Machine learning for network automation

How machine learning can give better insights for network optimization and automation?

What is Machine Learning?

Machine Learning is the area of study dedicated to promote technologies capable of enabling computers to learn and develop assigned tasks and activities on their own.

There are lots of different machine learning algorithms, but most of them can be classified in one of three main learning processes: supervised learning; reinforcement learning and unsupervised learning.

Supervised learning methods (e.g. Convolutional Neural Networks with Supervised Backpropagation) are the ones which have evolved more in the last few years, common applications are text language translation, image object detection, chatbots, etc. It requires a labeled database with samples of the input data and the expected output data. It is called supervised because it depends on a supervisor to teach it and often this supervisor are humans who manually label the database. In **reinforcement learning** process (e.g. Deep Q Network) there is no need to tell the algorithm what is the expected output, but it still needs positive or negative feedback about its decision, pretty like the way you train a dog giving small rewards every time it does something right. This method has been showing good results for problems which can be virtually simulated to provide a large number of different situations and its consequences. The most famous application are the electronic games competitions in which AI have been winning against professional players. Finally, **unsupervised learning** (e.g. Deep Belief Networks) which state of art didn't evolve so much as the others approach in the last years. But it still has great potential to get valuable insights that humans could never expect, once these are the methods which can learn by itself from patterns on data and so are the ones which are least biased and limited by human knowledge and supervision.

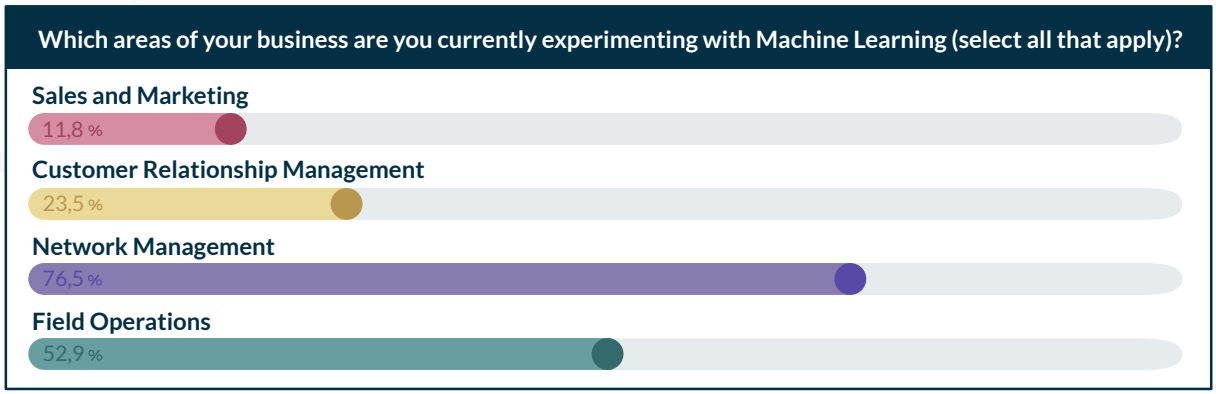
The idea of machine learning is that the machine becomes independent of human intervention, being able to identify problems and act upon them on their own.

Machine Learning in the Telecom industry

There are numerous possibilities for machine learning applications within the telecommunications industry. The main areas experimenting Machine Learning are:

- Sales & Marketing;
- Customer Relationship Management;
- Network Management;
- Field Operations.

Although there are many promising areas, Network Management has been highlighted as the most desirable in the short term, as shown by the poll results below.



Source: results of a poll made during the Heavy Reading Webinar "Automate Your Mobile Network Monitoring With Machine Learning" in February 12, 2019.

The reason is because the network complexity and the volume of data generated by network monitoring tools are increasing absurdly fast, turning out the traditional work of the telecom engineers impracticable.

The network complexity is also a challenge to those who wants to develop Machine Learning solutions, because unlike many other applications as chatbots or image recognition which have millions of people unconsciously teaching the machine every time they chat or tag photos in social networks, in Network Management there is not enough labeled data or supervisors to teach efficiently the machine.

