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RESEARCH PAPER

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PROACTIVE MONITORING FOR SMEs USING APPINSIGHT

Atdhe Buja
Faculty of Contemporary Sciences and Technologies
South East European University
Tetovo, North Macedonia

Zana Beqiri Luma
Mother Teresa University
Skopje, North Macedonia

Abstract: Data Security is a worldwide concern mostly for small medium enterprise (SMEs) and frameworks, approaches, methods are constantly evolving that has a connection with cloud computing, information systems, artificial intelligence, blockchain. Many developers, administrators or product teams running blind. Those are not knowing of problems with their application or do not have the information to fix the problems. The things which can go wrong with web and mobile applications or services is unlimited like dependency failures, resources, and crashes. Main argument is an evaluation of benefits by using Cloud as infrastructure and application on proactive monitoring called Azure Application Insights (AppInsight) towards target like web application, web API, PKI etc. The findings, demonstration of the study should reveal and support our main hypothesis that there is direct link between the proactive monitoring and the main factors that affects utilizing the cloud services. To address this need, in this paper, we introduce AppInsight, the best practice and a model of proactive approach to monitor different targets using Microsoft technology on Azure Cloud services. AppInsight – a model of proactive monitoring includes several functionalities: (1) identifying availability, (2) failures dependencies, (3) performance and (4) using telemetry data generates ad-hoc solution to fix potential failure of web application, web API etc. AppInsight a feature of Azure Monitor used to monitor live applications. AppInsight will automatically detect performance anomalies, and includes powerful analytics tools to help you diagnose issues. You will get a range of telemetry data of analytics of your target which is monitored by AppInsight. To evaluate this tool, we conduct an empirical evaluation by comparing data from actual live monitoring of Y target.
Demo Video: https://www.youtube.com/watch?v=q7R8-c0ge7M

Keywords: cloud proactive, microsoft azure, appinsight, monitoring evaluation, government gateway

I. INTRODUCTION

As H. James Harrington said "If you can't measure something, you can't understand it. If you can't understand it, you can't control it. If you can't control it, you can't improve it.", has been a big engagement of this time to modernize lifecycle management of development and operations. Proactive monitoring plays an important role in software, hardware development. Since the emergence of the Covid-19 pandemic worldwide, the need for monitoring, information security has increased more than ever. The trend of technological developments, the demands went beyond the expectations of the time. It serves as an essential source channel of telemetry data between app and users, resources used.

AppInsight in a fast and powerful way helps to diagnostics and solve real world problems, of two levels Service Level impact (Availability, Reliability), Operational Level impact (Responsiveness, Latency). Despite its benefits, analyzing monitored data called logs often is a challenge to IT professionals. Digitization, the advancement of applications has brought a new era for SMEs. SMEs are facing the security and availability of services in the face of cyber threats and various IT risks. The distribution, expansion of infrastructure and IT in general with the various services of SMEs has an urgent need for a different approach so far in terms of monitoring. European agency for cybersecurity (ENISA) their analyses of SMEs shows how to deal with the cybersecurity issues triggered by pandemic through a report advice action [21].

More the time goes and monitoring, collection of the logs etc., the more challenges bring on high number of such logs. To solve this challenge, Realtime Telemetry feature at AppInsight were presented by detecting, triage, and diagnose process. The current techniques assist in analyzing, but they are mostly focusing on static analyzing. IT people mostly developers, administrators need to shorten the time and produce solutions or insight for the issue, and this can be done by using Realtime Telemetry – AppInsight.

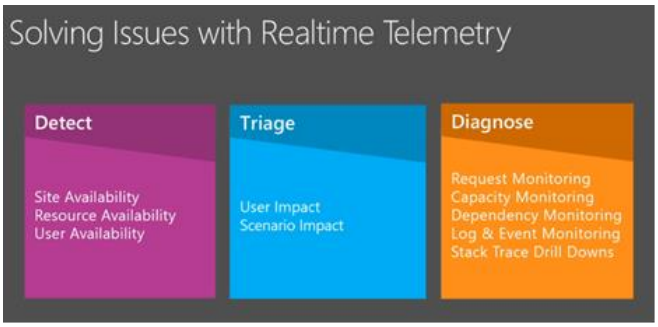

Figure 1. Realtime telemetry process of collection, analyzing, report

Microsoft Azure is a cloud computing platform, and serves for building, deploying and managing applications and services [1] by providing PaaS and IaaS services. Transformation toward cloud services is important IT capability building action to improve an organization in this digital world [2]. As within those Coronavirus disease time Cloud computing can be used to rapidly enhance the prediction process using high-speed computations and predictions [3].

