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Intuitionistic fuzzy estimations of establishing connections with File Transfer Protocol for virtual hosts

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Abstract: The article provides an overview of the process for establishment of links via FTP virtual hosts. The represented model of the considered process is based on definition of generalized nets.
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1 Introduction

In this article is presented a mechanism for FTP clients to identify individual virtual hosts on an FTP server. Virtual hosting is a method for hosting multiple DNS (domain names system) on one or more servers. For example, a server shares its resources, such as processor and memory cycles, without requiring all services provided to use the same host name. The term 'virtual hosting' is usually used in reference to web servers but the principles carry to other internet services like FTP [5].

The concept of generalized nets is an extension of the concept of Petri Nets, and the rest of the modifications and extensions. Generalized nets [1, 2, 4] costitute one of the well-organized alternatives of a methodology of describing processes and algorithms in formal and abstract way. In this article is proposed criteria for evaluating and comparing the messages sent by the FTP server or virtual clients for this purpose we using the apparatus of IFS (intuitionistic fuzzy sets) offered by K. Atanasov [3].

2 Establishing connections with File Transfer Protocol for virtual hosts as an object modelling

With the increased use of virtualization technologies, there may be several possible definitions for the term ‘virtual host’. In this case, the server would use the contents of the request's Host header field to select the correct virtual host.

The state diagram shows a typical sequence of flow of control when HOST is used with USER and PASS to log in to a particular FTP virtual host in Fig. 1. For each command, there are three possible outcomes: success (S), failure (F), or error (E). In the state diagrams is used the symbol "B" for "begin" and the "W" for "wait for reply" [5].

According to [7] code of:

- 100 series include the requested action is being initiated, expect another reply before proceeding with a new command.
- 200 series include the requested action has been successfully completed.
- 300 series include the command has been accepted, but the requested action is on hold, pending receipt of further information.
- 400 series include the command was not accepted and the requested action did not take place, but the error condition is temporary and the action may be requested.
- 500 series include syntax error, command unrecognized and the requested action did not take place.