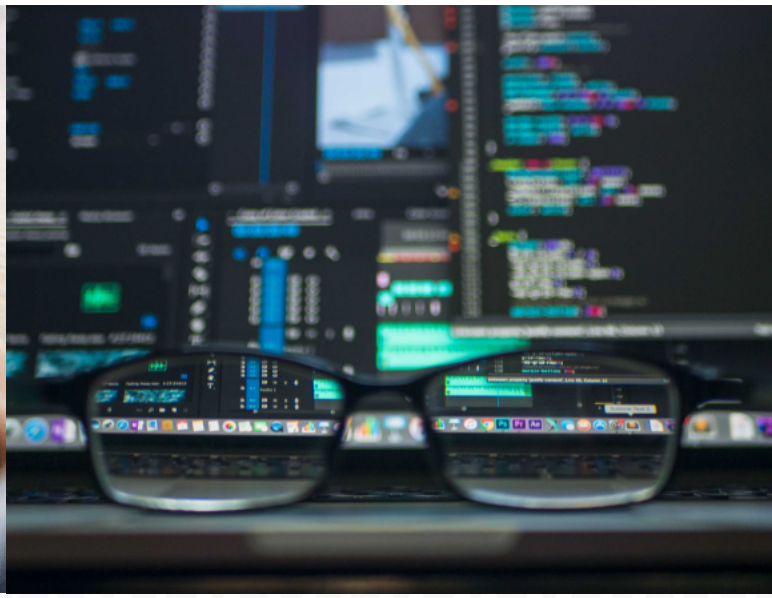
The number of different variables and issues which may affect the network is so big and it changes dynamically in time following how humans and, with IoT, even how machines uses the network, that even the most expert engineers can't teach efficiently the machine. For network management, a good customized machine learning solution must combine unsupervised learning with the two others approach, resulting in semi-supervised learning.

Machine Learning in network management

There are a lot of opportunities to improve Network Management with different Machine Learning techniques.

Anomaly detection algorithms can be used to analyze many performance indicators (KPIs) for hundreds of thousands of network elements (NEs) to automatically pinpoint the most relevant issues in the entire network. Anomaly detection algorithms are capable to learn the normal behavior of each NE and alert when it is behaving abnormally. This approach is much more efficient than traditional worst cells analysis and fixed threshold rules, once it takes into account that many groups of cells have different performance behavior (e.g. indoor/outdoor cells) and so they shouldn't be ranked and compared in the same way.

Many other network data sources as triggered alarms and network parameters can also be analyzed by a combination of unsupervised machine learning methods like clustering, correlation and probabilistic graphical models to infer possible causes of network issues.



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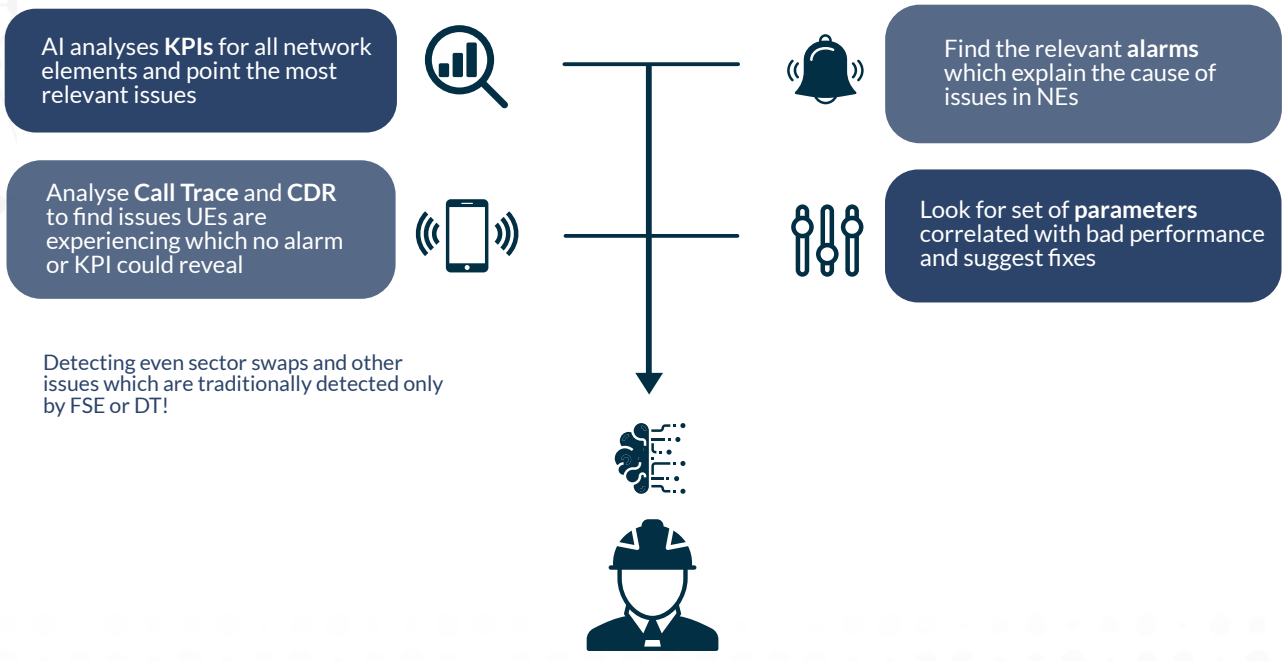
The learned causal relation between network parameter changes and KPIs can be used to find the causes of issues and also to recommend fixes.

