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NETWORKING SOLUTIONS IN COMBINED DISTRIBUTED WORLDS

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Анотація. *У статті аналізується швидкозростаюче значення застосування моделей графів, мережевих моделей та інструментів у сферах транспорту, зв'язку, соціальних та військових систем, виробництва та розподілу товарів, освіти, економіки, біології, психології, кримінології, зміни клімату тощо. Мета роботи полягає в розробці ефективних методів, здатних інтегрувати абсолютно різні типи мереж в інфраструктури вищого рівня, які представляють передові соціальні системи, зокрема, враховуючи симбіоз виробництва й оцінки товарів і систем доставки отриманих продуктів згідно з універсальною концепцією мережі. У пошуках останнього у статті коротко описується розроблена й запатентована модель і Технологія просторового захоплення (ТПЗ) та її базова Мова просторового захоплення (МПЗ), які дозволяють виконувати повністю розподілені та паралельні задачі в будь-яких великих і складних мережевих структурах. На початку роботи продемонстровано елементарні мережеві операції, описані за допомогою МПЗ і необхідні для кращого розуміння решти матеріалу. Потім наводяться практичні приклади комбінованих мережевих рішень, які включають описані за допомогою МПЗ сценарії для пошуку найсильніших виробничих центрів у цих мережах, а також найпотужніших спільнот користувачів, які зацікавлені в певних типах продуктів і роблять на них запит. Після відбору конкретних виробників і споживачів формується орієнтована на них розподілена віртуальна та фізична інфраструктура доставки на основі найкоротших шляхів від виробників до споживачів. Процес розподілу в МПЗ також демонструється в режимі реального часу. Отримані результати підтверджують, що глибока інтеграція гетерогенних розподілених систем може бути організована природно та автоматично в рамках глобальних процесів цілісності, обізнаності та свідомості завдяки парадигмі просторового захоплення, як уже обговорювалося в попередніх публікаціях про ТПЗ.*
Ключові слова: *мережеві та графові операції, Технологія просторового захоплення, Мова просторового захоплення, зіставлення патернів, виробничі мережі, мережі оцінювання, мережі доставки, цілісність системи, обізнаність та свідомість.*

Abstract. *The paper analyzes the rapidly growing importance of graph and network models and tools in such areas as transport, communications, social and military systems, goods production and distribution, education, economy, biology, psychology, criminology, climate change, etc. It aims at the development of effective methods capable of integrating different types of networks into higher-level infrastructures representing advanced social systems, particularly considering the symbiosis of goods production, goods evaluation, and the obtained product delivery systems under some universal networking concept. In a search for the latter, the article briefs the developed and patented Spatial Grasp Model and Technology (SGT) with its basic Spatial Grasp Language (SGL), which allow for fully distributed and parallel operations on arbitrary large and complex networked structures. The paper first shows some elementary networking operations in SGL useful for a better understanding of the rest of the material. Then it provides several practical examples of combined networking solutions, which include scenarios in SGL for finding the strongest production centers in their networks, as well as the most powerful user communities interested in and requesting particular types of products. After the selection of specific producers and consumers, the paper forms a distributed virtual and physical delivery infrastructure oriented on all of them and based on the shortest paths from producers to consumers and shows live the distribution process in SGL. The obtained results confirm that the deep integration of heterogeneous distributed systems can be organized naturally and automatically within the global integrity, awareness, and consciousness processes under the Spatial Grasp paradigm, as was already discussed in the previous publications on SGT.*

Keywords: *network and graph operations, Spatial Grasp Technology, Spatial Grasp Language, pattern matching, production networks, evaluation networks, delivery networks, system integrity, awareness, and consciousness.*

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1. Introduction

Networks as models and their operations are widely used in practically every area of human activity. We have analyzed and reviewed numerous and very different types and areas of networking, including transport [1–6], communication [7–13], social [14–18], battle and military networks [19–23], economic [24–29], distribution [30–34], virtual [35–39], neural [40–44], psychological [45–49], and criminal networks [50–55].

After this analysis, we have come to a sound conclusion about the suitability and efficiency of both the theoretical and practical use of the developed and patented Spatial Grasp Model and Technology (SGT), with its basic Spatial Grasp Language (SGL) [56–71], for expressing and solving numerous problems in very different types of networks.

The aim of this paper is to investigate the applicability of SGT and SGL for the development of higher-level social infrastructures effectively integrating very different types of networking, say, reflecting distributed goods production, different item evaluation and assessment by consumers, and requested goods delivery to registered users. The rest of the article is organized as follows.

