PSYOPS and CIMIC operations: From concepts to G-DEVS models

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Abstract

In the context of the stabilization phase of modern conflicts, Civil-Military Cooperation actions (CIMIC) and Psychological actions (PSYOPS), which are actions of influence, are essential and take precedence over combat actions. Both types of actions have effects on info-targets and aim at influencing them by generating in them feelings and behaviors. CIMIC projects through CIMIC advertising and PSYOPS through messages diffusion both conducted by Allied forces. In both cases, the effects are propagated from the direct info-targets to the people they are connected to, directly or indirectly, through the social networks they belong to. In this article, we describe CIMIC and PSYOPS actions, we then present the different types of social networks concerned and explain the mechanism that underlies the propagation of effects from people to people in these social networks. Finally, we present the G-DEVS simulation models for the people to people direct propagation of both types of actions. This study is carried out in the context of the CAPRICORN system, whose goal is to assess psychological effects of combat actions, CIMIC actions and psychological actions.

1. INTRODUCTION

Nowadays modern conflict management is divided into three phases, the intervention, the stabilization and the normalization phases, [Faucher 2011], each of them being characterized by a main action (coercion for the intervention phase, security maintaining for the stabilization phase and aid for the normalization phase).

During the stabilization phase, combat actions are relatively limited compared to actions of influence, e.g. actions of communication, [Operational Communication], [N°297/DEF/CICDE 2007], psychological actions (PSYOPS), [N°069/DEF/CICDE 2008], and civil-military actions (CIMIC), [N°262/DEF/EMP.1 2005].

The paper presents a simulation system that is used in the stabilization phase of conflicts. It takes as inputs different types of force actions: PSYOPS actions, CIMIC actions and combat actions, and it aims at assessing the psychological effects of those actions on the friendly forces, the actors of the threat and the population.

In this article, we will first define what the PSYOPS and CIMIC actions and will explain how the effects of these actions are propagated through social networks. Finally, we will present the G-DEVS models used to formalize and simulate the propagation of the effects of both types of actions.

2. PSYOPS ACTIONS

Psychological actions aim at elaborating and spreading out a message that must be read, listened to and understood by the *info-targets* in order to get the desired effect, that is, influencing the info-targets to get from them the desired behavior by the modification of their attitudes, by acting on their perceptions, [N°069/DEF/CICDE 2008].

The info-targets are the people to whom psychological messages are intended. They are divided into *intentional* info-targets, that is the info-targets towards whom the messages are directed and *non-intentional* info-targets who will receive the message, but whom the analysts had not thought of, when designing the message. The intentional info-targets can be *direct* (they receive the message directly from the means of conveyance) or *indirect* (the message is propagated to them through social networks).

A message can generate in the info-targets, reasoned *thoughts*, spontaneous *feelings* and *emotions* and/or reflex *behaviors*, depending on the means used to spread the messages and the content of the message. The message can convey either *propaganda* or a *rumor,* [Defencejournal 2000].

Different *means of conveyance* can be used for spreading out messages:

- Audio, visual or audiovisual means: printed medias (leaflets, posters, magazines, newspaper ads), radio programs, TV programs, local telecommunication networks (messages are spread via texts or mobile phone calls), loudspeakers, internet, goodies and face-to-face verbal communication.
- «Means of opportunity»: non-verbal communication (appearance, behavior), [non-verbal communication 2011],

parades (shows of power from the allied forces). Those means function through the satisfaction of a need or the loss of satisfaction of this need by the info-target. It is referred to the needs expressed in the Maslow pyramid (physiological needs, need of safety, need of belonging, need of self-esteem, need of actualization), [Maslow 2011].

While the first type of means of conveyance allow to generate thoughts, feelings and behaviors in the info-targets, means of opportunity convey more instinctive, less intellectualized messages that are rather dependent of the info-targets' local custom. When a message is spread out, it's important to be able to measure its impact on the info-targets by using *efficiency criteria*:

- The *impact of the message* on the info-targets, that is, whether the message has effectively reached them or not,
- The *effect(s) of the message*. Has the message generated the desired effects, behaviors, feelings and so on? (More details are given in [Faucher 2011]).

