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Monitoring Service Catalogue services

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The case company of the thesis was lacking a common Service Catalogue for its IT services. The company was already monitoring its infrastructure and some applications, but it was lacking service and more complex business process monitoring.

The target of the thesis was to evaluate and select the most suitable monitoring tool available and to implement monitoring service for the most business-critical services. A tool already in-house had to be used which limited the selection process only for a couple of tools.

First, a current state analysis of the existing monitoring tools in the case company was made. The current state analysis included interviews of the stakeholders and based on that information the requirements for the service monitoring tool was set. After that existing tools in the company were evaluated against the requirements and the most suitable tool was selected.

After the tool had been selected, the first services to be monitored needed to be decided. A list of the most business-critical services was received from the business unit representatives and four services were selected from the list where the service measurement creation did begun.

Finally, measurements for four most critical services were created. The outcome of the thesis; tangible measurements for the services along with the alert and report configurations using the most suitable tool available was demonstrated. Even though the tool had some limitations, it provided a good starting point and improved the monitoring capability greatly.

Keywords	Service Monitoring, Service Catalogue, ITIL

Contents

Abbreviations

APM	Application Performance Management
B2B	Business2Business
BAC	Business Availability Center
BPM	Business Process Monitor
BSM	Business Service Management
BT	Business Transaction
E2E	End-To-End
GSO	Global Services & Operations
GUI	Graphical User Interface
HPE	Hewlett Packard Enterprise
HTML	Hypertext Markup Language
ITIL	IT Infrastructure Library
ITIMF	IT Information Management Forum
itSFM	IT Service Management Forum
KPI	Key Performance Indicator
MTTR	Mean Time To Repair
NIC	Network Interface Card
OSS	Operations Support Systems
PDCA	Plan-Do-Check-Act
RUM	Real User Monitoring
SLA	Service Level Agreement
SMS	Short Message Service
SNMP	Simple Network Management Protocol
SPAN	Switched Port Analyzer
SSN	Social Security Number
VuGen	Virtual User Generator

1 Introduction

The need for IT Service Management has grown in the past couple of decades exponentially worldwide. IT was mostly focused on developing applications in the early years, but nowadays to be successful, IT must be able to support business by delivering the applications as a part of a larger service offering. (The Stationery Office 2007a: 15)

There are different IT Service Management frameworks, but this thesis concentrates only on IT Infrastructure Library (ITIL) framework since that is the framework the case company was using at the time of writing the thesis. ITIL is a collection of books describing the best practices of IT service management. ITIL will be introduced in chapter two.

1.1 Case Company Background

The case company in this project was Telia Company. Telia Company is an international telecommunications company founded in 1853. The company started with telegraph and telegrams in 1853 when The Royal Electrical Telegraph Administration was established, being the first telecom operator in Sweden. In 2002 Swedish company Telia and Finnish company Sonera merged together forming a first multinational telecommunications company both in Sweden and Finland. The merged company was named TeliaSonera, but both countries kept their separate brand names Telia and Sonera in their national markets for the next fifteen years. The company changed its name from TeliaSonera to Telia Company on March 2017. (Teliacompanyhistory.com 2017)

Today Telia Company operates in 14 different countries and has over 21000 employees. Telia Company has more than 190.6 million mobile and broadband subscriptions worldwide and it’s the fifth largest telecom operator in Europe. In Finland Telia Company is the second biggest operator after Elisa. (Teliacompany.com 2017)

This study was conducted for the Telia Company’s Operations Support Systems (OSS) unit within Global Services & Operations (GSO) IT organization. OSS IT domain maintains support systems to connect business and operative processes to technical resources such as networks, service applications and IT infrastructure. (Telia intranet 2017)

1.2 Business Challenge

The IT organization of Telia Company consists of many different departments in several countries. The number of IT systems and services is huge, they are spread to many countries and there is not yet one common list of all the IT services available. This unclear picture regarding the available IT services is also visible in the current state of Service Catalogues.

