Web Service Composition Software with the Visual User Interface

(Visuaalse kasutajaliidesega veebiteenuste kompositsioonitarkvara)

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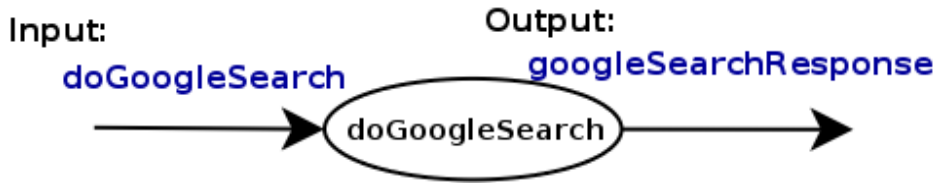
Outline

Web services

Web service is software component that accessible over the Web.



Web service description includes:

- name, description, inputs and outputs
- location
- invocation information

Service description languages: WSDL, WSDL-S, SA-WSDL, WSMO, OWL-S, ...

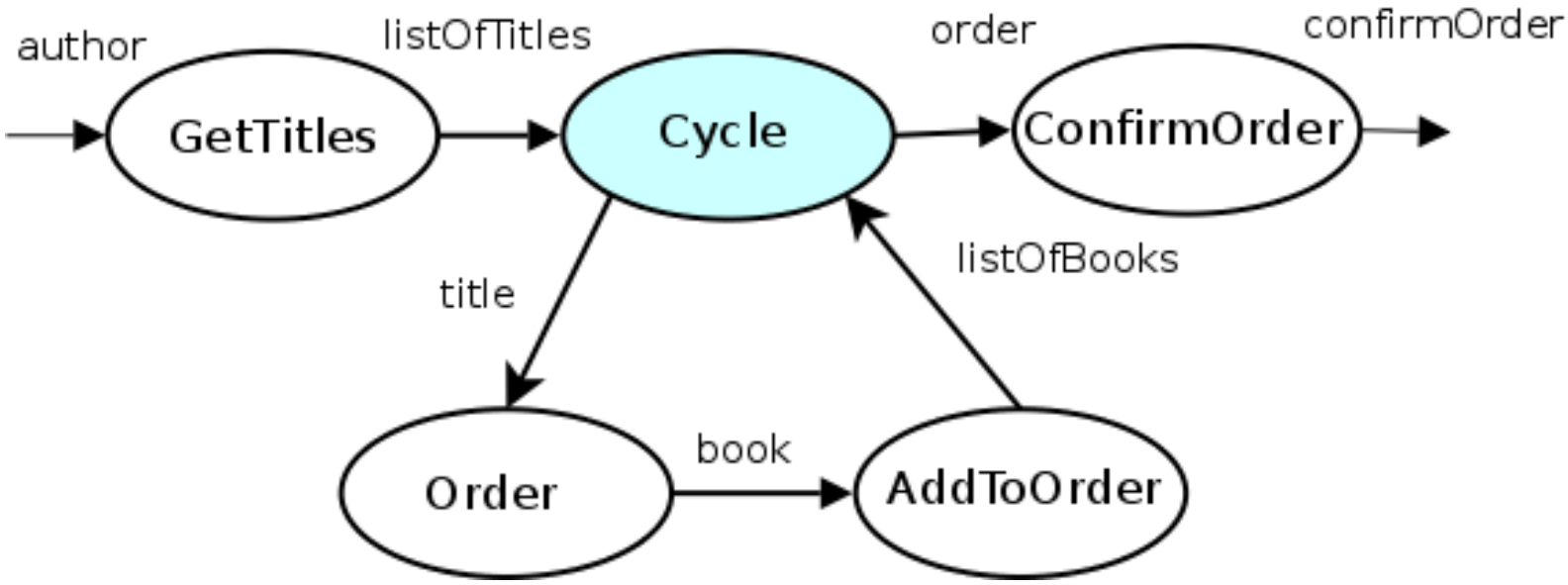
Web service composition

- Web service composition is the task of combining and linking existing Web services to create new Web processes in order to add value to the collection of services.
- Web service composition can include services from several different computers.
- Composition constructions can be sequences, cycles, conditions etc.
- Composition languages: WS-BPEL, WSMO, OWL-S, XLANG, WSFL, BPML, WSCI, ...

Problems

- Expressing the meaning of composed service is complicated from the user's perspective (Petri nets, state-machines),
- Restricted visualisation possibilities (Protégé OWL-S editor , OWL-S IDE, Eclipse BPEL designer etc),
- Automatic composition needs precise semantics.

Higher order workflows and representation in logic



$$\texttt{author} \supset \texttt{listOfTitles} : \mathit{GetTitles} \qquad \text{(T1)}$$

$$\texttt{order} \supset \texttt{confirmOrder} : \mathit{ConfirmOrder} \qquad \text{(T2)}$$

$$\texttt{title} \supset \texttt{book} : \mathit{Order} \qquad \text{(T3)}$$

$$\texttt{book} \supset \texttt{listOfBooks} : \mathit{AddToOrder} \qquad \text{(T4)}$$

$$\texttt{listOfTitles} \wedge (\texttt{title} \supset \texttt{listOfBooks}) \supset \texttt{order} : \mathit{Cycle} \qquad \text{(T5)}$$

$$\texttt{author} \supset \texttt{confirmOrder}$$

Proof of solution

Formulae:

$$\texttt{author} \supset \texttt{listOfTitles} : \mathit{GetTitles} \qquad (\texttt{T1})$$

$$\texttt{order} \supset \texttt{confirmOrder} : \mathit{ConfirmOrder} \qquad (\texttt{T2})$$

$$\texttt{title} \supset \texttt{book} : \mathit{Order} \qquad (\texttt{T3})$$

$$\texttt{book} \supset \texttt{listOfBooks} : \mathit{AddToOrder} \qquad (\texttt{T4})$$

$$\texttt{listOfTitles} \wedge (\texttt{title} \supset \texttt{listOfBooks}) \supset \texttt{order} : \mathit{Cycle} \qquad (\texttt{T5})$$

Rules:

$$\frac{A \supset B \wedge C : f \quad B \wedge D \supset G : g}{A \wedge D \supset C \wedge G \wedge B : f;g} \qquad (1)$$

$$\frac{(A \supset B) \wedge X \supset Z : f \quad A \wedge W \supset B : g}{X \vee W \supset Z : f(g)} \qquad (2)$$

$$\texttt{author} \supset \texttt{confirmOrder}$$

Proof:

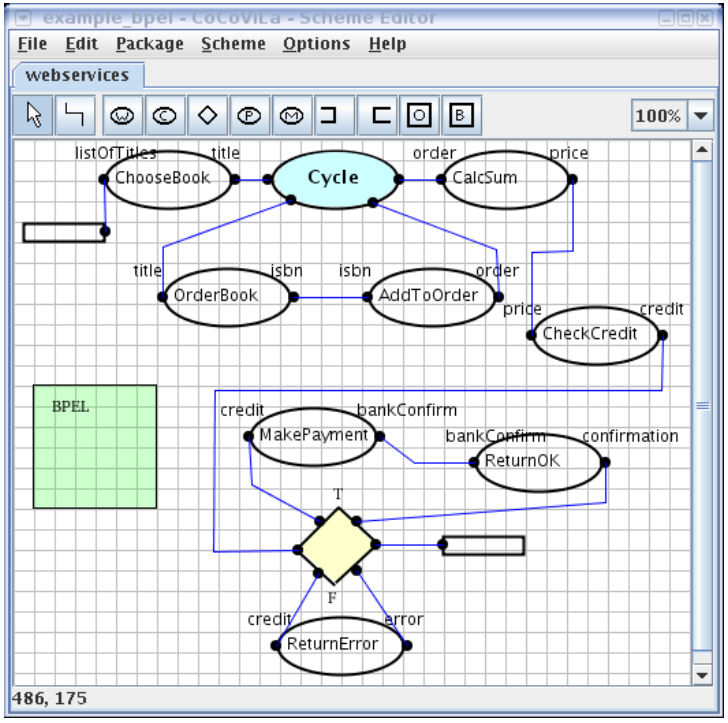
$$\dfrac{\texttt{T1} \quad \dfrac{\texttt{listOfTitles} \supset \texttt{order} : \mathit{Cycle}(\mathit{Order};\mathit{AddToOrder}) \qquad \texttt{T2}}{\texttt{listOfTitles} \supset \texttt{confirmOrder} : \mathit{Cycle}(\mathit{Order};\mathit{AddToOrder});\mathit{ConfirmOrder}}\,(1)}{\texttt{author} \supset \texttt{confirmOrder} : \mathit{GetTitles};\mathit{Cycle}(\mathit{Order};\mathit{AddToOrder});\mathit{ConfirmOrder}}\,(1)$$

$$\dfrac{\dfrac{\texttt{T3} \quad \texttt{book} \supset \texttt{listOfBooks} : \mathit{AddToOrder}}{\texttt{title} \supset \texttt{listOfBooks} : \mathit{Order};\mathit{AddToOrder}}\,(1) \qquad \texttt{T5}}{\texttt{listOfTitles} \supset \texttt{order} : \mathit{Cycle}(\mathit{Order};\mathit{AddToOrder})}\,(2)$$

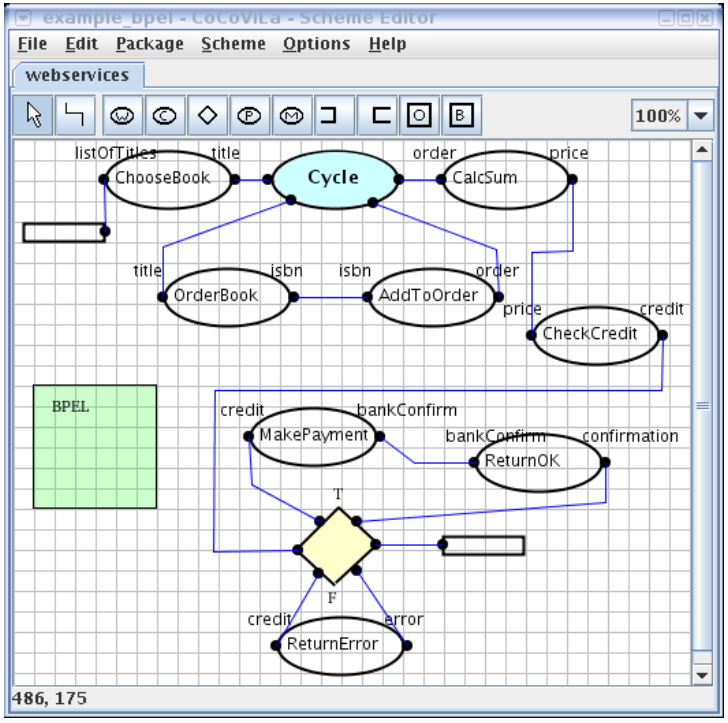
Service composition in CoCoViLa

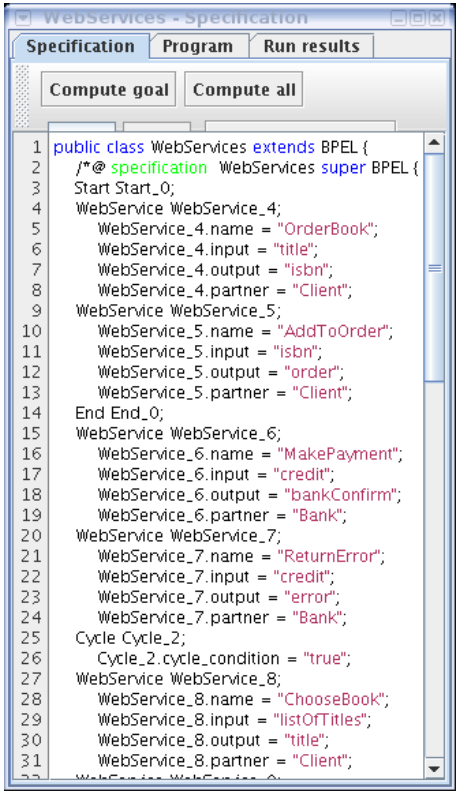
- CoCoViLa provides a framework for developing visual specification languages.
- Includes algorithm synthesis based on Structural Synthesis of Programs.
- Composition steps:
  - Specification
  - Problem description in logic and formulation of the goal
  - Proof of solvability of the problem
  - Java program