Section 2 describes some examples of networking in the following areas (including details): production networks (global production, design and operation, centers and connectivity), product evaluation networks (development systems, sustainable design, and network algorithms), and product distribution networks (decision-making, delivery in marketing, and flow of goods).

Section 3 briefs the main features of SGT, SGL, and its distributed networked implementation, useful for better comprehension of the following sections, with full availability of existing publications on this paradigm and its numerous applications.

Section 4 shows elementary networking operations in SGL which can be useful for understanding SGL solutions in other sections and provides references to existing world publications on graph and network operations, SGT-based too.

Section 5 provides some practical examples of combined networking solutions, which include solutions in SGL for (1) product development networks, expressing design and production of different types of products, as well as possible links between these networks, and finding their strongest or central nodes; (2) product assessment and request networks, finding the strongest communities interested in same or different products like discovering cliques among them; (3) networks of product delivery to most interested consumers, with the delivery of resultant products via specially designed optimal infrastructures; (4) summary of these combined networking solutions, where SGT can provide and integrate even much more complex networking solutions within global production-assessment-distribution social infrastructure; and (5) which represents SGT as a universal networking concept and tool capable of world creation, analysis, modification, and management.

Section 6 concludes the paper by confirming the effectiveness of SGT for various network operations, including higher-level ones for the integration of different types of networks within advanced social infrastructures, up to being the universal networking concept. References cite many publication sources that were reviewed, analyzed, classified, and used in this paper.

2. Examples of networking in the selected areas

The following is a brief analysis and review of different types of networks chosen for the investigation of their possible holistic integration within higher-level social infrastructures, which may be both national and international.

2.1. Production networks

A Global Production Network (GPN) [72] is the one whose interconnected nodes and links extend spatially across national boundaries and, by doing so it integrates some parts of disparate national and sub-national territories. GPN frameworks combine the insights from the global value chain analysis and actor-network theory.

Figure 1 — Production networks

The design and operation of industrial companies acting in global production networks are discussed in [73]. Globalization has led to profound changes in the economy in recent decades. Nowadays, companies of any size operate globally in the form of GPNs.

Centers and connectivity in global production networks are discussed in [74]. Global production network fluxes go beyond materials, energy, or other tangible goods. It has impacts on the movement of ideas, information, culture, and people. A symbolic production network image is shown in Fig. 1.

2.2. Product evaluation networks

The evaluation of product development systems by network analysis is described in [75]. It proposes the integration of two systems engineering analysis tools, the Design Structure Matrix (DSM) and Network Analysis (NA), to study task interactions in a Product Development Process (PDP).

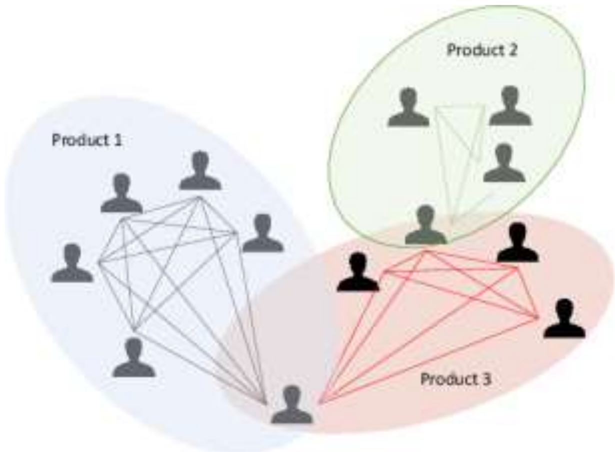


Figure 2 — User interconnections for the assessment of different products

Sustainable product design evaluation based on deep residual networks is presented in [76]. This evaluation has become an increasingly crucial aspect of product design. This study proposes an integrated approach that combines manual design evaluation based on the analytic hierarchy process (AHP) with an automatic design evaluation. A symbolic product evaluation network image is shown in Fig. 2.

Machine learning and network algorithms for expressing product opinions are discussed in [77]. E-commerce is the fastest-growing segment of the economy. Online reviews play a crucial role in helping consumers evaluate and compare products and services. There are many reasons why it is hard to identify opinion spammers automatically, including the absence of reliable labeled data.

2.3. Product distribution networks

The role of decision-making parameters for distribution networks is discussed in [78]. Distribution networks have to interconnect the consumption and production sides of the supply chain. Decision-making has special parameters according to perspectives related to strategic, tactical, and operational levels.

Figure 3 — Product distribution networks

A value delivery network in marketing [79] refers to the network of relationships and interactions between various entities involved in delivering value to customers. It includes the coordination and collaboration between suppliers, manufacturers, distributors, and customers to ensure the effective and efficient delivery of products or services.