The rest of the paper is organized as following: Section 2 AppInsight background and architecture. Our research how should be implementation are describing in Section 3. Section 4 describes comparative analysis of different monitoring tools, with the main results presented in Section 5. Success stories to respective government countries are showed in Section 6. Conclusions can be found in Section 7.

II. APPINSIGHTS

In this section, we briefly illustrate AppInsight and its architecture. The purposes of AppInsight is to identify the anomalies or problems and in very shorten process of time give a solution by monitoring its dependencies and roles, including powerful analytics tools which supports you in diagnose issues and behaviors actual users is doing with your app. National Institute of Standards Technology (NIST) see cloud computing as a model for enabling convenient, on-demand network access to a shared pool [1].

A. *Architecture*

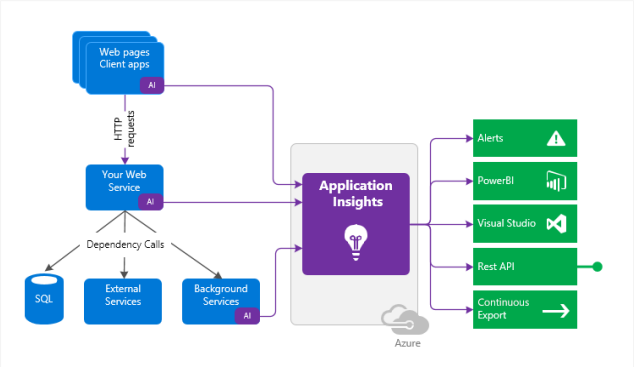

Figure 2. Application Insights functionality

By using Application Insights involved a process of monitor, detect, diagnose, build, measure and learn. AppInsights is a functionality of Azure Monitor dedicated for developers and IT professionals. Monitors your live applications and automatic mode detects performance anomalies and has powerful analytic tool to diagnose the issue [1].

First installation of SDK instrumentation package at your application or web API, enable AppInsights. Instrumentation monitors application and sent telemetry data to an Azure AppInsight resource. All the telemetry data are integrated to Azure Monitor and showed in Azure portal where you can apply and use analytic and search tools to the raw data. Azure AppInsight using Availability alerts sends web requests to your application or web API on regular intervals from different points of the world and this can alert if your applications behavior has changed or is not responding.

III. THE PROPOSED APPROACH

This section illustrates the details of the implementation, discusses representative usage scenarios for our framework. Prediction techniques are widely used in software engineering, from assessing future operational to forecasting whether a system would encounter a runtime failure [3]. Forecasting techniques are also used in cybersecurity response strategies and all software solutions are based on them. They help a lot in preventing the development and emergence of threats in security incidents.

Web applications, web API and other services often are hosted on the cloud to meet the desired Quality of Service (QoS) such as reliability, availability and performance [4]. Many services exhibit dynamic QoS variations that result in frequent changes in their behaviors, leading to SLA violations [4]. To avoid this a proactive monitoring can prevent violations. The importance indication, the existing literature provides a large amount of work in this area.

A. *Implementations details*

In this paper, we propose AppInsight, a best practice and a model of proactive approach to monitor different targets using Microsoft technology on Azure Cloud services for SMEs improving service availability and operations by predicting component failure in a cloud or on-premises service. AppInsight can be used in combination with SCOM System Center Operation Manager simultaneously or separately for monitoring and are tools providing monitoring that is flexible and cost-effective.

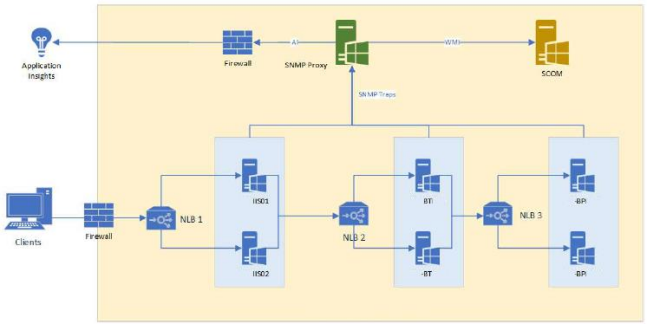

Figure 3. The overview of Appinsight [2]

The development trend of Cloud service providers has reached an advanced level and there are a variety of products and opportunities for SMEs. Cloud technology supports and enables many SMEs, giving focus and commitment to providing customer services with a good level of security and response in case of incidents. Without having to invest a lot of time and resources in the construction of the infrastructure, because this is perfectly provided by Cloud technology.

Required technology for this monitoring is Azure resources: Azure Application Insights, Azure Storage Account (for storing test business messages). This monitoring can be executed in defined times by schedule Web Job in Azure. In case of using Web Job it will required to use: Azure App Service (B1 service plan), Azure Logic app. The following figures shows an example of configured Azure resources for AppInsights Recorded errors will be visible on the Application map in configured Application Insights resource in Azure. Drill down is an option to results by selecting component, which reports failure.