Composition steps

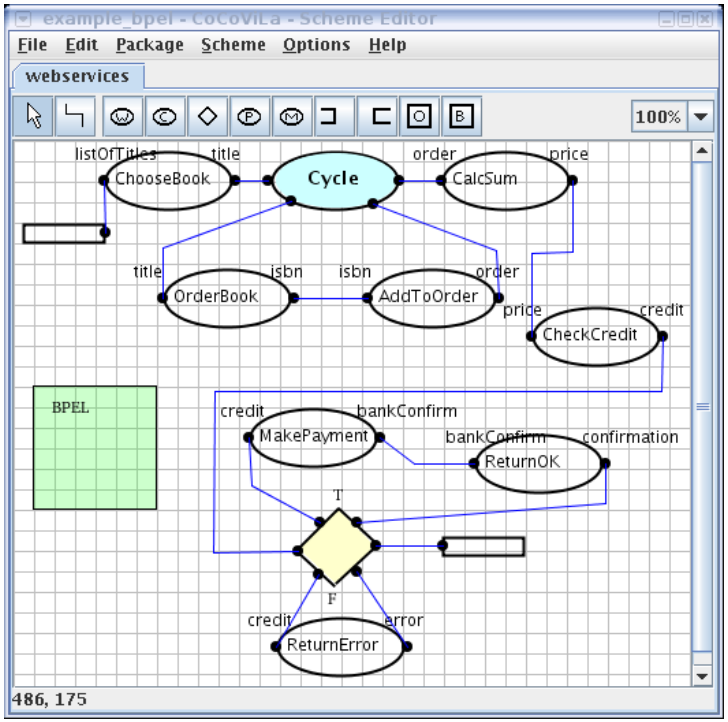


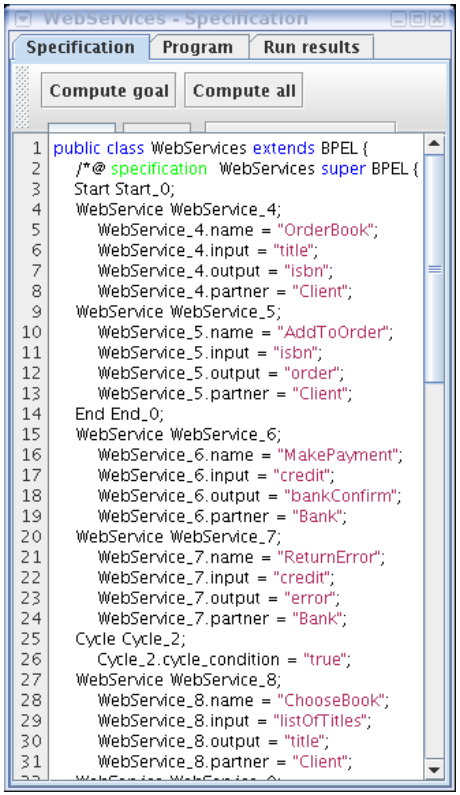
Composition steps



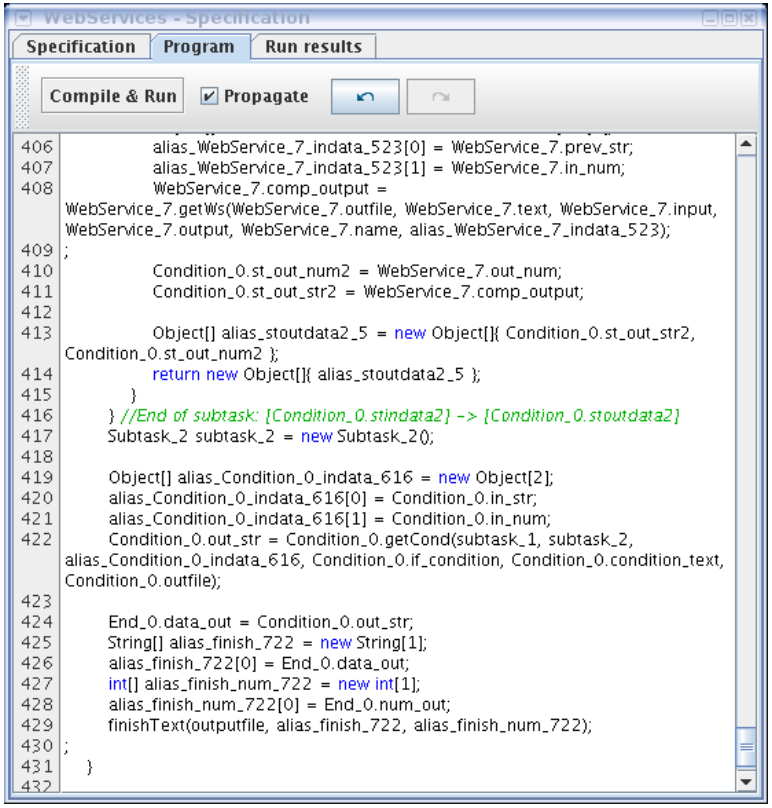


Composition steps



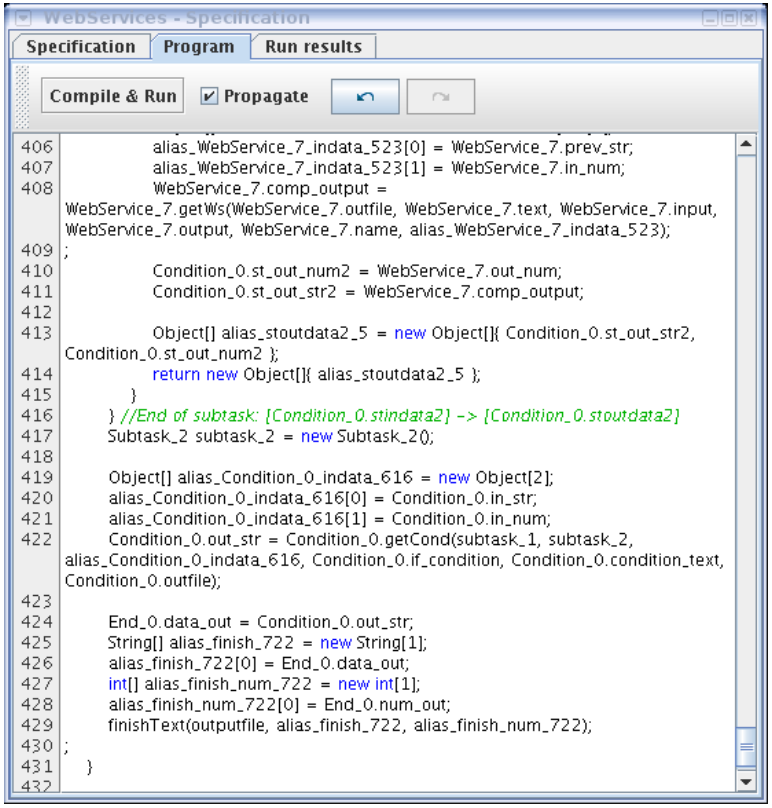


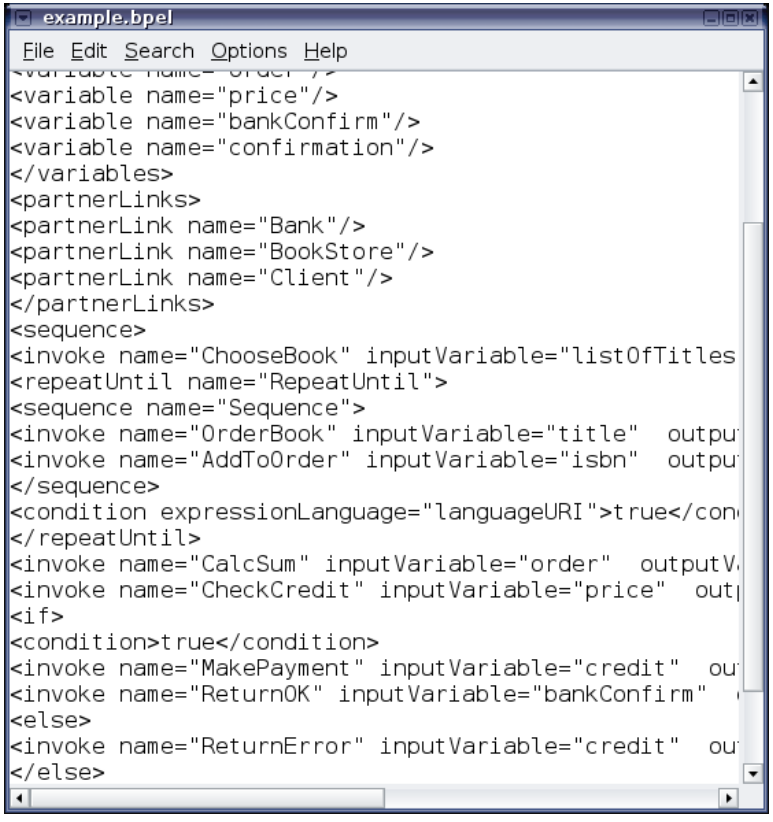
Composition steps




```
406             alias_WebService_7_indata_523[0] = WebService_7.prev_str;
407             alias_WebService_7_indata_523[1] = WebService_7.in_num;
408             WebService_7.comp_output =
    WebService_7.getWs(WebService_7.outfile, WebService_7.text, WebService_7.input,
    WebService_7.output, WebService_7.name, alias_WebService_7_indata_523);
409 ;
410             Condition_0.st_out_num2 = WebService_7.out_num;
411             Condition_0.st_out_str2 = WebService_7.comp_output;
412
413             Object[] alias_stoutdata2_5 = new Object[]{ Condition_0.st_out_str2,
    Condition_0.st_out_num2 };
414             return new Object[]{ alias_stoutdata2_5 };
415         }
416     } //End of subtask: [Condition_0.stindata2] -> [Condition_0.stoutdata2]
417     Subtask_2 subtask_2 = new Subtask_2();
418
419     Object[] alias_Condition_0_indata_616 = new Object[2];
420     alias_Condition_0_indata_616[0] = Condition_0.in_str;
421     alias_Condition_0_indata_616[1] = Condition_0.in_num;
422     Condition_0.out_str = Condition_0.getCond(subtask_1, subtask_2,
    alias_Condition_0_indata_616, Condition_0.if_condition, Condition_0.condition_text,
    Condition_0.outfile);
423
424     End_0.data_out = Condition_0.out_str;
425     String[] alias_finish_722 = new String[1];
426     alias_finish_722[0] = End_0.data_out;
427     int[] alias_finish_num_722 = new int[1];
428     alias_finish_num_722[0] = End_0.num_out;
429     finishText(outputfile, alias_finish_722, alias_finish_num_722);
430 ;
431   }
432
```