To summarize, when a user sets a psychological operation as an input for the system, he must specify the following parameters (some of the parameters are optional):

- The name of the operation.
- The means of conveyance used.
- The scenario: for complex behaviors including several sub-behaviors that are related to customs to be respected, the analyst has to fill up a form where he will indicate for each sub-behavior if it conforms the customs or not.
- The content of the message.
- The type of the message content (propaganda or rumor).
- The info-targets and their respective message receptivity.
- The importance of the message for each info-targets group.
- The expected effects (feelings, behaviors, needs).
- The efficiency criteria.
- The date of the operation.
- The scope of the message, e.g. the geographical area where it can reach the direct info-targets.

3. CIMIC ACTIONS

A Civil-Military Cooperation project is a project advocated to enhance the daily life of the local population in the context of post-conflict country reconstruction. These projects are identified by the task force which is based in the concerned territory after recessing the population needs. This study is conducted by the CIMIC team affiliated with the task force. Its main missions are:

- To satisfy population's safety, economic, social and cultural needs.
- To restore peace and appease anti-force feelings like: aggressiveness, hatred.
- To help restoring the state instances and the development of the country in economics, legacy, etc.
- To promote national interests.
- CIMIC projects are often delegated to Non-Government Organizations (NGO) and local companies that have a good knowledge of the terrain. The CIMIC team is led to provide human and material resources from the task force to guaranty the good progress and the success of the project.

Regarding generic context, some criteria, listed below, should be taken into account before a CIMIC project:

- The duration of the project. CIMIC projects have a short duration in order to have a quickly operational installation that leads to a quickly impact on the population.
- The population's adherence to the project is an important indicator. In fact the population subscribes naturally to the CIMIC project which is implied as workforce, administrator, etc. This fact leads the population to play a protective role on the CIMIC projects and installations against sabotage actions, to secure the CIMIC projects.
- The financing of the project. The CIMIC team can turn to funds and donations of the governmental and non-governmental organizations to finance the project. Possibly the CIMIC team can rely on the average human beings and the materials of the task force to insure the project success.
- The part of the population that the CIMIC project aims. In fact, the CIMIC project will serve a sub-population.
- In order to have the project succeed, the CIMIC team should identify a person or a group of persons that will carry the project and play the role of interlocutor(s) between the population and the task force. In fact, the quality of the interlocutor and his popularity are essential for the adherence of the population to the project.

On the basis of these definitions and criteria, a CIMIC project is defined as follows (Some parameters are to be instantiated for a CIMIC project):

- The name of the project: it should be readable and understandable to assimilate easily its objectives.
- The initiator: it is often the task force that initiates CIMIC projects. Other initiators like NGOs, local responsible can consult the task force about CIMIC first needs projects.
- The action agent: this entity (e.g. NGO, local company) is responsible for realizing and supervising a CIMIC project.
- The cost: the necessary budget to accomplish the project.
- The source of financing: it may be the local authority, NGO, Foreign government, etc.
- The agent to serve: it specifies the population or sub-population that will use the provided installations.
- The agent to value: this interlocutor is the carrier of the project for the local population: notable, responsible, etc. In fact, the message of the task force is to get on with the population by means of popular actors.
- The effects (feelings and behaviors): generated by the CIMIC project in the info-targets (intentional and non-intentional, direct and indirect).
- The receptivity of the direct info-targets (the agent to serve), as well as the receptivity of other groups of info-targets that may be reached when the direct info-targets propagate the effects that the CIMIC action has generated.
- The importance of the CIMIC action for the info-targets.

CIMIC projects have a common sub-scenario that consists in preparing the local population to accept the project via information dissemination in influence networks. Open meetings are organized where the CIMIC team and/or local leaders explain the benefits of the future project, listen to the population's first needs, etc. At the end of the projects, ceremonies are organized by the task

force with the participation of the local population to inaugurate the provided installations. Such actions are very important because they bring together the local population and the task force.

Actually, a CIMIC project can be regarded as conveying a message through a concrete action. A common scheme that illustrates the dissemination of a message can be defined and modeled, the term message being generic and covering both PSYOPS and CIMIC.

4. TYPES OF SOCIAL NETWORKS

Two types of social networks are considered.

4.1. Stable networks

The citizens naturally identify with those who speak their language and share their culture. Their loyalty is first to their national leaders, and local representative. Actually, age, family or even religion and ethnicity can also play one part in understanding countries and its people. The country networks are differently organized also according to many other factors.