A distribution network can be seen as a flow of goods from a producer or supplier to an end consumer [80]. The network consists of storage facilities, warehouses, and transportation systems that support the movement of goods until they reach the end consumer. A symbolic product distribution network image is shown in Fig. 3.

3. Spatial Grasp Model and Technology

Only the most general features of the developed paradigm are mentioned, with full availability of the extended publications on it in [56–71].

General issues

Within the Spatial Grasp Model and Technology (SGT), a high-level operational scenario expressed in recursive Spatial Grasp Language (SGL), starting at any world point propagates, covers, and matches the distributed environment in parallel wavelike mode, as symbolically shown in Fig. 4. Such propagation can result in returning and analyzing the reached states and data, which may be arbitrarily remote, or used for launching more waves.

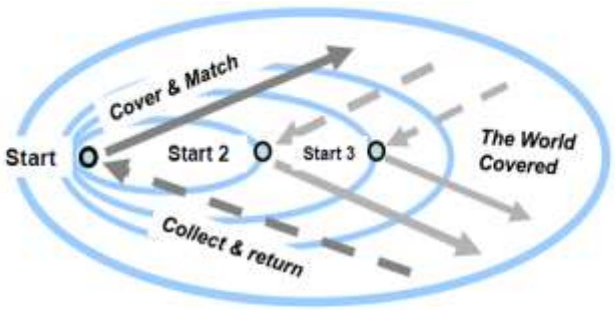


Figure 4 — Parallel recursive world coverage with Spatial Grasp Model

The distributed worlds in this model, that are effectively covering, conquering, and managing, may be of different types: Physical World (PW), considered as continuous and infinite where each point can be identified and accessed by physical coordinates; Virtual World (VW), which is discrete and consists of nodes and semantic links between them; and Executive World (EW), consisting of active doers, which may be humans or robots, with advanced communication possibilities between them. Different kinds of combinations of these worlds can also be possible within the same formalism.

Spatial Grasp Language (SGL)

The SGL allows for organizing direct space presence and operations with unlimited powers and parallelism. Its universal recursive organization, with operational scenarios called *grasp*, can be expressed by a single formula

grasp → *constant* | *variable* | *rule* ({ *grasp*, }).

The *rule* expresses certain action, control, description, or context accompanied by operands, which can be any *grasps*, too. The top SGL details can be expressed as

constant → *information* | *matter* | *custom* | *special*
variable → *global* | *heritable* | *frontal* | *nodal* | *environmental*

rule → *type* | *usage* | *movement* | *creation* | *echoing* |
verification | *assignment* | *advancement* | *branching* |
transference | *exchange* | *timing* | *qualifying*

The rules, starting at certain points, can organize the navigation of the world sequentially, in parallel, or any combination thereof. They can result in the same application points or cause movement to other world points with the obtained results left there or returned.

SGL interpreter organization

The SGL interpreter consists of specialized modules serving SGL scenarios or their parts that happened to be inside this interpreter, also organizing exchanges with other interpreters for distributed SGL scenarios, as shown in Fig. 5. Communicating SGL interpreters can be in an arbitrary number of copies, representing powerful spatial engines operating without central resources or control. They can effectively work with spatial graphs and network data of any volume and distribution.

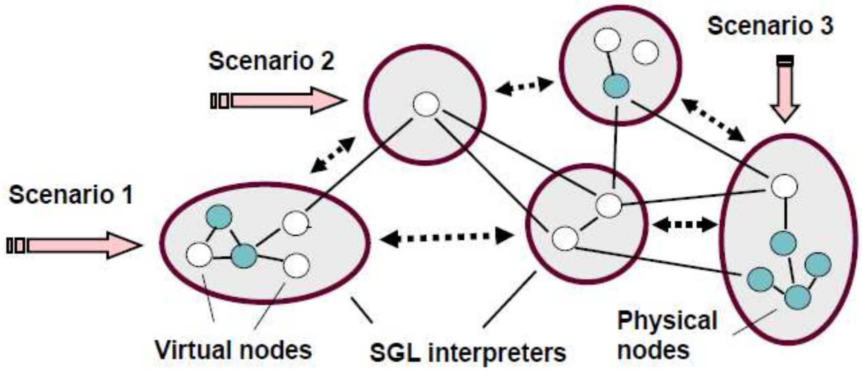


Figure 5 — SGL distributed networked interpretation

4. Elementary networking operations

Only some elementary graph and network operations expressed in SGL are shown in this section, as numerous sources on different graph and network operations are available everywhere [81–93], and many of them were discussed in detail and implemented in previous SGT and SGL based publications [56–71]. The chosen elementary operations useful for understanding networking solutions in the following session may be as follows.