IT Infrastructure Library (ITIL) description to Service Catalogue is “A database or structured Document with information about all Live IT Services, including those available for Deployment.” (The Stationery Office 2007b: 309)

Some of the IT departments have produced Service Catalogues for their own IT services. There are more than 20 different smaller Service Catalogues within the IT departments ranging everything between Excel documents to Sharepoint sites, but there’s no one common Service Catalogue. To improve the situation, a large internal project started in the company, and one of the project deliverables is to evaluate a common Service Catalogue tool for the whole IT organization. Services in the Service Catalogue must be monitored somehow, and this is what the thesis will concentrate on. The thesis will not follow the Service Catalogue tool evaluation process but will create a best practice process for monitoring the Service Catalogue services. Telia Company is trying to move from system-oriented perspective to service-oriented perspective, and one important aspect of this is the ability to measure performance of the IT services instead just measuring performance of a single system. The research question for the thesis is:

How and with what monitoring tool Telia Company should measure its Service Catalogue services?

1.3 Scope and Outcome

The objective and main focus of this thesis will be to explore the possibility of monitoring IT services in the Service Catalogue. How services can be monitored in the best way, what monitoring tool should be used, how the performance measurements are created in practice, how results are reported and what should be done if the services are not working in the way they should.

The outcome of the thesis is to develop functional performance measurements for couple of the most business-critical Service Catalogue services. To achieve this outcome, current state analysis was made to investigate the performance monitoring tools that Telia Company has. The tools were evaluated to find out which of them is the most suitable tool for service performance monitoring and based on the evaluation the tool was selected. After the tool was selected, the measurements, alerts and reports were planned in co-operation with IT system managers and Business Unit representatives, keeping in mind the possibilities and limitations of the selected performance monitoring tool. After the measurement specs were carefully planned, the measurements were created and implemented using the selected tool.

This thesis has been divided into five chapters. The first chapter introduces the research problem, scope and outcome of the thesis and gives background information of the case company. The second chapter explains what is ITIL framework that is being used in the case company. The third chapter analyses the current situation in the case company, evaluates the different performance monitoring tools and describes the tool selection process. The fourth chapter is a practical part where the business-critical services are defined and measurements, alerts and reports are created with the selected performance monitoring tool. The fifth chapter is for conclusions and recommendations. What was learned during the study and how Telia Company should continue with the service monitoring area.

2 ITIL Framework

This chapter introduces the IT Infrastructure Library (ITIL) framework. It first gives a general overview on ITIL and its different modules and then describes in more detail the Service Design module's Service Catalogue Management.

During the 1980s in the United Kingdom computerization program spread rapidly but there were no standard practices how to set up the IT infrastructure. For that reason, both public and private sector parties had to create their own frameworks to follow, which created complexity and increased the cost and effort. (Wolken 2015) To find efficiency, the government launched an initiative to document how the most successful organizations do service management. (The Stationery Office 2007a: 15) This lead to publication of first release of IT Infrastructure Library books between 1989 and 1996 by the UK Central Computer and Telecommunications Agency. (Wolken 2015) The library quickly grew to over 40 volumes and got a lot of interest from the UK IT service community. IT Information Management Forum (ITIMF) was created for ITIL users in the early 1990s so that they can exchange ideas and learn from the other users. ITIMF was later renamed to IT Service Management Forum (itSMF) and has currently members around the world as ITIL is getting more and more popular. (The Stationery Office 2007a: 15)
The next version of ITIL, ITIL v2, was released in 2004. (The Stationery Office 2007a: 15) The aim was to make ITIL more approachable for its users. The vast library was structured to nine logically arranged sets where the related elements were combined. (Wolken 2015) ITIL v2 focused on narrowing the gap between technology and business units and the processes that were required to deliver the services to the business customer. (The Stationery Office 2007a: 15)

Three years later, in 2007, was turn for the next ITIL release, ITIL v3. Again, the number of volumes was decreased from the previous version. ITIL v3 contains 26 processes in five books and it's built around the concept of service lifecycle structure. The current version of ITIL was released in 2011. It's not a new version but an update to existing ITIL v3 containing five books: ITIL Service Strategy, ITIL Service Design, ITIL Service Transition, ITIL Service Operation and ITIL Continual Service Improvement. (Wolken 2015)