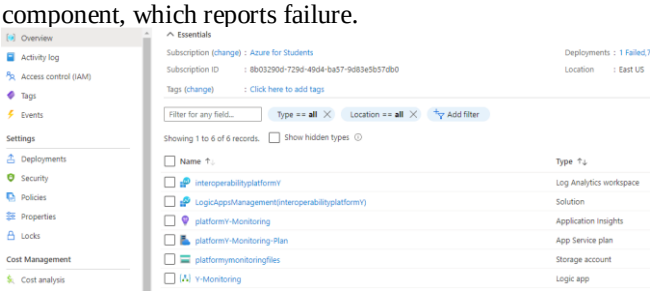

Figure 4. Example of configured resourcde group for monitoring

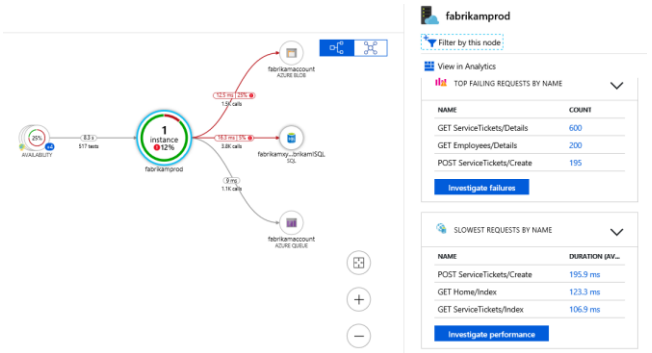

Figure 5. Selected component with recorded error

There are different business models in the markets, such as B2C, B2B, B2G. These types of business models very rarely are in demand worldwide but now with pandemic Covid-19 has unexpectedly increased the use of technology and cloud services [6]. As mentioned above, the increase in demand for digitization, use of advanced technologies such as Cloud are the top choices of SMEs. The choice of methods, techniques in Cloud technologies such as proactive monitoring, includes the adequate solution of the right approach for SMEs. Such an approach gives results in the operational phases, that is, after the final implementation of the service, be it web application, API or other.

IV. TYPES OF PROACTIVE MONITORING METHODS

A considerable number of monitoring tools, were launched on the market in the last few years, but not all of them established solution of proactive monitoring [6]. Not all tools or solutions are intended to provide a dynamic, proactive approach to presenting data, first collecting it. Proactive monitoring approach, shows the constant way of identification, assessment of likely event to occur or being an issue, which creates and obstacles for the SMEs. Proactive countermeasures are those of prevention that stop or reduce the development or occurrence of an incident, i.e. the likelihood. Usually this approach offers an advantage of identifying problems before the user sees and recognizes them and impact the business. Proactive monitoring through the tools also enables the evaluation of the team's capacities to react to cases when they happen or have happened. This approach can be used in many cases including business models and operations, IT, production, incident prevention, etc. Such an approach would help the SME team in changing the mindset, the work culture from the traditional one where you wait for things to happen and then take preventive measures, while proactive monitoring helps prevent the event.

Comparative analysis of different monitoring tools as shown in TABLE 1:

Table I. Comparative analysis of different Monitoring tools

Feature ↓ / **Tool →**	Cloud Azure AppInsights	On premises monitoring tools (SolarWinds, PRTG)
Application map, dashboard	☒	☒
Codeless monitoring	☒	☐
Load, responsiveness, and the performance of your dependencies	☒	☐
Slowest and most failing requests	☒	☐
Live Stream new release deploy, degradation	☒	☐
Assess how many users are affected	☒	☐
Correlate failures with exceptions, dependency calls, and traces	☒	☐
Examine profiler, snapshots, stack dumps, and trace logs	☒	☐
Usage demographics and statistics	☒	☐
Retention - how many users come back?	☐	☐
Funnels	☒	☐
User Flows	☒	☐
Workbooks	☒	☐
Smart Detection	☒	☐
Transaction diagnostics	☒	☐
Availability	Free/Paid	Free/Paid

V. EVALUATION

A. *Research Questions*

a) In this section, we evaluate our approach using real-world data. We aim to answering the following research questions:

b) RQ1: How does proactive monitoring through Cloud application helps in terms of security on-site infrastructure, operation support for SMEs?

c) RQ2: Can proactive monitoring on Cloud applications impact in time to reveal potential gaps, problems and providing a solution to it?

B. *Evaluation setup*

Target. To evaluate the proposed proactive approach, we collect data from a production interoperability platform Y on premises. For this experiment, we select dataset over two months and each dataset covers one month and two-month period in 2020, 2021. The data are from part of the interoperability platform monitoring performance, availability, and failures, containing over ten million monitored data.