4.2. Temporary networks

Apart from constituted networks the boundaries of which can be unstable, but the content homogeneous according to certain criteria, there are networks that we call *temporary networks*, in the sense that they gather together people with no obvious common characteristics, but who are connected to each other because of their common attendance to an event. We are alluding to events like markets, for example. Those networks of connected people during an event must not be neglected in the study of the dissemination of messages, because they do communicate during events and their role is important, because they actually allow information to be spread between constituted groups (stable or unstable), otherwise information would «stay» within the types of constituted networks we just listed.

These networks are not permanent. They vary according to the moments. The links they rely on are not systematically activated.

Such networks can be activated: *permanently during a determined period of time* (for example, a network representing a CIMIC project) or *periodically* (for instance, a weekly market).

5. DYNAMICS OF EFFECT PROPAGATION

Both PSYOPS actions and CIMIC actions generate direct and indirect effects to the info-targets. These effects are generated during two phases:

- The effects are first generated to direct info-targets, who receive the psychological message in the case of a PSYOPS action or who are the agent to serve of a CIMIC project.
- During the second phase, these info-targets will propagate the effect(s) produced on them to the people who are part of the same networks.

We must notice that when it comes to studying the propagation of psychological messages, it is necessary to distinguish between messages conveying *propaganda* and messages conveying *rumors*.

Messages conveying propaganda mostly have an effect on direct info-targets. The messages delivered to them are not propagated to other people, so the dynamics of the effect propagation is limited to the first phase. At the opposite, messages conveying rumors are largely propagated through word of mouth and the high-tech equivalents of word of mouth: phone calls, texts and the internet, so the dynamics covers the two phases defined in in detail in the next section.

5.1. First phase of the dissemination process

5.1.1. In the framework of PSYOPS actions

At this step, different means of conveyance e.g. mentioned in §2. Actually forces can use printed supports, radio programs, loudspeakers, goodies, mobile communication, face-to-face verbal communication, non-verbal communication and parades.

It's important to notice that certain means of conveyance require specific conditions for reaching info-targets with a message: e.g. for a printed message, the info-targets must be able to read the language of the message, for broadcasting audio programs, info-target must dispose of a radio. We designate the potential info-targets by the expression "practically receptive info-targets". The adverb "practically" is used because the type of receptivity relies on logistic constraints. The receptivity of an info-target can be understood otherwise, if we consider the way a message affects an info-target depending on their sensitivity (age, location, religious, ethnic, etc.) or their political opinion, family status, etc.

Intentional info-targets are defined by the analysts. However, the means used for spreading messages define the physical scope of the message, that is, if a message is disseminated by means of the radio, for instance, the message will reach people of a determined area. Within the area where the message is reachable, it can indeed reach other people than the direct and intentional info-targets. Those people are the non-intentional info-targets. In figure 1, the means of conveyance in white are those that are not used in the system in this phase.

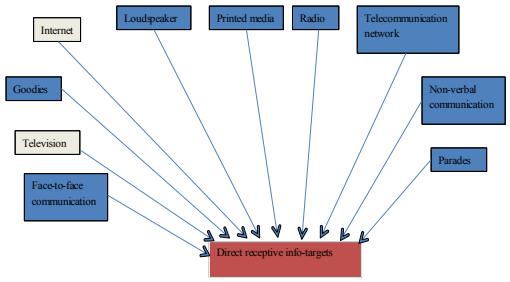

Figure 1: PSYOPS First Dissemination Phase Process

5.1.2. In the framework of a CIMIC action

As discussed previously, the actor serves a project towards the effects generated first; it can be regarded as the direct info-targets in the context of a CIMIC project.

5.2. Second phase of dissemination: the propagation

A direct or an indirect info-target propagates, in its turn, a message to an indirect info-target. It is in the form of a message in the case of a PSYOPS action, or an effect on the feeling about a CIMIC action, it is propagated by word of mouth, mobile phone, (if technology is available for both the sender and the receiver) an e-mail, if both have an internet access.

The sender of a message or the emitter of an effect propagates it to people belonging to one or several networks he is also part of as illustrated by figure 2.

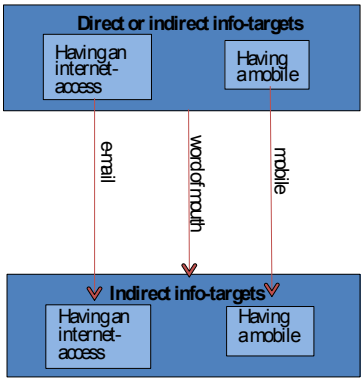

Figure 2: Second dissemination phase: the propagation

At this step, the ways an effect is propagated through the different types of networks need to be differentiated.

