by Petri nets. The paper is organized into sections, each focusing on a different aspect of semantic web service composition using Petri nets.
operator with communication, represents the parallel execution of two services and describes the interaction
between the services, (5) Discriminator, where number of services executed in parallel but there is no
interaction between the services, (6) Selection, here one service is chosen dynamically from 'n' number of
services, (7) Refinement, here one service is substitute by another service which is a non empty service.

This work of Hamadi is proposed by a relational algebra given by equation (1):

\[ S = \epsilon \mid S1 \Theta S2 \mid S1 \circ S2 \mid S1 \circ S2 \mid \mu S \mid S1 \parallel C S2 \mid (S1 \parallel S2) \sim S3 \mid S(p1, q1) : S(pn, qn) \mid \text{Re f}(S1, a, s2) \]  

(1)

Where \( \epsilon \) represents empty service, \( S_1 \) \( \bigcirc \) \( S_2 \) represents service one and service two which performs Sequence operation, \( S_1 \) \( \Theta \) \( S_2 \) represents Unordered sequence operator of two service, \( \mu S \) represents Iteration operator, \( S_1 \parallel C S_2 \) represents Parallel operator with communication of two service , \( (S_1 \parallel S_2) \sim S_3 \) represents Discriminator, \( S(p1, q1) : S(pn, qn) \) represents Selection and Refinement by \( \text{Re f}(S1, a, S2) \) respectively. Here the semantic web service composition translated from relational algebra to Petri net models.

web service described by OWL-S. The service process models and service profile phase of OWL-S are
described by colored Petri net models. Colored Petri nets can be defined by colors and more number of tuples.
In these Petri net model precondition, post condition, input and output are replaced by Petri net's tokens.
Services are replaced by Petri net's place, service operations are represented by Petri net's transition.
The proposed Petri net models for semantic web service compositions are (1) Atomic process model, which
represent a single service with its one operation, (2) Sequence model, where set of services performed one after
another, (3) Split model, where set of services are executed simultaneously, (4) Split-join model, services are
executed in parallel with an fence, (5) Choice model, one service which is represented as a process if content
some condition, that condition will be executed. (6) If-then-else model, based on if-else conditions. If if
condition is correct then if condition section will executed else section will executed, (7) Any order model,
where services are not executed in parallel and follows a undefined order, (8) Repeat while model, which
follows a certain condition and after that it stops when given condition is incorrect. (9) Repeat untill model,
which act as just opposite to the previous model where the model stops when given condition is correct.

These proposed model is verified by the help of incidence matrix algorithm to test reachability, deadlock and to
test boundness property of Petri nets followed by a case study.

composite web services. For composition of web service business process execution language(BPEL) plays an
important role. Here BPEL is translated in to CPN (colored Petri net ) model for verification of web service
composition. These CPN models helps to identify the errors in composition process. They proposed two types of
activities named (1) Primitive activities contains activities like message exchange, data manipulation and (2)
Structural activities includes activities like a) Sequence activity model, where activities are performed one by
one order, b) Switch activity model, which is based on some condition of activities, c) While activity model,
where one activity is performed until the condition is true for a process, d) Pick activity model, helps to identify
the required transition and based on that transition of one event is performed, e) Flow activity model, helps to
identify the message transition and completes its operation, when all message transitions are executed in
parallel, f) Link activity model, it checks whether one activity completed its operation or not , based on that
another activity is selected.

These models are converted in to CPN models and verified through occurrence graph and CPN tool.

Miao et al.2008[5] proposed Petri net models for semantic web service composition. They have used the
models as , Atomic process model, Sequence model, Split model ,Choice model, If-then-else model, Repeat
while model, Repeat untill model and represented these models using elementary Petri nets, except Any order
model. Elementary Petri nets contains four to five tuples. These models are defined by some set of tuples given
by BN, S, F, W,M0. Where BN is defined as set of Petri nets, S is defined as set of service, F is defined as the
operation of service, W is defined as the input and output of the service operation and M0 is represented as state
of a service. Here all the Petri net based models are represented by 'n' number of services. These models are also
helpful to identify the deadlock or a dead cycle in a semantic web service composition through some
mathematical definition.

These models are verified through some theorems to test reachability, liveness properties of elementary Petri
nets model followed by reachability graph algorithm.

Petri net's transition represent service operation and Petri net's place represent input and condition value of
the web service. Then after they have calculated state space function of CPN models. State space function describes
particular state of a Petri net through places and transitions. CPN models also pick the true values of web service composition and state space analysis is done by directed graph and followed by a case study.