Table II. Summarizes the dataused in this experiment

	Period	No. transactions
Data 1	30 days 17/12/2020 – 16/01/2021	4.15 million
Data 2	60 days 17/11/2020 – 16/01/2021	8.41 million

Tool Implementation. Implemented proposed approach provided by Microsoft Azure Cloud [2]. The experimental evaluation is running on an environment of azure cloud platform using monitor services Application Insights, Azure Storage Account used for storing test business messages. AppInsights (AI) is a tool provides monitoring that is flexible and cost-effective, helps to ensure the predictable performance and availability of target put to be monitored. Evaluation Metrics. Azure AppInsights use existing classification based proactive model. Collection of AI telemetry data is needed provisioned Application Insights

resources in the Azure subscription. The following figure shows the example of the application map, which has been created based on the telemetry data from Web Application Weather Service components. Azure AppInsight offers different data views and connects to different data sources by creating dashboards. Cloud technology has changed the way SMEs operate by enabling expandable infrastructure with service capabilities. It is a similar model as with utilities, that is, using resources as much as you need and when you need them. The benefits of SMEs from using Cloud technology, in this case Azure, are obvious, including security, speed, integration, disaster recovery, etc.

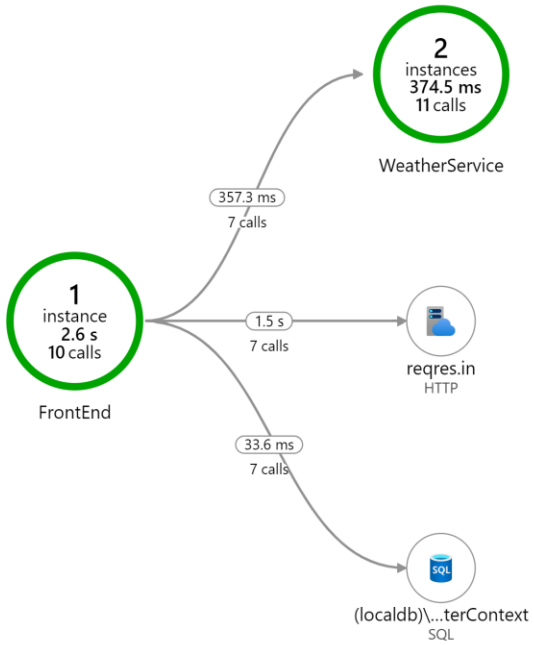

Figure 6. Example of the application map for Web Application components [3]

Collected data, which are been sent to Azure Application Insights never contain any personal data. SNMP Proxy is a Windows service, which receives SNMP traps which are converted WMI and to AI. Azure Application Insights provides with some metrics, but having deeper insights you might want use custom performance indicators or business-specific metrics [4]. On this experiment Azure AppInsights we are using custom metrics, we add those metrics and aggregation based on the needs, also other telemetry data on investigate, monitoring and usage.

C. *Evaluation Results*

RQ1: How does proactive monitoring through Cloud application helps in terms of security on-site infrastructure, operation support for SMEs?

Azure monitor AI gives you collection, analyze, and act on telemetry data from your cloud or on-premises environments. With these insights helps you no investigation to maximize the availability and performance on the application and proactively identify problems in very shorten time. In our scenario, time to identification, solution is important. My telemetry data can be shown by using Smart detection and manual alerts, the following figures shows that warn of potential performance problems and failure anomalies in your web application. Smart detection performs proactive analysis of the telemetry were your app send to Application Insights. The Smart Detection tab in AppInsights, selected under the Investigate menu were a list of recent detections is generated, shown example in the following figure for the Data 1. The problems detected with Smart Detection includes a variety of issues: Failure Anomalies, Performance Anomalies, Trace degradation, Memory leak, Security anti patterns.

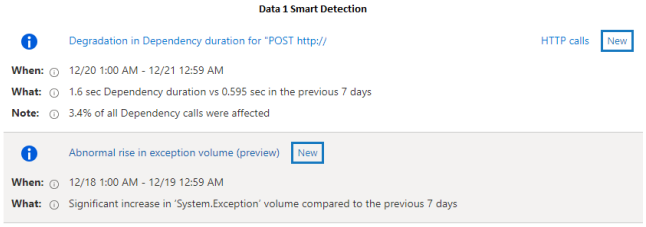

Figure 7. Detection analysis for security & behaviour

At Application Insights you can use Search feature to explore individual telemetry as page views, exceptions, web requests etc. The following figures shows filter event types: Availability, Request, Exception, Page View, Trace, Custom Event and Dependency for the Data 1 filtered on property values.