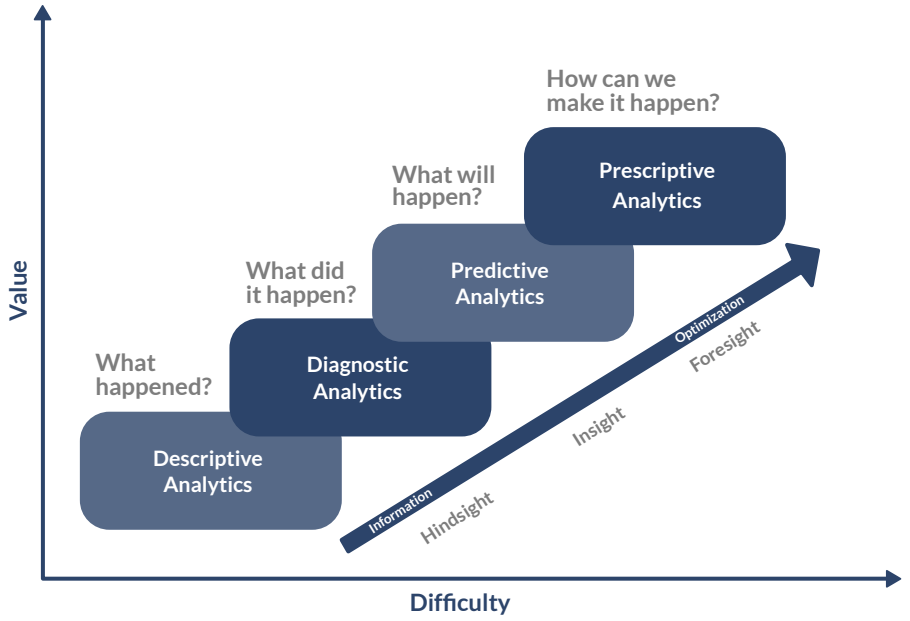
Natural Language Processing (NLP) is able to get useful insights from the huge amount of text information contained in alarms, Call traces and CDRs. While alarms are a good source to find causes of issues in Network Elements, Call Traces and CDRs are very useful to find issues being experienced by the user equipment in its specific location and environment. That means Machine Learning could find even issues which are traditionally discovered only by Drive Tests or Field Site Engineers.

Automatic Root Cause Analysis



Evolution of network management systems

The evolution of Network Management System (NMS) should follow the Gartner Analytic Ascendancy Model, which classify four types of analytics and its respective complexity and value. The types are: Descriptive, Diagnostic, Predictive and Prescriptive.



Source: Gartner Analytic Ascendancy Model (Gartner, March 2012)

Descriptive Analytics:

is the first and simplest step. Descriptive NMS solutions are capable of describing what happened in the network, e.g. which network element had a KPI degradation and when it happened. This type of solution helps the engineers to find faster the issues which they should investigate to fix and improve the network.

Diagnostic Analytics:

a diagnostic NMS solution adds the capability to the system to say why something is happening. This means this type of solution not only helps the engineer to find which issues to investigate but also their probable cause, e.g. a network parameter change or a BTS power failure.

Predictive Analytics:

at this stage, the system could tell you what is likely to happen, so the engineer can take preventive actions to handle a possible issue before it happens. Predictive analytics are not so useful for NMS if the foundation, descriptive and diagnostic, are not efficiently implemented.

Prescriptive Analytics:

the most advanced step enables the NMS to drive the network to a desired state, giving to the engineer (open loop) or to an autonomous controller unit (closed loop), what needs to be done. E.g. changes in network parameters, reboot systems or advises to increase network capacity.

Netwarden

In order to use the power of Machine Learning for Network Management, Bwtech has developed NetWarden, an advanced NetChart module which significantly reduces telecom engineers analysis time through intelligent automation.

NetWarden helps engineers to find out which network elements are performing badly, why it is happening and how to solve the issues. With NetWarden, engineers can ask the tool to perform a fully automated investigation, which will check multiple network data sources. These checks are not only performed against the abnormal cell which is under investigation, but also over all the related network elements (e.g cell neighbors, network controllers, transmission links, etc.).

All those steps that an engineer would usually take hours to do manually are done automatically in a few minutes. Only this automation brings already a big gain in the efficiency of troubleshooting process. But NetWarden is not only about automation, it is also intelligent. Often the number of parameters changes and triggered alarms are huge, so let it to engineers to analyze all those events is impracticable. Here is where NetWarden comes in action again, filtering out all irrelevant parameter changes and triggered alarms and highlighting to the engineer only a few events which are more likely to be impacting on performance.