Wang et al.2010[7] proposed CPN (colored Petri net) models for analysis and verification of semantic web service composition. According to them the web service composition model includes dead lock and dead cycle due to improper design. In dead lock and dead cycle a service can not able to complete it operation as it depend upon another service and performs a cyclic structure. So the models should be verified through some algorithm and tools. To verify this models first they map service elements to Petri nets place, transition and tokens. Here the service profile and service model phase of OWL-S ontology of semantic web service mapped in to CPN models and lastly verified through reachability graph followed by an example.

Zhu et al.2010[8] proposed logical Petri nets for web service composition. Logical Petri nets are used to identify the uncertainties in semantic web service compositions. Logical Petri nets are high level Petri nets where input and output condition of semantic web services are represented by logical input and logical output, which are expressions. They proposed three logical Petri net models named (1) Logical input transition ,which gives input value for Petri net models, (2) Logical output transition, which gives output value for Petri net models, (3) Delay transition, states about transitions. All these expressions are represented by logical operator " ∆ ". They proposed an case study to validate this model. The case study is based on three layers of web service composition. They are named as session layer, information management layer and service composition layer. Session layer explain about user interaction, information management layer describes quality constraint and service composition layer responsible for web service composition.

Bao et al.2013[9] proposed semantic web service composition using generalized stochastic Petri nets. They described this web service composition through OWL-S service profile and service model. They analyze these OWL-S service profile and service model and converted them in to generalized stochastic Petri nets (GSPN). Then these GSPN models are analyzed through a case study. They proposed GSPN for semantic web service composition are (1) Sequence executive structure, where processes are executed one by another, (2) Choose perform combination process, where after completion of one sequence executive structure based on some conditional value the process will be executed. (3) Choose execute group member service, where group of processes are executed according to conditional value. (4) Parallel execution, which helps to execute the service in parallel, (5) choose executive structure 1, execute until the condition changed and (6) choose executive structure 2, where after execution of service decide to continue the process or execute the process.

These model are analyzed with help of incidence matrix followed through a case study.

III. COMPARISON

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>AUTHOR'S NAME AND YEAR</th>
<th>PETRI NET MODEL</th>
<th>OWL-S SERVICE PROFILE AND SERVICE MODEL</th>
<th>VERIFICATION OF SEMANTIC WEB SERVICE COMPOSITION BY</th>
<th>OWL-S SERVICE GROUNDING(INTERACTION)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hamadi et al.2003 [2]</td>
<td>Elementary Petri nets</td>
<td>Yes</td>
<td>Case study</td>
<td>Partially Yes</td>
</tr>
<tr>
<td>2</td>
<td>Yong sang et al.2007 [3]</td>
<td>Colored Petri nets</td>
<td>Yes</td>
<td>Incidence matrix algorithm</td>
<td>No</td>
</tr>
<tr>
<td>6</td>
<td>Wang et al.2010 [7]</td>
<td>Colored Petri nets</td>
<td>Yes</td>
<td>Reachability graph</td>
<td>No</td>
</tr>
<tr>
<td>7</td>
<td>Zhu et al.2010 [8]</td>
<td>Logical Petri nets</td>
<td>Yes</td>
<td>Case study</td>
<td>No</td>
</tr>
</tbody>
</table>
IV. DISCUSSION

After review of literature on semantic web service composition using Petri nets we concluded that the Petri net models are used to represent OWL-S service profile and service model Phase of semantic web services. We have already discuss service profile and service model helps to identify the functionality of the services and process models respectively. Another main phase of OWL-S is service grounding, which identifies the interaction between services. But above models are not able to represent the interaction of semantic web service composition. Two of them able to represent partially but specific model representation is not given. So to represent service grounding phase of semantic web services we need to propose some advance Petri net models, which are helpful for to represent the interaction between web services. So our main aim to verify “Semantic web service composition from OWL-S to advance Petri net models”. In our future work we will propose some advance Petri net models which helps us to identify the service interaction phase of semantic web service composition, then we will validate our model by incidence matrix algorithm following by a case study.

V. CONCLUSION

After study of few papers related to semantic web service composition using Petri net models, we came to know that composition of semantic web service plays an important role to explain service functionality and service execution processes of OWL-S due to its properties like interoperable, self descriptive and automation. To represent these properties of semantic web service through OWL-S, Petri nets are helpful to identify formal semantics and also responsible for representation of control flow and data flow of semantic web services. In our future work we will include some advance Petri net models for service grounding phase of the semantic web service composition which will help for interaction between services and verify them along with an algorithm followed by a case study.

REFERENCES