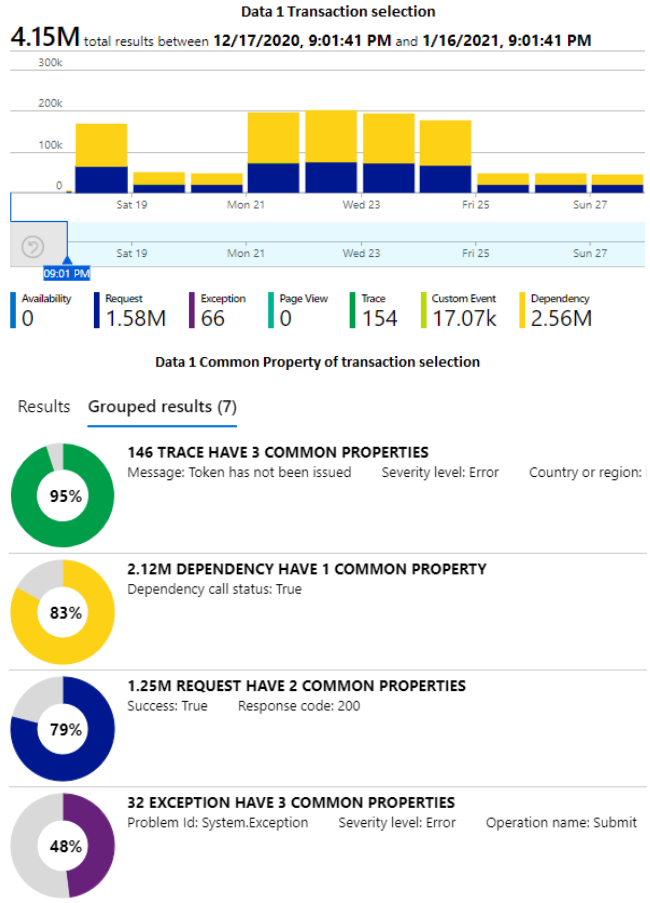

Figure 8. Search Transaction selection of the Common property

More level of details showed on the following figure presents End-to-end transaction details. It shows that communication has started with success certificate authentication, then the token was issued by Federation Provider, at that moment business message was read from Azure File Storage and in those steps, we can easily identify the errors.

Figure 9. End-to-end transaction details selection of the Flows (1 step before and 5 steps after transaction: Certificate)

In summary, the experimental results show that the proposed approach is effective in proactive monitoring predicting failure and its transaction lifecycle in cloud service. Also, this effective approach offers greater security of information, in the face of risks, various cyber threats.

RQ2: Can proactive monitoring on Cloud applications impact in time to reveal potential gaps, problems and providing a solution to it?

In this RQ, we evaluate if the method of effective diagnosing failures and its dependencies using AppInsight analysis feature with Data 2. The following figure 10 is showing an example of timeline with failed operations, a screen view that shows you the failure rate trends for your requests, how many of the have failed, users impacted.

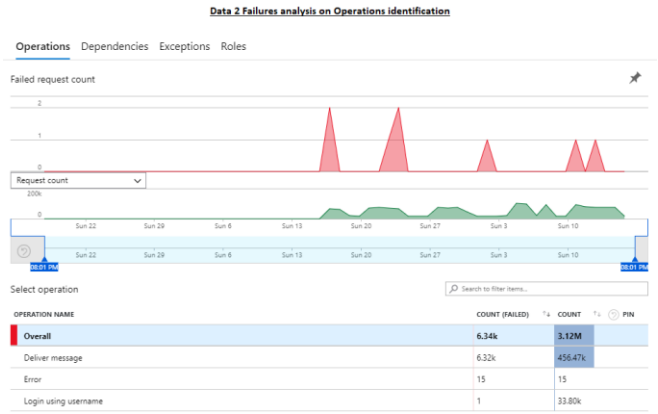

Figure 10. Failures analysis on Operation name, type, count and timeline

The following figure 11 on the right, you will see the most useful distribution specific to the selected failing operation, including top three responses code, top three exception types, and top three failing dependency types.

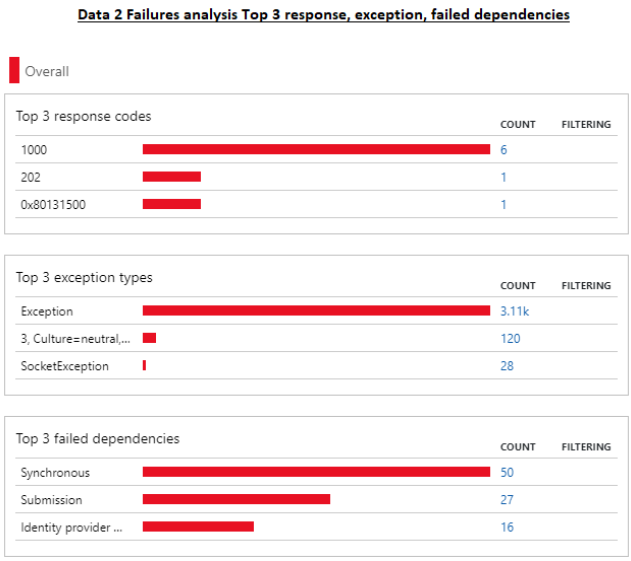

Figure 11. Failures analysis Top 3 response, exception, failed dependencies

In one click you can review each of these subset of operations (refer previous figure). To diagnose exceptions, you can click on the telemetry data of a particular exception to be presented with the End-to-end transaction details tab, such as this one following figure 12:

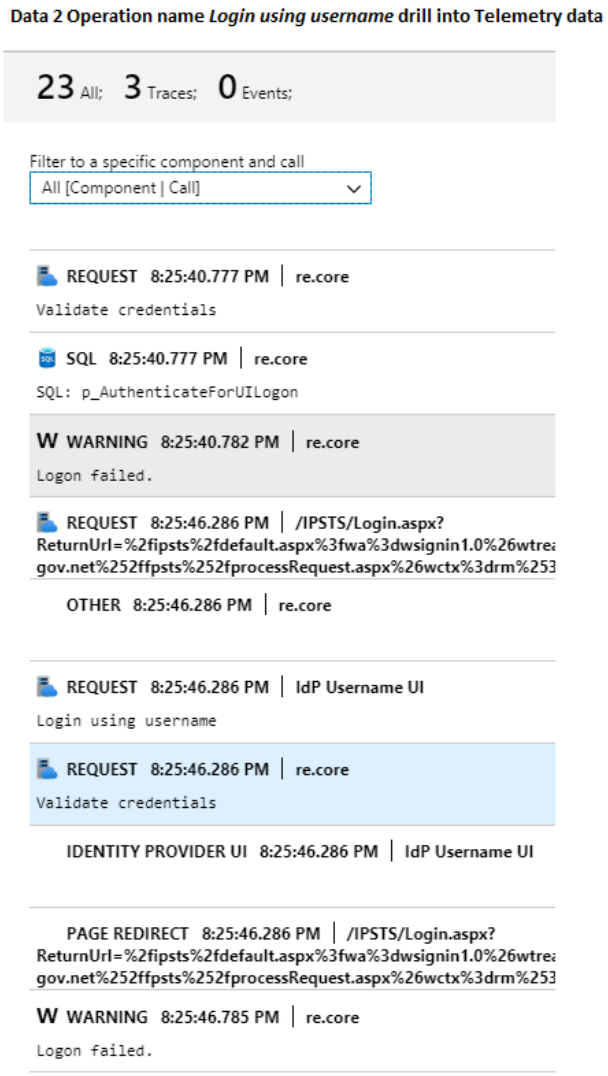

Figure 12. Failures analysis on Operation name by Login using username drill into Telemetry Data

Telemetry data has an important role in supporting to quickly identify and fix issues in customer deployments and configurations. The data, or as it is known, the telemetric representation shows a deep understanding of the current one, it aims to enable different measurements and further develops the research towards a certain goal to find the right solutions.

Related Items to Azure AppInsight feature Operation, IT professionals can further more investigate just there by: (1) see what happened before and after this request using User Flows; (2) trends of this request over time; (3) all available telemetry 5 minutes before and after this event.

Table III. Summarizes the data used on Operations identification

	Period	No. transactions	Operations COUNT (Failed)
Data 1	30 days 17/12/2020 – 16/01/2021	4.15 million	6
Data 2	60 days 17/11/2020 –	8.41 million	6.32k

	16/01/2021		

Table IV. Summarizes the data used on Dependencies identification

	Period	No. transactions	Dependencies COUNT (Failed)
Data 1	30 days 17/12/2020 – 16/01/2021	4.15 million	92
Data 2	60 days 17/11/2020 – 16/01/2021	8.41 million	3.46k

The data of operations, dependencies on both previous tables, was generated by using Azure AppInsight Failures function on period of time, specifying roles (i.e. target of monitored WebAPI, IIS, and DB etc.) The following figures takes you through the process of analyzing the performance of the server components of your application and can be expanded on the perspective of the client. Giving a picture of performance server operations, analyzing server operations to identify the root cause, identify slowest client operations, page views. The following figure graph data currently shows the average duration of the selected operations over time. If you switch to 95th percentile you will find the performance issues. Select the operations that you're interested in by pinning them to the graph, and if there is a peak worth investigating this will show that. And ad-hoc you can isolate this further by reducing the time of the graph.