Composition steps

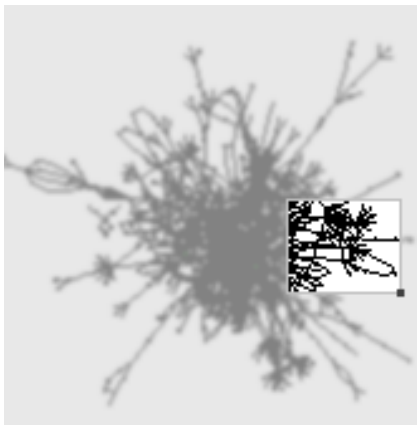




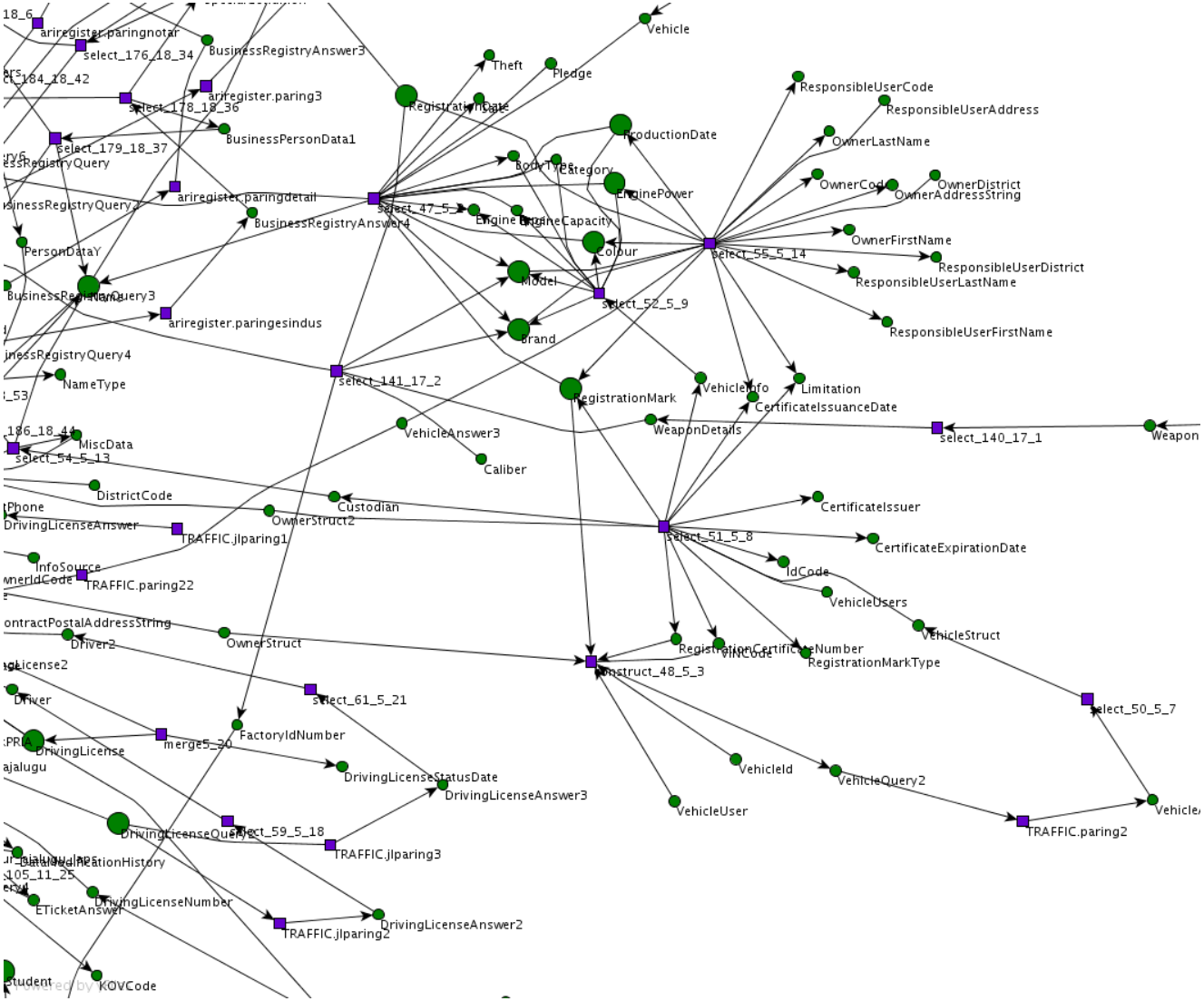
X-road data exchange layer

- X-road enables secure access to nearly all Estonian national databases.
- Hundreds of services provided by information systems of different institutions work over the X-Road on the 24/7 basis.
- All Estonian residents with the national ID card or a contract for the use of Internet banking codes can make use of its enquiry services targeted at citizens.
- Officials as well as legal and natural persons are allowed to search data from national databases over the Internet within the limits of their authority.

