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Artificial Intelligence for Intent Based Networking

Alex Mathew
Department of Cyber Security
Bethany College, USA

ABSTRACT

Intent-based networking, taking the technological world and market by storm, is an emerging technology that helps in planning, maintenance design and reducing the downtime in networks [1]. Many businesses are turning to this technology to help reduce the errors they face daily and increase the productivity of their departments. The exponentially growing number of nodes in the region has led to the need for an increased workforce to maintain all these nodes. This led to the need to have a network that can 'take care' of itself. A network that can find errors and rectify them, a network that with time will notice an impending danger and deal with it or take the correct action. This increases speed and efficiency. This action mimics human's behaviour. Artificial intelligence then comes to play. The ability of a machine to mimic human behaviour [2]. The combination of the two gives rise to a self-driven, intent-based network. All a user needs to do is specify the intent (what he expect the machine to do) and the machine accomplishes all these tasks dynamically to all nodes. This system increases security in a network.

Just like any other technologies, there is room for improvement, new features need to be added as the need arises and with time the system will be complete and achieve most of what all network users' desire.

Keywords: Intent, Artificial intelligence, machine learning, machine reasoning, Natural language processing, software-defined network (SDN).

I. INTRODUCTION

An intent is an action or need that needs fulfilling in the computing world. A good example being the permissions that a client can have across a network. In a traditional setting, all these permissions will have to be granted manually. When scaling is needed, the new devices have to be added manually. In case of a security issue, the issue has to be searched manually and sorted manually. In a case where the firm has millions of nodes and end devices, this can be quite a task, time-consuming and an expensive task. Human error is another deficiency affecting networks. The exponentially increasing number of devices increases the complexity of these devices. It is documented that many errors in networks are as a result of wrong inputs and other types of human errors [3]. With the introduction of intent-based networking, a solution to all this has come our way. Intent-Based Networking (IBN) simplifies the actions of creating and managing policies in an organization [5]. In a case scenario where there exists a head office and its sub branches elsewhere. There will be a need for the payroll department in the sub branches to connect to the payroll application running in the main office. With IBN all the administrator needs to do is specify the intent (connection to the main office allowed only for these nodes) and the system implements the intent across the network. In a traditional setting, this can be quite a time consuming and expensive [4].

To achieve all these functions, the IBN uses loops (building blocks) with which the intent from the first stage to the implementation stage will follow. These are

- Translation and validation-With a good graphical user interface, the system allows the users to input commands in natural language which is different from machine language. The translation of these languages involves the first phase. Human is prone to errors and may input a wrong intent, in this phase the validation of weather an intent is achievable is made and any necessary communication made.
- Automation-Once the intent is defined the rest is done by the system. The implementations are done on the fly, no need for user intervention or any manual monitoring. The system will ensure that all policies are met and the final goal achieved.
- Security-the ever-increasing number of nodes together with the advancement in technology poses a huge risk to any network. IBN protects the network from any intrusion or from malicious activities [6].
- State updates – The system periodically runs programs that check the networks state and gives the desired updates. In case of any failures, the administrator is notified of the issues and probably the correct course of action to take.

- Dynamic optimization- Using ML algorithms the network is able to take actions to optimize itself and do other actions dynamically as stipulated by the algorithm it runs [5].

Artificial intelligence and Machine learning as used in the last stage forms the next big thing in the IBN field now that the algorithm and the power to run these machines have come to be, due to the high level of technology. In a real-world scenario, for example, a case of live streams and live meetings, video and audio data formats are sent over the network. The video quality at the client end may vary depending on the gadget being used, a given network may only be able to carry some limited bandwidth per time. If the bandwidth exceeds the networks optimal conditions, then some of the packets may be lost or a complete overall disconnection. Finding this kind of error in real-time may be impossible. But with the use of Artificial Intelligence and Machine learning algorithms, an algorithm can be trained to check certain conditions in a network, in our case optimum bandwidth, if the bandwidth exceeds the set, notify the relevant authorities or the algorithm can rectify the situation as trained. The solution would be to reroute the data to other paths and avoid saturation of current path as stipulated by Apostolopoulos[7]. Using this kind of technology enables administrators to check on errors in real-time and correct these errors in real-time avoiding faults like loss of data or connection loss in a networked setting. With this kind of technology installed, then the workload is not on the administrator, he or she can now focus on dealing with inventions and other duties and not spend all time checking for errors and maintaining a networking environment which in itself discourages invention.