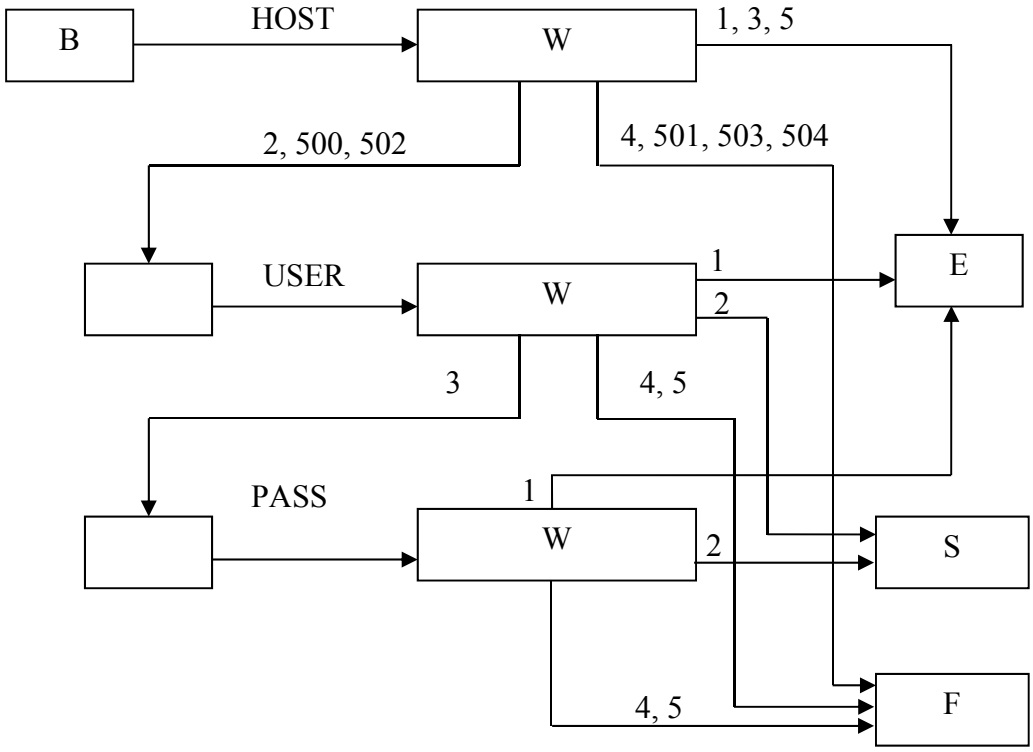

Figure 1. Login Sequence with HOST Command

According to [6], Cyclic Redundancy Check (CRC) codes are shortened cyclic codes used for error detection. In this technique, a bit string called 'generator polynomial' is determined on first place; it is used to generate checksums, which are appended at the end of frames. The receiver checks the input by using the same generator to detect transmission errors. There are two conditions for the selection of generator polynomials:

- They must be shorter than the frame length;
- They must start and end with 1.

If the text is attacked on its way to the receiver and some bits are changed, the corresponding bits in the decrypted plain text will change. Also, if an attacker can capture two cipher texts encrypted using the same key stream and applies XOR to these two cipher texts, then this result is also the XOR of the two appropriate plain texts. Having gained and collected this information, the attacker can use statistical attacks to recover the plain texts.

The more frequently a key stream is used for encryption and is captured by an attacker, the more easily statistical attacks can be performed. When the attacker recovers one of the plain texts, he can also recover the others.

The integrity check field referred to above is a checksum with 32-bit CRC and is also encrypted.

Each packet has CRC through which we excerpt information if it is whole or there it has some losses on it. Transmission over TCP gives reliable delivery. Sequence numbers are used to coordinate which data has been transmitted and received. TCP will arrange for retransmission if it determines that data has been lost. On the basis of this information we make the estimations μ and ν of the success of establishing FTP connections for virtual hosts.

3 Intuitionistic fuzzy estimations of establishing connections with File Transfer Protocol for virtual hosts

Establishing connection with File Transfer Protocol for virtual hosts is a process which depends on a variety of factors, and not always finishes successful. Among the relevant factors are the stability of the connection, the size and number of sent messages, any syntax errors, denied requests for policy reasons, closed connections by the client, etc. For this reason, in the current time moment it is worth making certain estimations of past connection rates.

In the present research, we propose estimations of establishing File Transfer Protocol for virtual hosts; in each session these estimations take the form of ordered pairs $\langle \mu, \nu \rangle$ of numbers belonging to the [0; 1] interval, where [4]:

- μ is the ratio of the number of sent and confirmed messages to the total number of sent messages. The value of μ is calculated as $\mu = \frac{C}{M}$, where
    - M is number of all sent messages in the current session;
    - C is number messages, which in the current session have been sent and confirmed by the FTP server.

- v is the ratio of the number of sent and unconfirmed messages to the total number of sent messages. The value of v is calculated as $\nu = \frac{U}{M}$, where
    - U is number messages, which in the current session have been sent but unconfirmed by the FTP server.

The degree of uncertainty $\pi = 1 - (\mu + v)$ stays for the number of sent and received messages, which have not been yet confirmed by recipient, divided by the total number of sent messages.

4 Generalized net model

Initially the following tokens enter the generalized net with the respective information characteristics:

- In place l_{11}, token enter with a characteristic "*user, pass, rules*";
- In place L_{2A} a token enter with a characteristic "*list with FTP users an passes, rules*";
- In places l_{13}, l_{14}, l_{21}, l_{22}, l_{23}, l_{31} tokens have more than one characteristic.