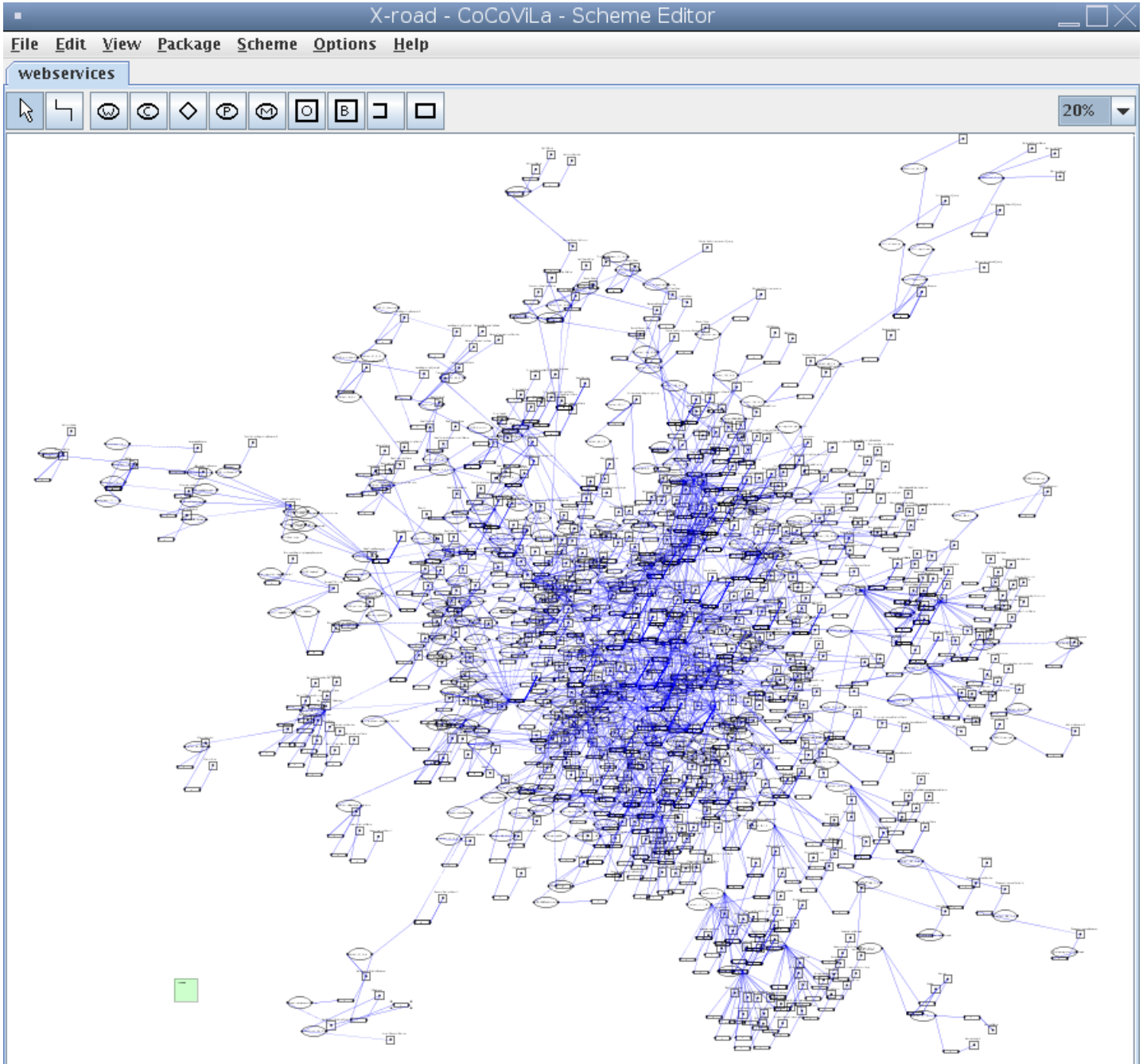
X-road model



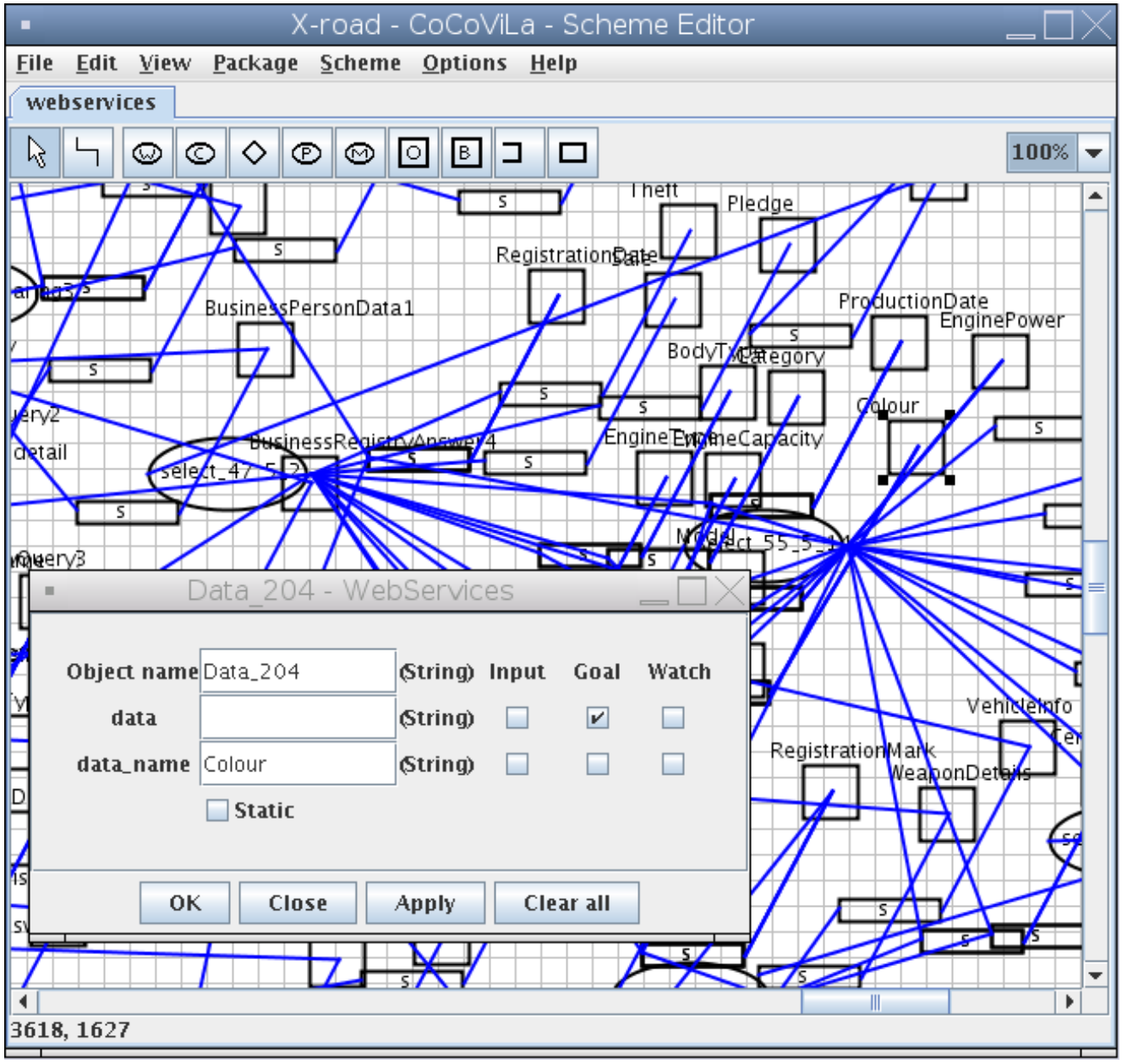
(Peep Küngas)