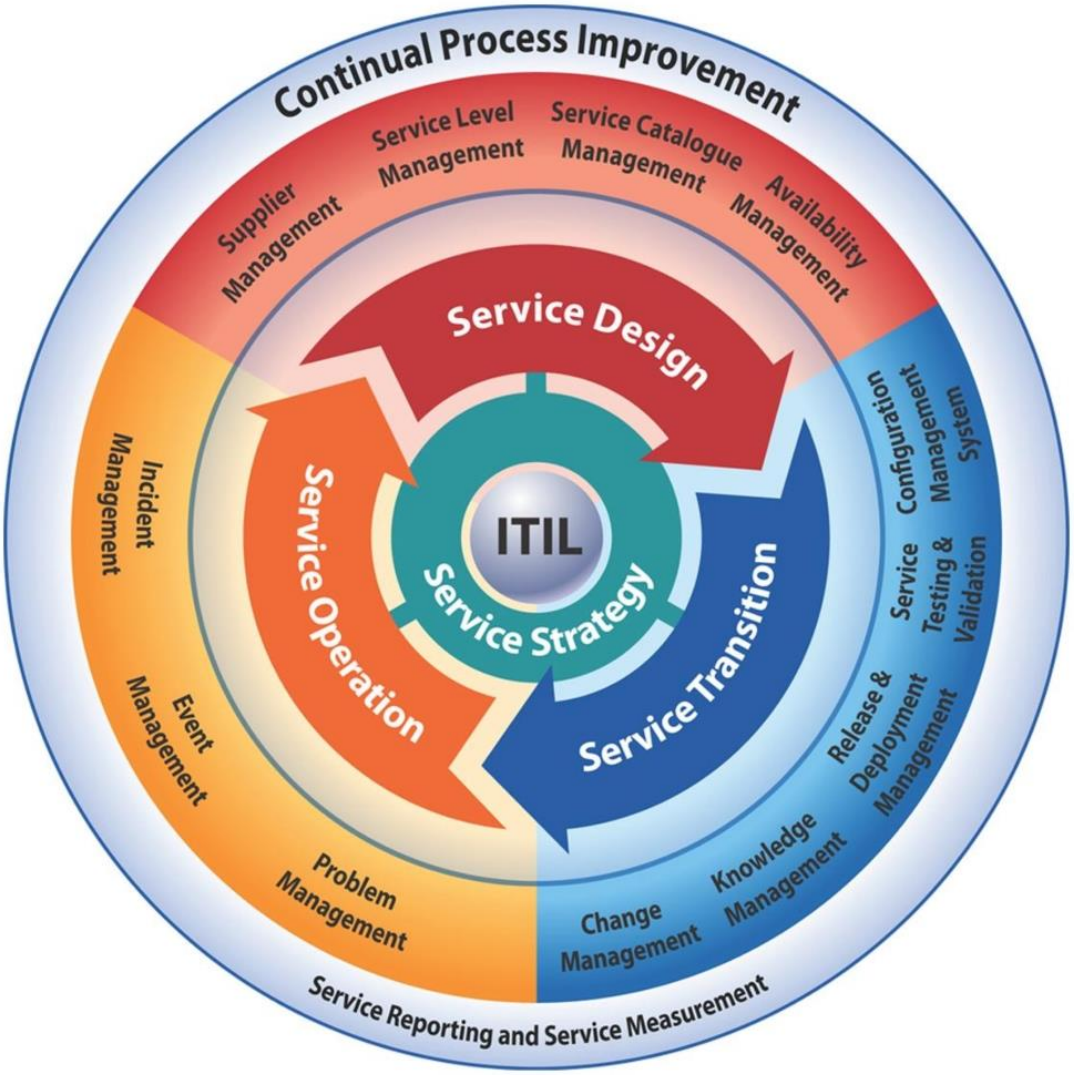


Figure 1. ITIL Service Lifecycle. (Milldesk 2013)

Figure 1 shows the five ITIL modules, some of the processes and how they fit into the ITIL Service Lifecycle.

2.1 ITIL Modules

This section describes the main five ITIL modules.

Service Strategy

Service Strategy is at the core of the ITIL Service Lifecycle. It includes guidelines on how an IT service organization should set and reach its objectives. There are several topics

covered in the Service Strategy, such as Organizational Development and Strategic Risks, Financial Management and Demand Management. (The Stationery Office 2007a: 23) Service Strategy helps organizations to implement the service management as a strategic asset and to identify and prioritize opportunities. (Ucisa 2010) The five processes in Service Strategy are: Strategy Management for IT Services, Service Portfolio Management, Financial Management for IT Services, Demand Management and Business Relationship Management. (Certguidance 2018a)