5.3. The different ways of propagating an effect within the different types of networks

Within a constituted group (network), certain people, the *opinion leaders*, have a central position and the dissemination of information within the group largely relies on them, [Lazersfeld 1948], [Weimann 1982].

If the message reaches the leader, the latter propagates the information to all the members of his network.

If the message reaches a member of the group, he communicates the information to the leader, who propagates it to all the members of his group.

Within a local network, if the message reaches a member of the network; in turn, this member propagates the information to all the people connected to him via a connection link modeling for instance a neo-patrimonial behavior or a link representing the resources sharing.

Within a temporary network, when a member receives a piece of information, the event node to which this member is connected is accessed and the information is propagated in a radial way to the other members of the network.

We must now specify how the effect propagation process is controlled through the different networks.

5.4. Control of the message/effect dissemination process

Differing from most social networks systems that use models of message/effect dissemination that are inspired from the epidemiological model of propagation, [Keeling & Rohani 2009], [Salter 2011], we have defined in our system an original model (Figure 3) taking into account the dynamic (so more adapted to simulation). The effect/message propagation scheme will be explained progressively.

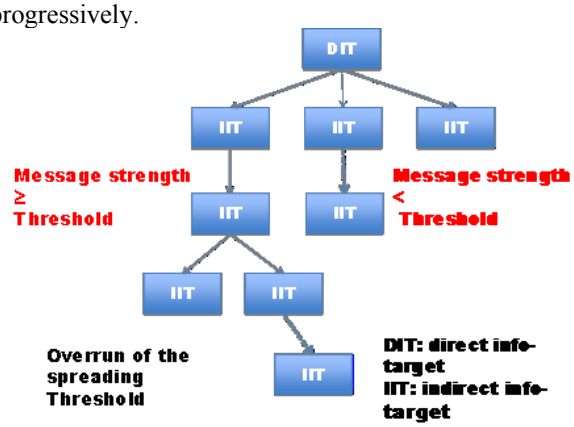

Figure 3: Message propagation model

5.4.1. Strength of a received message

The strength of a message received by direct info-targets is defined by analyst (usually army) as the *importance of the message* for each group which the info-targets can belong to (discretely evaluated from 1 and 3).

Initially, the strength of a message is equal to its importance/3 (the value is normalized between 0 and 1).

For indirect info-targets, the strength of the received message is calculated functions of:

The *strength of the message before the transmission* is the strength of the message as received by the present sender. The info-target's *receptivity* is defined by social, geographical and techno parameters. The sender's *credibility* completes the previous parameters to compute the *strength of the transmission*.

The info-target's receptivity is defined by an analyst depending on the local context. An info-target's receptivity expresses the interest of the receiver concerning the content of the message. The sender's credibility depends on the concerned info-target. For instance, if the sender is a leader the receiver is part of, his credibility will be high to the eyes of the receiver. In the system, the possible values of the receptivity and credibility factors are low, medium and high (quantified 1, 2, 3). The strength of the transmission depends, among others, on the connections strength between the sender

and the receiver (if they are linked via several networks, the strongest link is chosen).
The strength of a message can be computed as follows, using the abbreviations:

SMBT: strength of the message before transmission
RR: receiver's receptivity
SC: sender's credibility
SMT: strength of the message transmission
SM: strength of the message when the receiver gets it.

$$SM = SMBT * RR/3 * SC/3 * SMTS$$

This value is defined between 0 and 1.

5.4.2. Message Transmission Strength (SMT)

- If Sender and Receiver belong to same group

The strength of a message transmission depends on the Intra-Culture Factor (ICF) of the ethnic group, the Link Strength (LS) connecting the sender and the receiver, the product of the stability factors of, respectively, the sender's and the receiver's zone and the easiness of communication between those zones.

- If the means of conveyance is word of mouth:

SMT = ICF * LS/4 * product of the stability factors of the zones/9 * easiness of communication/3

- If the means of conveyance is telephone or e-mail:

SMT = ICF * LS/4 * product of the stability factors of the zones/9

- If Sender and Receiver belong to different groups

The strength of a message transmission depends on the Between Culture Factor (BCF) of the groups, the strength of the link (LS) connecting the sender and the receiver, the product of the stability factors of, respectively, the sender's and the receiver's zone and the easiness of communication between those zones.
The means of conveyance is mainly word of mouth; as only two very closed people (belonging to the same group) communicate via telephone or e-mail.