It is developed a generalized net model with an introduced set of transitions A:

$$A = \{Z_1, Z_2, Z_3, Z_4\},$$

where the transitions describe the following processes, respectively: Tasks performed by FTP client – transition Z_1; Tasks performed by FTP server – transition Z_2; Services performed by FTP server – transition Z_3; Calculating of intuitionistic fuzzy estimations – transition Z_4.

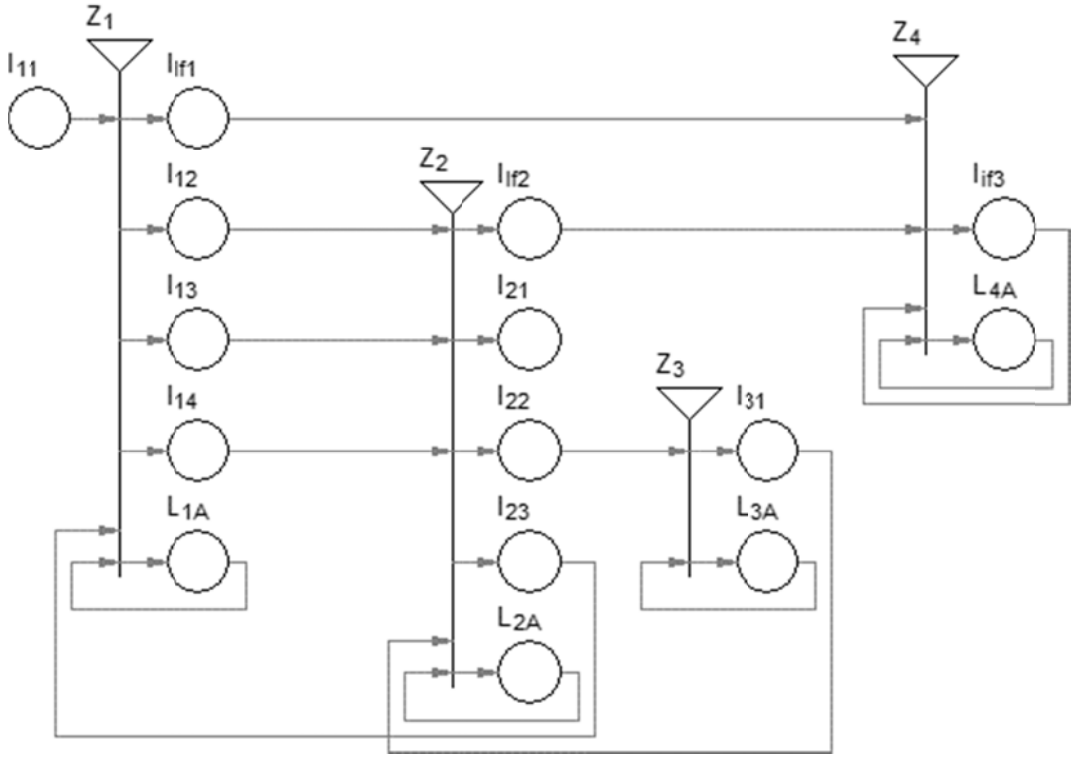

Figure 2. GN-Model of establishing connections with File Transfer Protocol for virtual hosts

The index matrix [4] of the transition conditions is:

$$Z_1 = \langle \{l_{11}, l_{23}, L_{1A}\}, \{l_{If1}, l_{12,} l_{13}, l_{14,} L_{1A}\}, R_1, \wedge (l_{11}) \vee (l_{23}, L_{1A}) \rangle$$

$$R_1 = \begin{array}{c|ccccc} & l_{If1} & l_{12} & l_{13} & l_{14} & L_{1A} \\ \hline l_{11} & false & false & false & false & true \\ l_{23} & false & false & false & false & true \\ L_{1A} & W_{1A,If1} & W_{1A,12} & W_{1A,13} & W_{1A,14} & true \end{array}$$

where:

- $W_{1A,If1}$ = “current token is sent from FTP client”;
- $W_{1A,12}$ = “request for connection is sent FTP client”;
- $W_{1A,13}$ = “data about request FTP user or pass are sent”;
- $W_{1A,14}$ = “data is sent through defined rules”.