About Bwtech

Bwtech is an innovative provider of end-to-end performance optimization solutions for Fixed and Mobile Operators, Managed Service Providers, Telecom Regulators and MVNE/Os.

More than 20 Communication Providers in 15 different countries trust Bwtech solutions for mission critical activities, such as real time Network Monitoring, Network Quality reporting, NOC and SOC operations, Capacity Planning and E2E Network Optimization.

Bwtech's team is made of a passionate group of Telecom specialists, software developers and data scientists all driven by the mission to innovate the way network optimization is performed. Innovation, passion, excellence and team spirit: those values guide our team in the daily goal of delighting our global customers.

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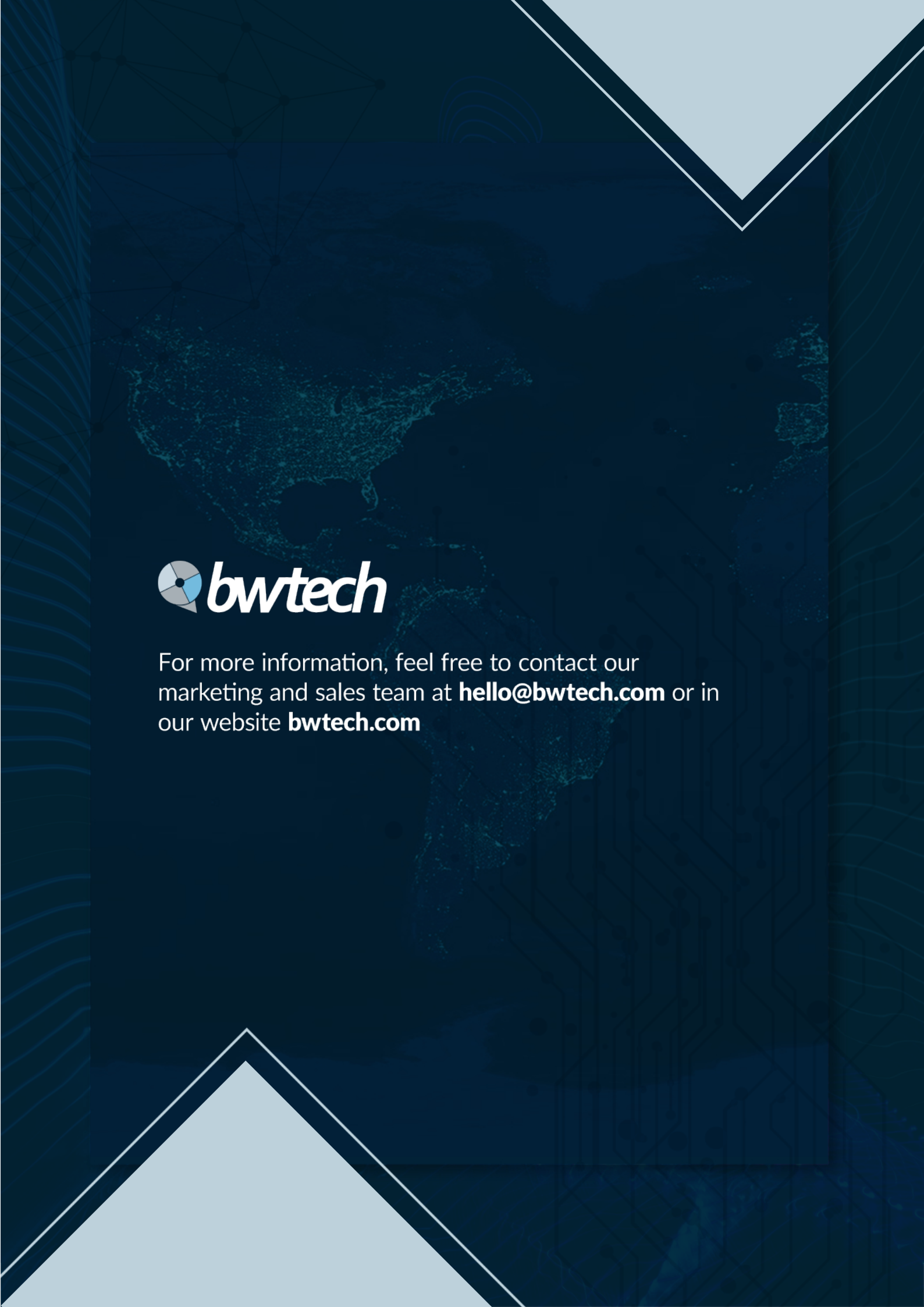

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