SMT=BCF * LS/4 * product of the stability factors of the zones/9 * easiness of communication/3

5.4.3. Computation of the moment M a message is received

- If Sender and Receiver belong to same group

- If the means of conveyance is word of mouth:

M = T + average number of days required for a person to reach another by usual means of transportation

- If the means of conveyance is mobile phone or e-mail:

M = T + 1

- If Sender and Receiver belong to different groups

The means of conveyance is word of mouth.

- If the sender and the receiver do not belong to a common temporary network:

M = T + average number of days for a person to join the other by usual means of transportation

- If the sender and the receiver belong to a common temporary network:

M = T + the number of days between the diffusion of the message and the next opportunity of a new meeting gathering

5.4.4. Propensity to diffuse a message within an ethnic group: Intra-Culture Factor (ICF)

It depends on the value of the following characteristics in the ethnic group's culture, [Hofstede 2001]: Collectivism, Power Distance, Femininity, Uncertainty Avoidance, Long Term Orientation. Its value is defined between 0 and 1.

A characteristic reinforces the value of the ICF, if its value goes along with a more important dissemination of the information.

Each contribution is weighted according to the importance of the associated characteristics. Let a, b, c, d, e, be the respective weights associated to the different characteristics. According to Hofstede's findings, [Hofstede 2001], it is possible to define:

Collectivism (C): Given the ambiguity of the collectivism factor, its contribution is always evaluated 0.5.
Power distance (PD): If it's low, its contribution is 1, 0 otherwise.
Femininity (F): If it's high, its contribution is 1, 0 otherwise.
Uncertainty avoidance (UA)**:** If it's high, its contribution is evaluated 1, 0 otherwise.
Long term orientation (LTO)**:** If it's high, its contribution is evaluated 1, 0 otherwise.

$$ICF = aC + bPD + cF + dUA + \frac{eLTO}{a+b+c+d+e}$$

5.4.5. Propensity to disseminate a message between ethnic groups: Between-Culture Factor (BCF)

It is defined between 0 and 1. It depends on:

- the existence of previous conflicts in the history of the ethnic groups,
- the similarity of the values of the following characteristics in the respective cultures of the ethnic groups: Habits, Appearance, Language, Economic and Social Status, Family Size, Political Participation, Collectivism.

Two values are possible for evaluating the existence of previous conflicts (PC) (0, if no conflicts, 1 otherwise). For the other characteristics, we evaluate the contribution (respectively H, A, L, ESS, FS, PP, Col) to 1, if they have identical values in both ethnic groups and 0, otherwise.

$$BCF = a(1-PC) + bH + cA + dL + eESS + fFS + gPP + \frac{hCol}{a+b+c+d+e+f+g+h}$$

5.4.6. Value of the link strength between two people of a network (LS)

This value depends on the semantics of the link connecting the two people.

- If the network is family or ethnic group: **LS = 4.**
- If the network is a religious network: **LS = 3.**
- If the network is of another type: **LS = 2.**
- If the network is a temporary network: **LS = 1.**

5.4.7. Value of the stability factor related to a person of a network (SF)

That is the measure of the stability factor of the zone where the group the person belongs to is located. Its values are defined according to the classification found in [Driedzic 2008]:

- **SF = 3**, if the zone is in the stability state 2 ("Self-sustaining peace").
- **SF = 2**, if the zone is in the stability state 1 ("Assisted stability").
- **SF = 1**, if the zone is in the stability state 0 ("Imposed stability").

5.4.8. Value of the factor «easiness of communication» between two people (EC)

This factor evaluates the easiness to communicate between two places (for instance, no mountains between the two places) where the people who communicate are located. The easiness of communication between regions depends on geographical factors, as well as political and economic factors.

- **EC = 3**, if the regions can easily communicate.
- **EC = 2**, if the regions can fairly communicate.
- **EC = 1**, if the communication is difficult.

The area covered by our system is divided into regions. The matrix of «easiness of communication» is calculated between the regions taken two by two. The latter must be updated regularly.