Creating an isolated virtual node with some name (see Fig, 6 *a*, at the top):

create_node(a).

Adding to the node a link named *r* leading to node *b*, to be created too, will be as follows (see Fig. 6 *a*, in the middle):

hop(a); create(link(r), node(b)).

Creating the two linked nodes from scratch can be done by using

create(node(a); (link(r), node(b))).

Full details of both nodes and the link connecting them can be set up as follows (see Fig. 6 *a*, at the bottom):

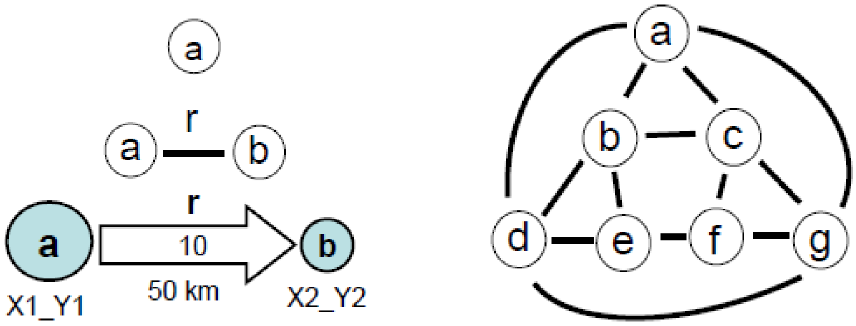
create(node(a, WHERE == *X1_Y1*, SIZE == big);
(link(r, DIRECTION == +, WEIGHT == 10, LENGTH == 50km),
node(b, WHERE == *X2_Y2*, SIZE == small)))

Creating an arbitrary network, as in Fig. 6 *b* (assuming for simplicity that all the links are named *r*):

align(split(a:(b,c,d,g), b:(a,c,d,e), c:(a,b,f,g), d:(a,b,e,g),

e:(b,d,f), f:(e,c,g), g:(a,c,d,f));
frontal(Next) = VAL[2]; create(VAL[1]));
hop(Next); NAME < BEFORE; linkup(r, BEFORE)

This scenario first splits the network description as the collection of its nodes accompanied by the sets of neighboring nodes into parallel control points for each node (using the split rule), and then from each point creates an individual node with its name given, with all these operations globally synchronized using rule alignment. After their completion, each created node forms links named *r* to all its registered neighbors, already created. To resolve competition between neighboring nodes attempting to create the same link between them, priority for this operation is given to the neighbor having its name stronger (could be as opposite as well).



a *b*

Figure 6 — Elementary network operations

Having created a network infrastructure like the one in Fig. 6 *b*, we may, starting at some node like *g*, reach any other node like *b*, by the following SGL scenario navigating the network in a parallel wave-like mode, without cycling.

```
hopfirst(g);
repeat(hopfirst(all_links); if(NAME == b, done))
```

The rule `hopfirst` enters each node only once, with marking them, thus blocking possible cycles during the network navigation, also not guaranteeing all possible paths between given nodes to be processed. It is also very easy to find any paths in networks using SGL between nodes of interest. For example, all simple paths from node `g` to node `b` (i.e. with non-repeating nodes) can be easily found in Fig. 6 *b*, and finally printed by

```
frontal(Path); hop(g);
repeat(append(Path, NAME); if(NAME == b, done_output(Path));
       hop(all_links); notbelong(NAME, Path))
```

The scenario accumulates each possible path (with all developing independently and in parallel) by collecting names of subsequent nodes during movement through the path, allowing hops to the next nodes only if they are not already registered in these growing paths.

This scenario will register all paths from `g` to `b` including `(g,c,b),(g,f,e,b),(g,f,e,d,b),...`

5. Practical examples of combined networking solutions

5.1. Product development networks

Some basic features of production networks (sources [72–74] are reviewed in Section 2.1) include the following. A global production network (GPN) has interconnected nodes and links that extend spatially across national and international boundaries. Nowadays, companies of any size operate globally in the form of GPNs, where globalization has two sides: (a) the lack of geographical barriers, increased mobility, the flux of capital, goods, and ideas; (b) the necessity for concentration.

In Fig. 7, three symbolic production networks are shown developing products of types `A`, `B`, and `C` (with the links inside them named with corresponding lowercase letters `a`, `b`, `c`) and having nodes of different shapes (like square, hexagon, and circle), also painted in different colors (their connecting links, too). Possible business links between the nodes of different networks are mentioned by broken black `x` lines.