X-Road services model in CoCoViLa



X-Road services in CoCoViLa

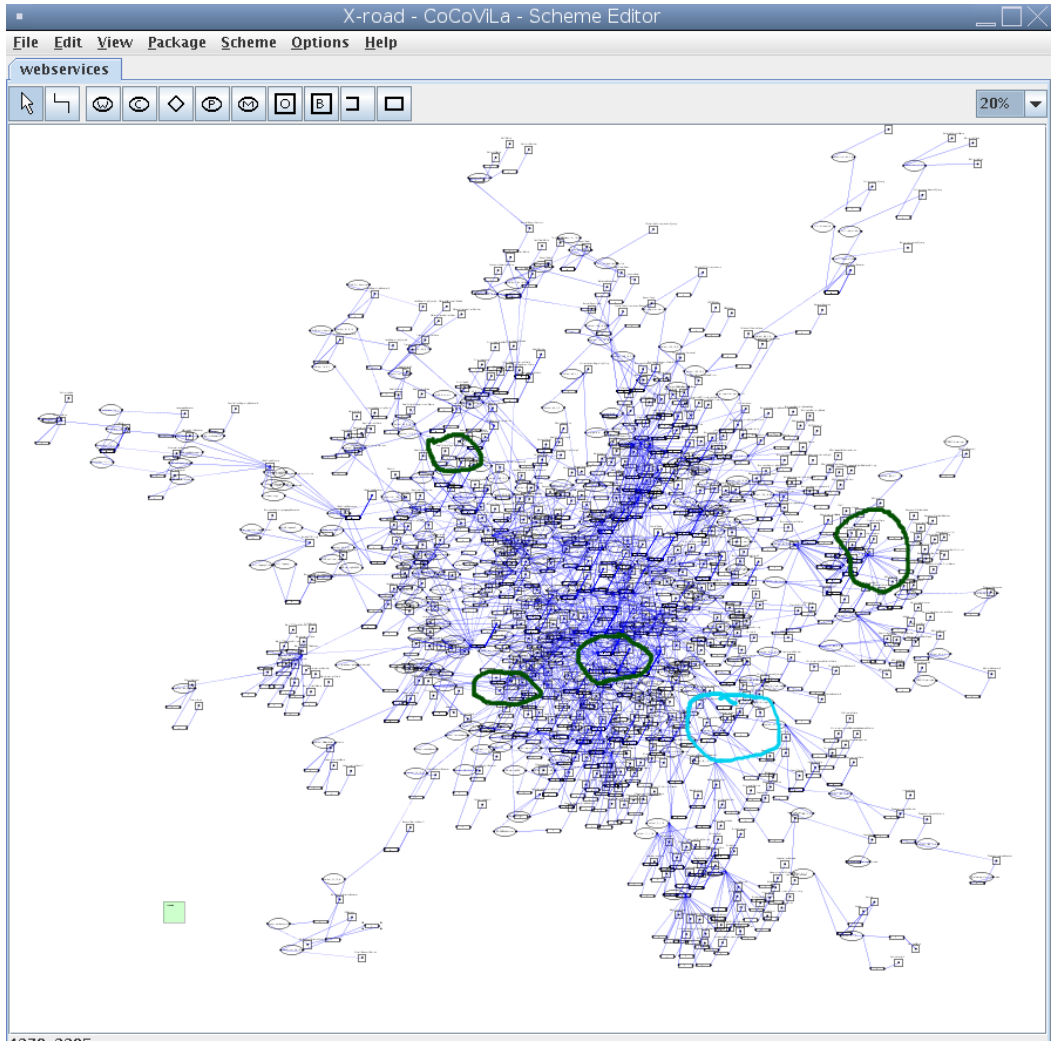


X-Road services in CoCoViLa

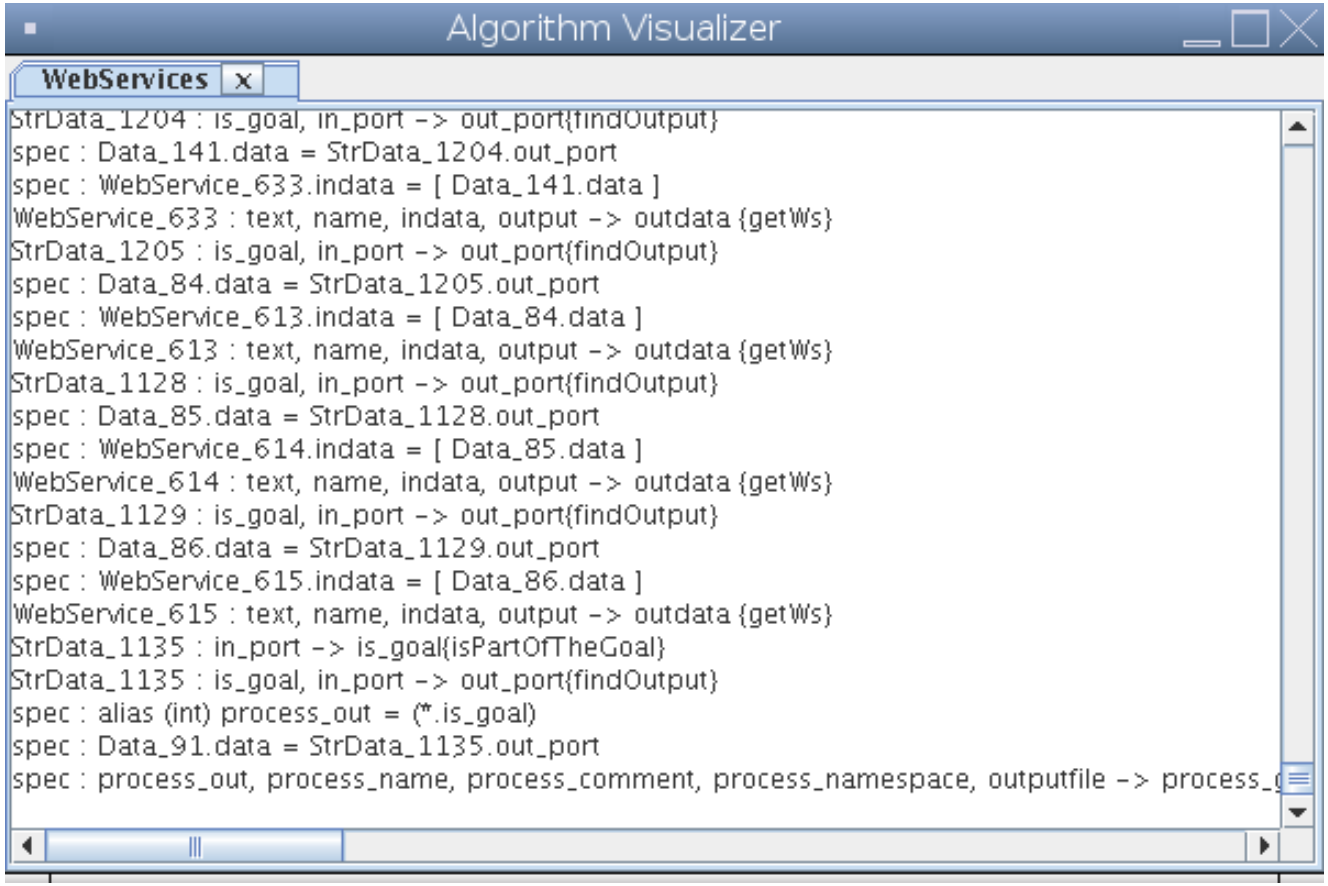
GraduationCertificate− >

RealEstateType, RegistrationMark, Colour, EstonianAddressString,

OccupationArea

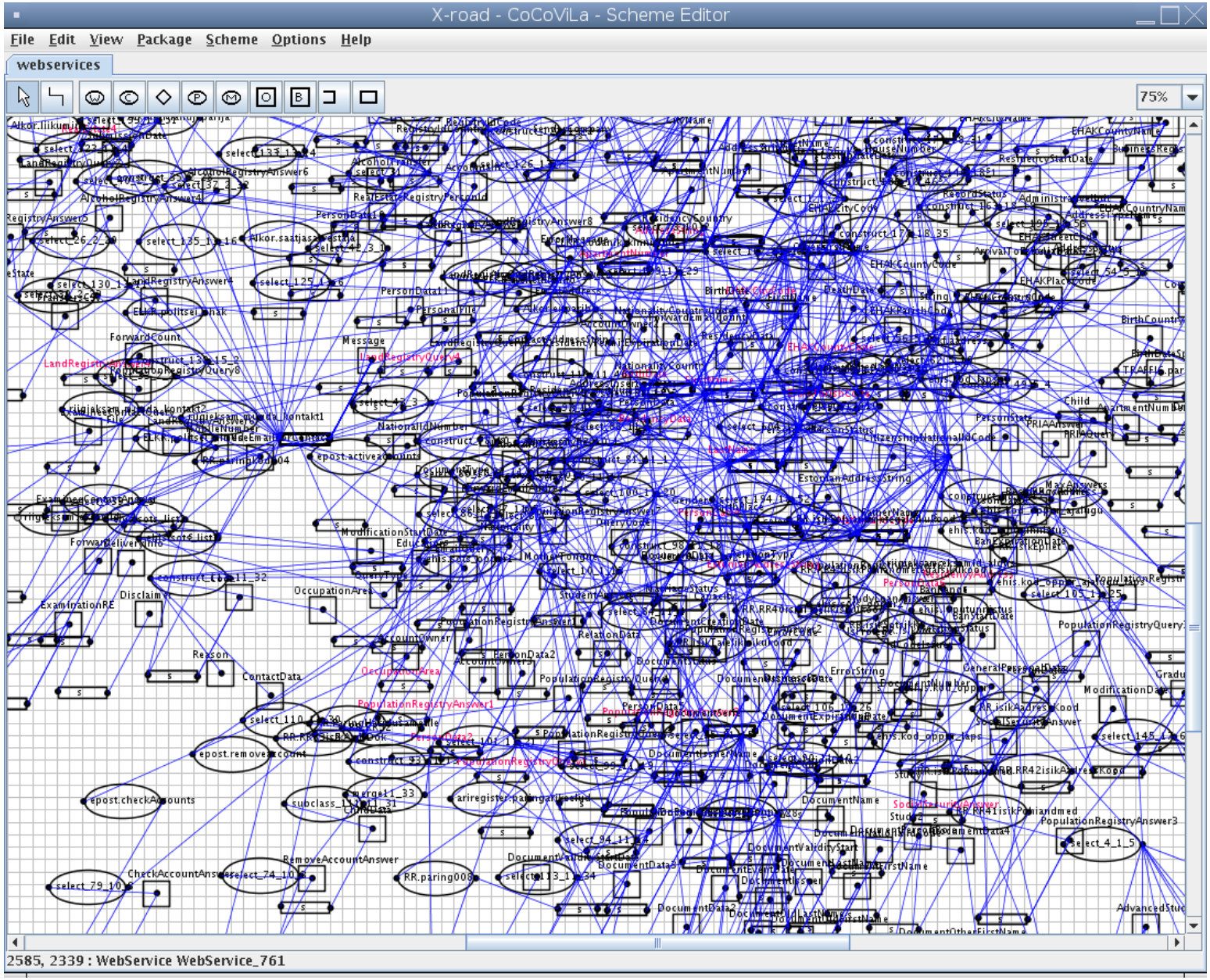


X-Road services in CoCoViLa