5.4.9. Stopping of a message propagation: dissemination threshold

The message is no longer propagated to a potential receiver when the dissemination threshold is reached, that is, either:

- the strength of the message for this potential receiver becomes lower than a certain threshold to be determined or,
- the time passed since the diffusion of the initial message (to the direct info-targets) exceeds a certain threshold or,
- the total number of informed people exceeds a certain threshold (the information has lost its value of «news»).

6. GDEVS MODELS EQUIVALENT STRUCTURE

In the following, we present the G-DEVS models that were developed according to the conceptual and mathematical descriptions of PSYOPS behavior given previously. The formalism elected, G-DEVS, is particularly adapted for formal modeling and simulation; it is recalled in the following point. The authors defined 3 classes of models to be instantiated. The first model is the PSYOPS/CIMIC construction and generator model. The second is individual sender/receiver. The last is the connection strength computing model.

6.1. G-DEVS recalls

N. Giambiasi proposed in early 90's the G-DEVS (Generalized DEVS) formalism. It emerged on the drawback that most classical discrete event models face (e.g. DEVS): they approximate observed input–output signals as piecewise constant trajectories. G-DEVS defines abstractions of information with piecewise polynomial trajectories [Giambiasi et al., 2000]. Thus, G-DEVS defines the coefficient-event as a list of values representing more accurately an input–output trajectory. G-DEVS keeps the concept of the coupled model introduced in DEVS [Zeigler et al., 2000]. Each basic model of a coupled model interacts with the others to produce a global behavior. On the simulation side, G-DEVS models employ DEVS abstract simulator.

G-DEVS model simulation defines an event as a list of coefficient values that differs to a unique value in DEVS. The multiple values of G-DEVS event are particularly adapted to transmit the complex information that is relayed between the PSYOPS components. For example, a message event is described by several information it includes the Emitter, Nature, Strength, Content, etc. This information is coded into a G-DEVS multi value event mixing numerical and symbolic values.

6.2. PSYOPS Engine Model

The PSYOPS model is building the PSYOPS message and initializes the spreading parameters. This G-DEVS model is described in figure 4.

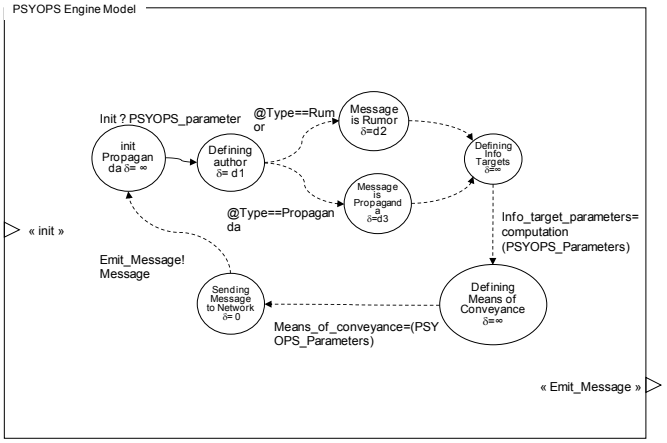

Figure 4 G-DEVS PSYOPS Model

First it initializes the message category. Then it takes into account the profile of the author for computing reliability. Then, depending on the message is qualified as a rumor or propaganda it customizes the message attributes. Then, the direct info targets are computed based on the author profile and the message contents. The last step is defining the means of conveyance of the message; it is based on the geographical area, available techno for authors and info targets to be reached. By reaching the "sending message" state, this model is generating a message with the structure: Message [Emitter, nature (rumor, propaganda), Type (PSYOPS, CIMIC), Media Employed, Strength, Content, Message Final Target, time since release]. The state life times are stochastically set.

6.3. Connection Strength Model

The PSYOPS connection strength model, not detailed in the paper, is taking into account the PSYOPS message, the sender and receiver profile to compute if the link between two individuals is strong enough to vehicle a message. The way the message is perceived is crucial. The strength of the connection is based on the social network the emitter and the receiver belong to. The strongest links has been given to family and religion. The model also takes into account the working group and ad-hoc network such as being present in a public place for the local market. At the end by combining the values computed for each network the link strength is transmitted to the receiver to influence its message perception.