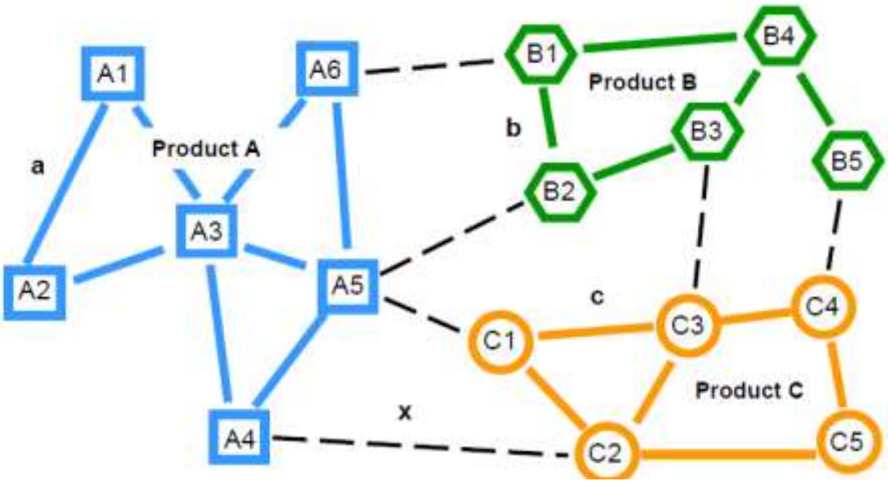


Figure 7 — Production networks

The importance of different interlinked production components in these networks can be analyzed by the network structures in a variety of ways, and first of all, using node centrality measures like those discussed in [70], named as degree centrality, closeness centrality, betweenness centrality, and eigenvector centrality, with some of them considered below.

In degree centrality, the degree of a node is defined as the number of direct connections a node has with other nodes. The following SGL scenario, applied in all network nodes of the chosen type (let it be `A` in Fig. 7) in parallel, will result in node names accompanied by their degrees (number of nodes directly connected with them by type `a` links for this case).

```
output(hop(all_nodes(TYPE == A));
       append(count(hop(all_links(a))), NAME))
```

The result will be `2:A1, 2:A2, 5:A3, 2:A4, 3:A5`.

To name the node of type `A` having maximum degree, which the use of links type `a`, we may write

```
output_max(hop(all_nodes(TYPE == A));
           append(count(hop(all_links(a))), NAME))
```

We will obtain 5:A3.

But if to include the nodes of type A that are also connected to the nodes of other types (i.e. by links x (see Fig. 7))

```
   output_max(hop(all_nodes(TYPE == A));
              append(count(hop(all_links(any))), NAME),
```

we will have either 5:A3 or 5:A5.

For closeness centrality, distances to all other nodes from each node and their summary can be found by the following SGL scenario also naming the node having a minimum of such sums (i.e. being the most central).

```
   output_min(
     hop(all_nodes(TYPE == A)); IDENTITY = NAME;
     frontal(Far) = 0; nodal(Distance);
     stay(repeat(hop(hop(all_links(a)); Far += 1;
                 or(Distance == nil, Distance > Far);
                 Distance = Far));
     append(sum(hop(all_other_nodes(TYPE == A)); Distance),
NAME))
```

The result will be 5:A3, which happened to be the same as for the degree of centrality.

But if to consider all the links related to the nodes of type A, as in Fig. 7 (i.e. named a and x), after making the following change in the previous scenario: hop(all_links(a)) → hop(all_links(any)), we will receive 9:A5, whereas A3 will result with 10:A3.

We can similarly examine parameters of the networks of types B and C shown in Fig. 7. Other centrality measures may also be used for such networks as in Fig. 7, like betweenness centrality and eigenvector centrality, which are described in detail in [70].