It is of importance to note that however SDN and IBN have similar functionalities, IBN takes a leading head by introducing artificial intelligence to its system for predictability and increased performance hence quality as a result [8].

II. METHODOLOGY

Theory

The three main stages in IBN 'Translation, Activation, Assurance' all have an aspect of Artificial intelligence in their various implementation.

The first stage, translation, makes use of natural language processing, a field in Artificial Intelligence that helps the machine convert human natural language to machine language [8]. Research has however shown that machine reasoning can also come to play in this area to help the machine filter only what is relevant to the domain in question [7];

The second stage is the activation stage. The intent is put into work, the AI comes into play by searching through the network and using machine learning algorithms. In a scenario, for example, a scenario used by Apostolopoulos [7] VP of Cisco Enterprise business, a company spanning the whole world will have multiple offices. Using machine learning algorithms it is possible to know where and when offices will be open and allocate enough bandwidth to these regions. The algorithm in the network would determine locations where a probable downtime is expected and notify the users in these regions to head to the offices or they may only receive audio with no video.

The third stage is the assurance. As Stated by Apostolopoulos [7] it possible that errors may arise in the user side. Prolonged connection time to the devices may be due to an arising issue. Using AI the system can know where to expect these errors including saturation errors and provide a desirable solution dynamically.

Feedback. Using AI algorithms it is possible to run through all communications in the network and give a summary of performance and any recommendations.