6.4. Individual Model

This model (Figure 4) is describing the way an individual perceives a received message. The receiver is waiting for incoming message. The first state consists in being in contact with an emitter. At contact of a receiver with an emitter, the two agents will start by exchanging their profile to compute the connection strength between them (as described previously) within the "Transmission Strength" event structure [Emitter location, Media Employed, message nature (rumor, propaganda), Emitter Maslow, Social network belonging]. The computation of its new Maslow attributes takes also into account its actual Attitude (hostile, peaceful, friendly or neutral) and its actual location for its reachability level. Then the message is received. The message causes an impact on the Maslow parameters of the agent (Psychology, Security, Esteem, and Accomplishment). Then, if the message strength is still strong enough the receiver is preparing on its turn to disseminate the message to its network neighbors considered as target info. The attitude of the agent is taken into account in the output message "Emit_Message" [Emitter, nature (rumor, propaganda), Type (PSYOPS, CIMIC), Media Employed, Strength, Content, Message Final Target, time since release]. Also the position of the agent will be part of the condition to generate the message. The social network itself is not tackled in the paper; only the direct transmission of the message is described.

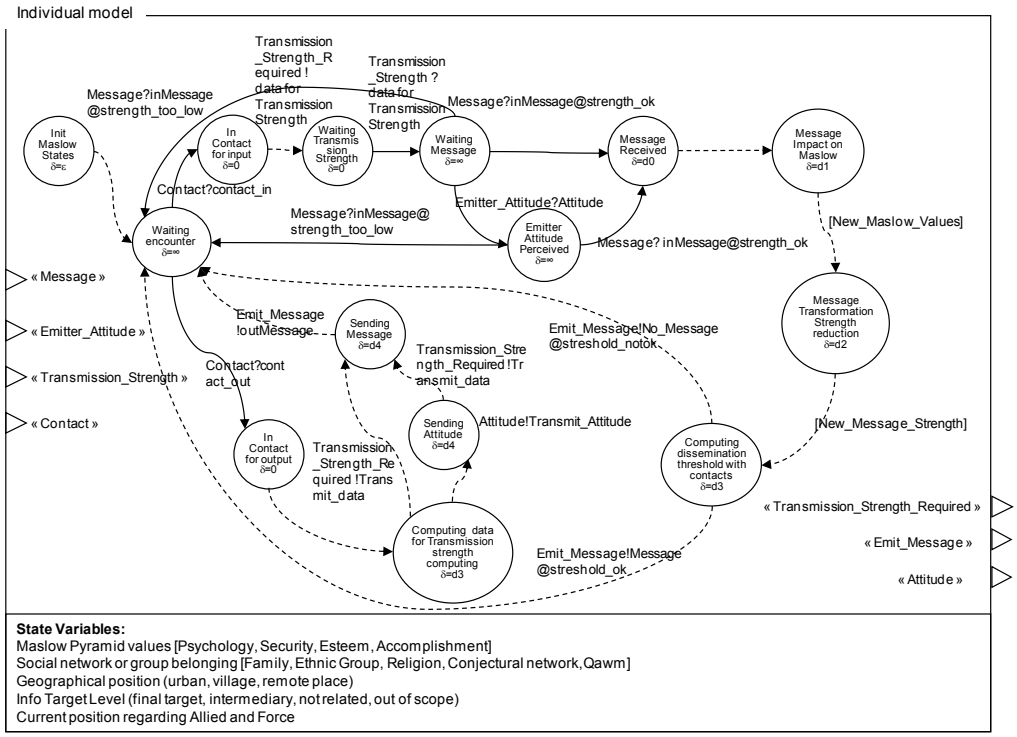

Figure 5 G-DEVS Individual model

7. SIMULATION RESULTS

Those models were simulated using LSIS_DME software. Some concrete CIMIC scenarios were conducted to test the effect on the behavior population. The models are still qualitative and stereotyped behavioral models but they can show some limits of a message spreading over a population. The simulation needs to be connected to the social network graph to compute the proximity of the agents in order to disseminate the messages.

8. CONCLUSION

This paper proposed a first approach for PSYOPS and CIMC M&S using the G-DEVS formalism. It shows that experimentations formulas based on stereotyped behavior can extracted from psychological reports and literature. Then this behavior can be fitted correctly into discrete event description to integrate in particular the temporal dimension.

This is still an ongoing work that basically shows the people to people PSYOPS or CIMIC message passing with its degradation and possible changes. For instance the social network itself is not already fully described by G-DEVS models. A simple matrix code is used. The authors believe that the approach can be improved by using matrix automata to represent the networks and the geography. For i.e. Cell-DEVS that have proven their efficiency in describing a geographical area or network can be the next step to describe the networks graphs.

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