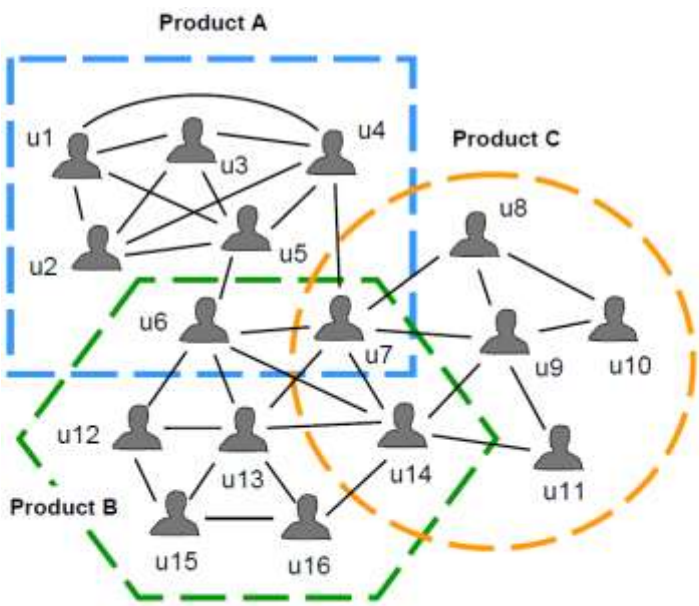


Figure 8 — Product assessment networks

5.2. Product assessment and delivery request

Some basic features of product assessment and request networks with sources [75–77] are reviewed in Section 2.2. The evaluation of product development systems by network analysis has become an increasingly crucial aspect of product design. Network algorithms are used for expressing product opinions and helping consumers evaluate and compare products and services. The product assessment models provide methods to evaluate product design and empower the development process.

In Fig. 8, we symbolically show the sets of interlinked users ui which are interested in particular products developed by the networks of types A, B, and C, as in Fig. 7, having different colors and shapes of their nodes (i.e. squares, hexagons, and circles). In

Fig. 8, these shapes are used as the borders of regions covering users having an interest in these particular products (the same users may fall under more than a single product and region influence). There may be different methods of discovering user communities most interested in a particular project, for example, based on how intensely they interlink and communicate with each other in relation to this product.

The strongest groupings of graph nodes are classically considered as cliques, which we will try to discover in relation to product `A`, analyzing the square blue region of Fig. 8 (its development network was investigated in the previous session). We are providing below a universal solution in SGL for finding customer cliques related to product `A` (i.e. maximum full sub-graphs in the customer interaction network), assuming their number of nodes exceeds some threshold to represent a realistic interest.

```
hop(all_nodes(customer, includes(INTEREST, A));
frontal(Clique) = NAME;
repeat(
  hop(links(all), nodes(customer, includes(INTEREST, A)));
  not_belong(NAME, Clique);
  yes(and_parallel(hop(links_any, nodes(Clique))));
  if(PREDECESSOR > NAME, append(Clique, NAME), blind));
count(Clique) >= 4; output(hop(Clique); append(NAME, DEMAND))
```

This scenario, starting at all nodes and following their links to other nodes in parallel, involves collecting node names in new individual hops that have links with all previously collected nodes, unless such nodes cannot be found. The finally collected set of node names in the frontal variable `Clique` is followed by a parallel hop to all clique nodes, issuing their names together with related product value demands, the latter picked up by special nodal variable `DEMAND` in each node. As the same cliques can be grown starting from all their nodes and evolved in any order by moving through other nodes, this duplicity is easily removed by allowing the clique nodes to proceed only in the reduced value of their names, which is unique (this can also be organized oppositely).

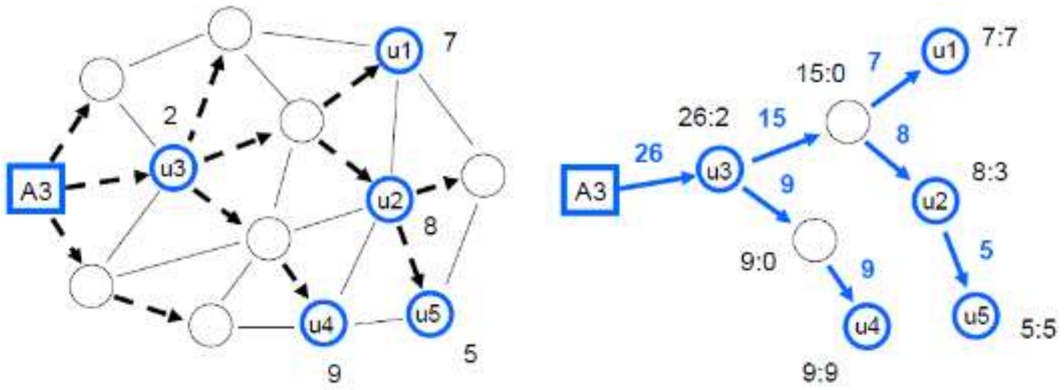
The reply for the obtained five-node clique in Fig. 8, related to product `A`, with supposedly discovered product demands, will be the following:

```
(u1:7, u2:8, u3:2, u4:9, u5:5)
```

5.3. Product delivery to chosen customers

Some basic features of product delivery networks, with sources [78–80] reviewed in Section 2.3, include the following. The distribution networks have to interconnect the consumption and production sides of the supply chain. The network consists of storage facilities, warehouses, and transportation systems that support the movement of goods until they reach the end consumer. The value delivery network emphasizes the importance of understanding and meeting customer needs by providing high-delivered value.