The token entering place l_{12} obtains new characteristics “data are available to establish a connection”.

The index matrix of the transition conditions is:

$$Z_2 = \langle \{l_{12}, l_{13}, l_{14}, l_{31}, L_{2A}\}, \{l_{If2}, l_{21}, l_{22}, l_{23,} L_{2A}\}, R_2, \vee (l_{12}, l_{13}, l_{14}, l_{31}, L_{2A}) \rangle$$

$$R_2 = \begin{array}{c|ccccc} & l_{If2} & l_{21} & l_{22} & l_{23} & L_{2A} \\ \hline l_{12} & false & false & false & false & true \\ l_{13} & false & false & false & false & true \\ l_{14} & false & false & false & false & true \\ l_{31} & false & false & false & false & true \\ L_{2A} & W_{2A,If2} & W_{2A,21} & W_{2A,22} & W_{2A,23} & true \end{array}$$

where:

- $W_{2A,If2}$ = “current token is sent from server”;
- $W_{2A,21}$ = “code of 500 series are available”;
- $W_{2A,22}$ = “response is sent for specific action”;
- $W_{2A,23} = W_{1A,14}$.

The token entering place l_{21} obtains new characteristics “available are: reply code is sent in response to a new user connecting to the FTP server to indicate that the server is ready for the new client”.

The index matrix of the transition conditions is:

$$Z_3 = \langle \{l_{22}, L_{2A}\}, \{l_{31,} L_{3A}\}, R_3, \vee (l_{22}, L_{2A}) \rangle$$

$$R_3 = \begin{array}{c|cc} & l_{31} & L_{2A} \\ \hline l_{22} & false & true \\ L_{2A} & W_{2A,31} & true \end{array}$$

where $W_{2A,31}$ = “authorized is query to perform”.

The token entering place l_{31} obtains new characteristics “has received a query for service”.

$$Z_4 = \langle \{l_{If1}, l_{If2}, l_{If3}, L_{4A}\}, \{l_{If3}, L_{4A}\}, R_4, \wedge (l_{If1}, l_{If2}, l_{If3}) \vee (L_{A4}) \rangle$$

$$R_4 = \begin{array}{c|cc} & l_{If\,3} & L_{4\,A} \\ \hline l_{If\,1} & false & true \\ l_{If\,2} & false & true \\ l_{If\,3} & false & true \\ L_{4\,A} & W_{4\,A,If\,3} & true \end{array}$$

where $W_{1A,If1}$ = "results are estimated";

The token entering at place L_{4A} obtains characteristic "estimations $\langle \mu_i, \nu_i \rangle$". All estimations take initial values of $\langle 0, 0 \rangle$, when $i \geq 0$, the current $(i + 1)^{\text{-st}}$ estimation is calculated on the basis of the previous estimations according to the iterative formula:

$$\langle \mu_{i+1}, \nu_{i+1} \rangle = \left\langle \frac{i.\mu_i + \mu}{i+1}, \frac{i.\nu_i + \nu}{i+1} \right\rangle$$

where $\langle \mu_i, \nu_i \rangle$ are the previous estimations and $\langle \mu, \nu \rangle$ is the latest estimation of the messages for $\mu, \nu \in [0, 1]$ and $\mu + \nu \leq 1$.

In this way, the token in place l_{if5} forms the final estimation of messages on the basis of the previous and the latest events.

5 Conclusion

The proposed generalized net model describes the main conception for construction and establishing connections with File Transfer Protocol for virtual hosts. The estimations made on the basis of intuitionistic fuzziness assist for the more accurate determination of the conditions, in which get the messages sent by the FTP server or virtual clients. The model allows to be looked through the different stages of the flowing of the process and its simulation and behavior in future.

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