III. BLOCK DIAGRAM

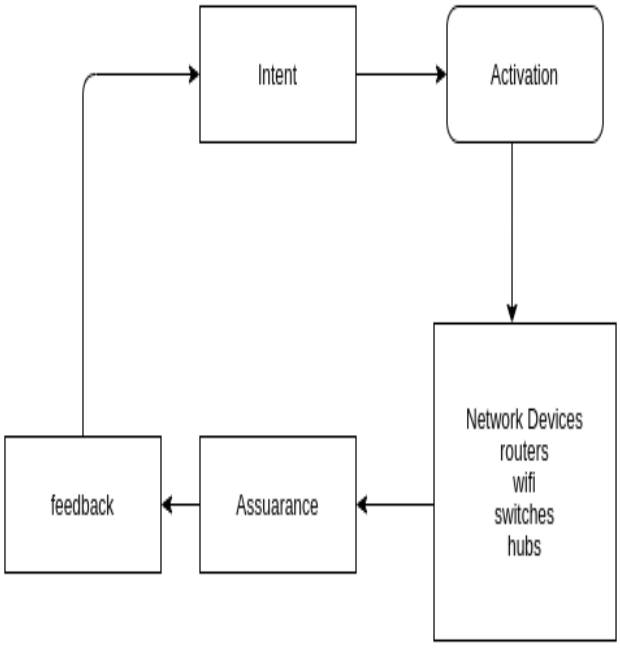

Figure i Block diagram

IV. ALGORITHM

Step 1: Start

Step2: Get intent from the user

Step 3: Translate user intent

Step 4: if intent !=valid

Step 4.1 Translate

Step 4.2 Output error

Step 5: Activation

Step 6: Check for saturation

Step 7: if saturation == True

Step 7.1: Reroute database

Else

Step 8: checks locations needing bandwidth

Step 9: if location needs bandwidth== True

while location needs bandwidth

step 9.1: Allocate bandwidth

Step 10: Reallocates bandwidth

Step 11: Assurance

Step 12: if errors==True

Step 12.1 correct errors where possible

Step 13: Output feedback

Step 14: Stop

V. FLOWCHART

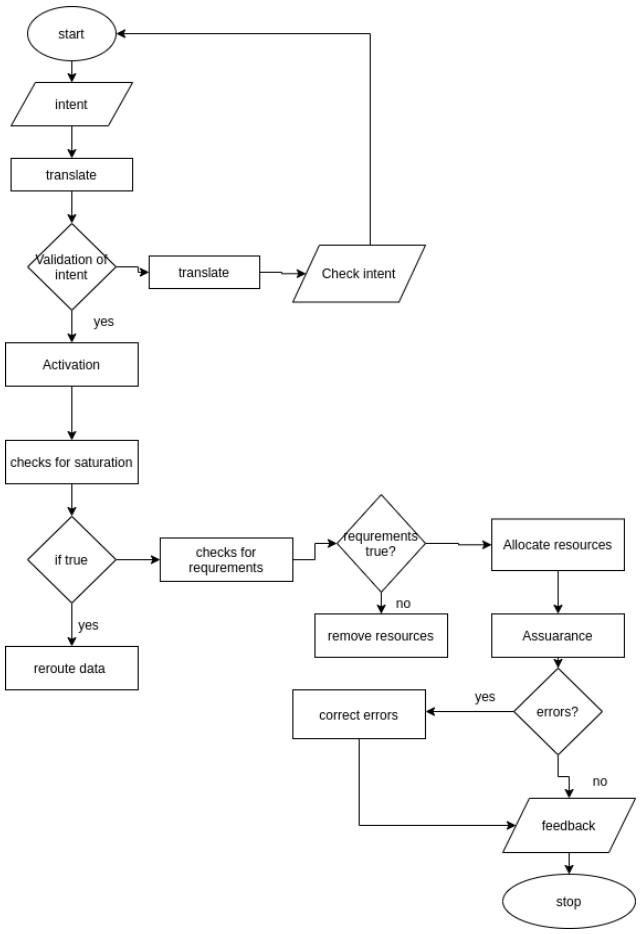

Figure ii flowchart

VI. RESULTS

The above system runs in an intent-based network.

After input of the intent, an error message is an output in-case the intent is wrong, the machine cannot understand it or is against the policies set. The other processes are run on the fly and decisions made as stipulated.

Users in locations with no bandwidth are advised appropriately.

of the errors the system can fix are fixed on the fly and a feedback message is given on the state and operation of the network.

VII. CONCLUSIONS

The speed errors are solved, the ability to scale and reduced risks are some of the main core issues as to why intent-based networking is succeeding in the tech world [10]. These key factors have a result of increasing the sale and encourages innovation in the ever-developing technology. In order to keep up with this speed, the need for artificial intelligence comes in. Predictive actions can be sorted by the use of algorithms and eliminate the work and risks involved in these situations [11]. In a nutshell, the field of networking is evolving, with the computing power and algorithms now in existence what was called a dream can now be a reality and the possibilities we can achieve with this kind of power and knowledge are limitless.

VIII. LIMITATIONS

New technologies have their advantages and disadvantages. In this case, being a new technology, not many are equipped with this kind of knowledge and thus needs quite some research to come up with solutions.

Many sessions create the networks we have and understanding these key features is vital [12]. With intent-based networks these factors are not put into much consideration, a perfect network may have issues due to an overloaded back-end. Probably this will be missed when doing the network analysis with IBN.

IX. FUTURE SCOPE

Intent-based networking has a lot to offer, being a new technology it has done well for now. Investments in technology can make it more comprehensive. The technology can add other metrics such as packet loss and latency to give more comprehensive reports.

Being a written program some of its results may be static and this reduces the network flexibility. Improvements can be made in this area for more efficient technology.

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