Let's imagine that we already have a distributed physical network (including road, air, and possibly other lines), using which we want to deliver a product from the production network, say, from node `A3` from Fig. 7, which showed the highest value by both degree and closeness centrality measures in Chapter 5.1 and Fig. 7, to some physically existing consumer nodes interested in this product. The latter may represent the chosen clique nodes `u1-u5` in the assessment network in Chapter 5.2 and Fig. 8, together with the discovered product `A` current volume demands. We may first find the shortest path tree of this network originating from node `A3` and leading to all other nodes (as in Fig. 9 *a*), and then leave only paths in it from `A3` to all `u1`-`u5`, altogether forming the best delivery infrastructure to particular users for the concrete product (as in Fig. 9 *b*, where some consumer nodes may happen to be on the shortest paths to other consumer nodes).



a *b*

Figure 9 — Forming delivery infrastructure for particular users

The nodes of this (Fig. 9 *b*) infrastructure are shown with two associated numerical values, with the second reflecting the value of the product they requested personally, and the first one – the amount of product needed to reach them, which represents the sum of their own need and the rest to be delivered to other nodes via them. The related delivery scenario may be as follows. It starts in node `A3` with the total product volume needed by all customers which is then gradually split and reduced during physically moving down through the delivery infrastructure to the defined users, ultimately leaving with the latter only the amount requested by them. For the physical product delivery process, a special nodal variable `Store` is used in each node, containing at `Start` (i.e. `A3`) the product total volume, and then reducing, if needed, in the following shortest path delivery nodes. At the end of distribution, `Store` will contain only the volume individually requested by each node.

```
   nodal(Dist, Up, Up2, Fin = (u1:7, u2:8, u3:2, u4:9, u5:5));
   frontal(Far, Demand, Pack); nodal(Start = A3, Full, Store);
   hop(Start);
   sequence(
    repeat(hop_links(all); Far += LENGTH;
           or(Dist == nil, Dist > Far); Dist = Far; Up = BACK),
     (wait(split(Fin); Demand = VAL[2]; hop(VAL[1]); Full = De-
mand);
      repeat(Up2 = Up; hop(Up); Full += Demand; Demand = Full)),
     (Store = assemble(product, Full);
      repeat(hop_links(all); Up2 == BACK; Demand = Full;
hop(BACK);
            Pack = withdraw(Store, Demand);
            move(BACK); Store = Pack))
```

5.4. Summary of the combined networking solutions

In the previous subsections, we showed separate but logically interconnected solutions for solving rather complex integral problems of the network-based creation of products, their assessment by customers, and then the physical delivery of the chosen products to the most interested customers. This combined multi-network heterogeneous process, with the same nodes belonging to very different networks, may be exhibited as the united one, as symbolically shown in Fig. 10. We can easily integrate all these and much more complex internetworking representations and solutions in SGL into the global production-assessment-distribution social infrastructure. In this infrastructure, the transference of parameters between heterogeneous networks (shown by dotted arrows in Fig. 10) can be done naturally and automatically within the social global integrity, awareness, and consciousness process, as discussed in [60, 65, 67–69].