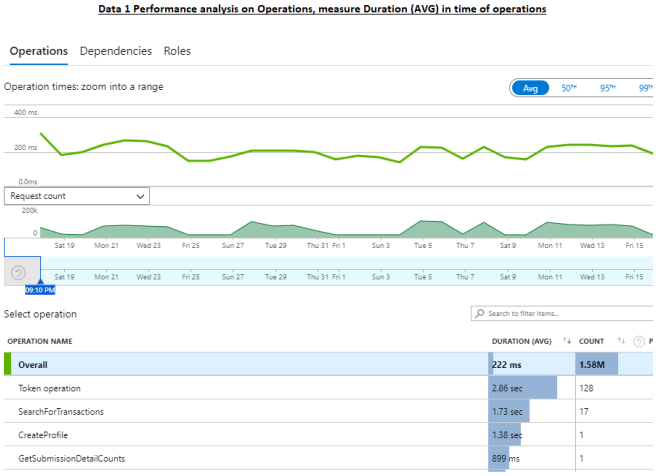

Figure 13. Performance analysis on Operations

Performance Dependency tracking in Azure Application Insights will make a measure the duration of dependency calls, its failing or not, along with additional information. Dependency data we can find almost on all Azure AppInsight features, like Application map, Transaction Diagnostics, Browsers tab, Analytics. For every Dependency Name under overall for you will be generated a graph of that dependency distribution where you can Drill down having the solution.

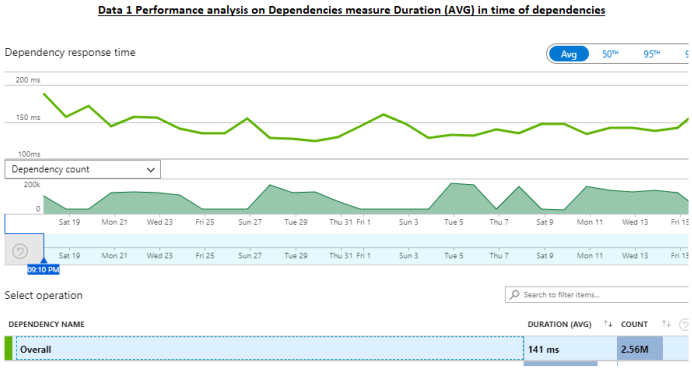

Figure 14. Performance analysis on Dependencies

D. Discussions

Organizations, companies today face a lot of threats towards their infrastructure, service availability, integrity and confidentiality. Every time getting worse to maintain the level of QoS and SLA by integrating proactive approach on business operations of doing this especially on IT with follow-up proactive actions ensures that cloud services and apps can maintain the expected requirements. The advancement of cyber-attacks in methods and techniques has brought the urgent need to face such challenges. Well, not only the use of technologies and tools is enough, but also the change in approach to certain IT operations. Like the traditional monitoring which was always waiting for the results of the events after they were developed and received a final epilogue. However, forecasting as a way of obtaining preliminary information about the situation, and the possibility of causing the event or other effects that will affect it, offers a benefit known as the proactive approach. The role and influence of SMEs in the digital transformation is great, especially in the industrial revolution Industry 4.0. SMEs are usually the first to adapt to the state and technological and other developments, they always offer innovative products using the technology itself.

At the same time of use for the behavior of the products, they also practice things that later the results are seen directly by its user. The success of the Industry 4.0 industrial revolution should also include SMEs, not only corporations or states. Usually, big and fast changes manage to be implemented and used in SMEs due to their size and demand for adaptation. One of the many opportunities that the Industry 4.0 revolution brings is the self-automation of Cyber Physical Systems (CPS).

Different countries like European ones provides different research program funds to assess the issues of digital transformation of SMEs in the Industry 4.0 era. The Industry 4.0 revolution is making the big change from automated systems to smart ones and is advancing rapidly through new technologies such as augmented reality, virtual reality, blockchain, etc. The large expansion of infrastructure and sensor games, especially in Industrial IoT, is finally changing CPS in SMEs with a control approach oriented to distributed services. This requires an advancement in the monitoring approach and methods and techniques, because

the tremendous generation of data today is appearing to be an issue that requires quick and wise solutions.
As shown by our experimental results, the proactive monitoring model in Azure AppInsight can better capture and diagnostic the characteristics of request, transaction producing better results.

VI. SUCCESS STORIES

This solution Azure AppInsight proactive monitoring was successfully applied to the Interoperability Platform of Government of Kosovo, which is a large scale on premises infrastructure build on Microsoft technology. Interoperability Platform allows developers and IT professionals to build, deploy, and manage web API that integrates system-to-system for data exchange.