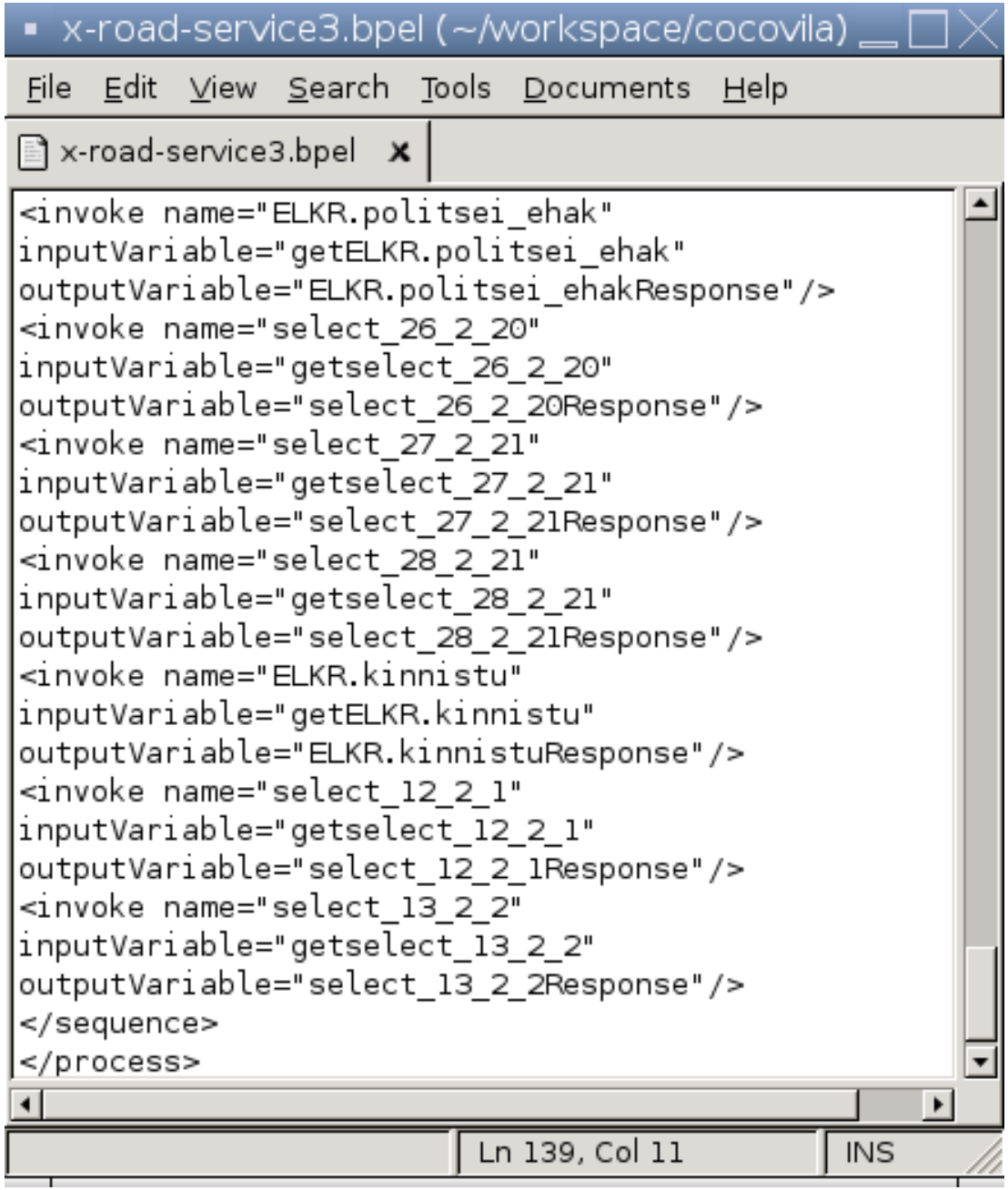


Finding the solution takes about one second.

X-Road services in CoCoViLa



X-Road services in CoCoViLa



Conclusions

The proposed method:

- allows to design composition visually,
- is suitable for large service models,
- can be used for automatic composition,
- allows to generate different process languages.

Thank you for listening!
Questions?