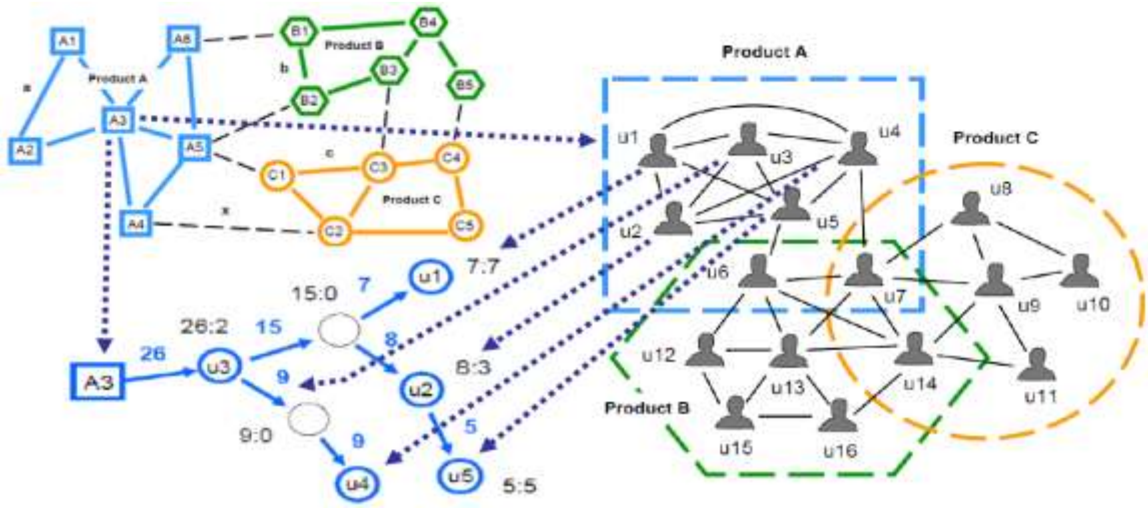


Figure 10 — Summary of combined multi-networking solution

In the above examples, we showed possible practical solutions related to product A and its production network, as shown in Fig. 10. But we can similarly organize these for other product types B and C, their networks, and communities of customers interested in them, as well as for much more complex united products with their collective development by different types of production networks.

5.5. Integral heterogeneous multi-networking world under SGT

We have analyzed and reviewed different types and areas of networking, including transport, communication, social sphere, battle, military, economic, distribution, virtual, neural, psychological, criminal, production, evaluation, and distribution [1–55, 72–80]; algorithms and operations on graph networks [81–93]; numerous graph and networking solutions and applications investigated and implemented under SGT [56–71]. After the detailed analysis, we can offer the developed Spatial Grasp Technology and its basic Spatial Grasp Language as a possible universal theoretical and practical concept and tool for working with any type of network, both physical and virtual, actually representing altogether the world of any terrestrial or celestial nature. This world can be effectively created, integrated, coordinated, and managed as a whole, as symbolically

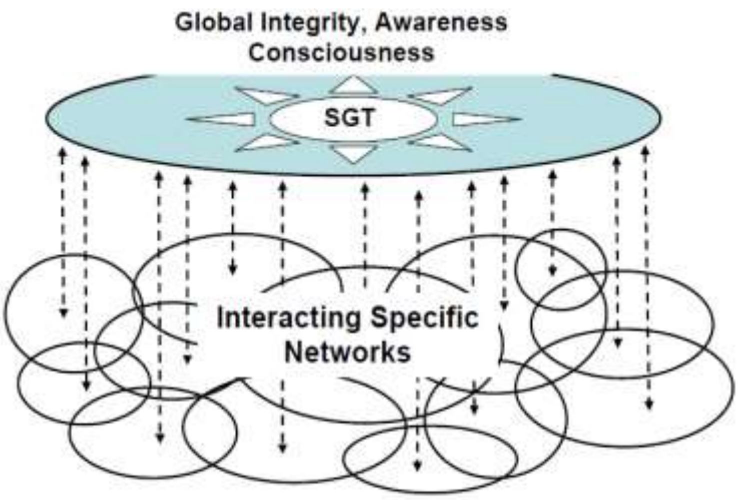


Figure 11 — Multi-networked world under SGT

shown in Fig. 11, using a very simple but powerful recursive language formula, as discussed in Section 3.

6. Conclusions

The results of this work confirm the availability and efficiency of using SGT and SGL for investigating, expressing, and implementing the basic network and graph creation and management issues. SGL allows us to provide detailed, very clear, and compact solutions for network problems that can operate in arbitrarily large and complex networks and in a highly parallel and fully distributed mode. Practical cases were investigated on the integration of different types of networks within holistic global production-assessment-distribution of social infrastructure, providing solutions potentially unachievable by separate networks or their mere collections. Deep integration of heterogeneous distributed systems can be organized naturally and automatically within the global integrity, awareness, and consciousness processes under Spatial Grasp paradigm, as already shown and discussed in previous publications. The current and many previous works on this paradigm confirm the effectiveness of SGT and SGL for various network operations, including higher-level ones integrating different types of networks within advanced social infrastructures, up to generally considering it as the universal networking concept.

The latest version of SGL can be quickly implemented even in traditional university environments, similarly to the previous version called WAVE, which was used in different countries (including former Czechoslovakia, Germany, the UK, Canada, and the US). It was practically used in intelligent network management and for solving network security problems, being financially supported by Siemens, Ericsson, UK Defense Research Agency, Alexander von Humboldt Foundation in Germany (twice), and the Japan Society for the Promotion of Science. Forthcoming plans of this work include the preparation of the new book «Spatial Networking in the United Physical, Virtual, and Mental Worlds» as a sequel to the just published Taylor and Francis one called «Providing Integrity, Awareness, and Consciousness in Distributed Dynamic Systems».

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