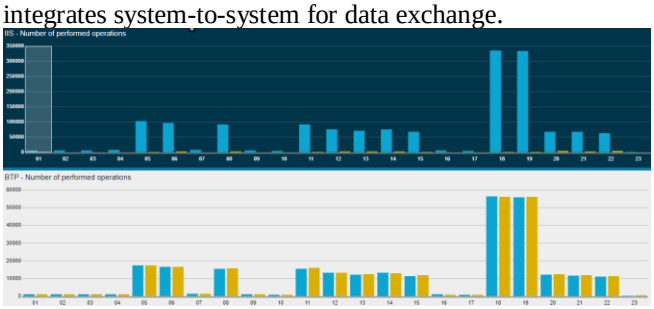

Figure 15. The operations performed in one month period Jan 1-23, 2021

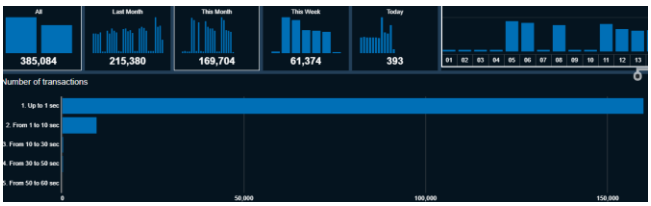

Figure 16. Time processing over 90% of transactions performed Up to 1 sec vs. in one month period Jan 1-23, 2021

Azure AppInsight proactive monitoring hosted on Azure Cloud is currently used by Interoperability Platform to monitor and alert for potential anomalies and healthier integrations between information systems. It's scheduled agent (called robot app) job on every 15 minutes to perform such proactive monitoring steps across the entire Interoperability Platform to diagnose anomalies and potential issues report back to IT administrator's team.
After deploying Azure AppInsight proactive monitoring, the IT administrator's team computes a lot of percentages and having prediction of performance, dependencies, and operations for each component. The results are shown in Figure 15,16. The results show that Azure AppInsight is able to intelligently diagnose, predict every operation happens on entire platform and has shorten the response time, diagnosis service problems of the team to the failures.

VII. CONCLUSIONS

In this paper we presented APPINSIGHTS, a proactive approach monitoring solution for any application, web API. To maintain SLA and improve service availability of IS, Web app, Interoperability Platform, we propose Azure AppInsight proactive monitoring approach. We have evaluated such proposed approach using real-data and have successfully applied Azure AppInsight to the maintenance of a production service system. Using a proactive approach to monitoring brings benefits to SMEs, including the aspect of security. The security built on the basis of such an approach raises its level in infrastructure, whether it is in Cloud technology. It is based on the adaptation and establishment of controls or protective mechanisms in order to prevent the event from happening, for example. cyber-attack. Something that protects the security of information and maintains the level of security to prevent, and within SMEs, a culture of entrepreneurship is created that acts more in prevention than in remediation or reaction after the event has occurred.
Much research is being done in terms of providing solutions to the challenges of the Industry 4.0 era [22], because every day it is becoming difficult for SMEs to deal with security problems. Industry 4.0 revolution is ongoing process of transforming every sector of the industry towards smartnes, for more, the Industry 4.0 concept should go beyond large companies with a personalized strategy approach and see the possibility of implementation in SMEs [23]. Moreover, digitalization depends directly on new technology, from the concepts of CPS, IoT, physical internet (PI) [24]. Among the big challenges for SMEs remains the transit or transfer to Industry 4.0 in terms of competence and technology in their premises. In addition to these, the organizational and managerial aspect remains a challenge. Here, different frameworks and models can contribute to be useful in determining the direction of the organization in achieving strategic goals. Innovation should be part of the strategy of SMEs, to increase the chances of success in this time of great technological development. Changes in the culture, the mindset of SMEs takes its own time, because people often embrace new operating concepts, but there are also influences that emerge for treatment from this challenge.
Industry 4.0 helps in the advancement of IT in terms of infrastructure, IT systems. The purpose of Industry 4.0 is to integrate the connection of intelligent systems, self-control in different processes of the industry and its sectors. This will be a work that requires further research as future work, and the provision of solutions to have an easier transfer for SMEs in Industry 4.0. Monitoring of information systems, web applications, or web services is important because it enables a 360-degree view of the situation, and possible incidents in terms of information security. Such solutions, providers of Cloud technology services have several types of tools and applications, which with an access from the web, that is, the Internet, enable the best operation of IT structures within SMEs. Manual or traditional monitoring takes a lot of time and is very worthless. Notifications play a key role in proactively monitoring various channels and cloud services. Azure AppInsights helps increase the availability and performance of systems and services. Cloud technology is advancing further Azure has further integrated Kubernetes services. Monitoring in Azure comes in three ways: platform as a service (PaaS), software as a service (SaaS), and infrastructure as a service (IaaS). The greatest strength in Azure AppInsight is the integration and presentation of telemetry data where through Azure Stack Hub it collects data with the aim of optimizing customer usage.
We believe that with this approach giving importance of service availability, failure prediction we have contributed in the design and maintenance of services.

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