Service Design

Service Design is the second stage in the ITIL Service Lifecycle. It helps the organizations in designing and developing the IT services and IT service management practices. Plans that were created in Service Strategy stage are turned into a blueprint for delivering the business objectives in Service Design. (The Stationery Office 2007a: 23) Service Design scope is not limited only to designing new services but includes changes and improvements to existing services as well. Service Design contains eight processes: Design Coordination, Service Catalogue Management, Service Level Management, Capacity Management, Availability Management, IT Service Continuity Management, Information Security Management and Supplier Management. (Certguidance 2018b)

Service Transition

Service Transaction is the third stage in the ITIL Service Lifecycle. It gives best practices on how to deliver services into the production environment. The services can be new services or existing ones that have been modified. Besides developing the organization's capabilities for deploying services into operation Service Transition gives guidance on how the changes to services are implemented in coordinated way and with minimal effect to the existing services. There are seven processes in Service Transition module: Transition Planning and Support (Project Management), Change Management, Change Evaluation, Service Asset and Configuration Management, Release and Deployment Management, Service Validation and Testing and Knowledge Management. (Certguidance 2018c)

Service Operation

Service Operation is the fourth stage in the ITIL Service Lifecycle. It gives guidance on managing the daily operation tasks of the service, such as resolving incidents and user account management. After Service Transition has delivered a new or changed service into production, Service Operation will take control of it. Service Operation is responsible

of keeping the service running smoothly and keeping the unplanned downtime as short as possible by utilizing efficient Incident and Problem management. User requests and questions are handled by Service Operation's Service Desk function. There are five processes in Service Operation: Event Management, Incident Management, Request Fulfillment, Problem Management and Access Management. (Certguidance 2018d)

Continual Service Improvement

Continual Service Improvement is the fifth stage in the ITIL Service Lifecycle. Continual Service Improvement aims to continually improve the quality of the IT services and it provides feedback to the other four modules in the Service Lifecycle. The feedback is based on the Plan-Do-Check-Act (PDCA) model. (Certguidance 2018e) PDCA model was developed by Dr William Edwards Deming, hence the model is sometimes called Deming Wheel or Deming Cycle. The model is used for continually improving processes and services. (Mindtools 2018)

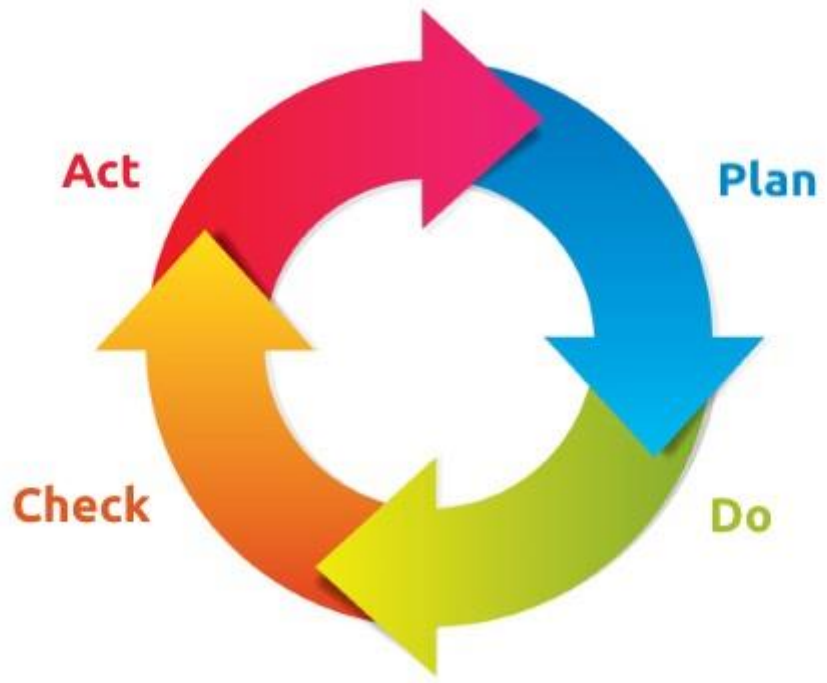


Figure 2. PDCA Model. (Revolution, 2014)

Figure 2 shows the four steps of the PDCA model. First, a problem or opportunity is identified and analysed in the Plan step. Next the solution is tested in the Do step. Then the solution results are studied in the Check step. Finally, if the solution was successful it's implemented in the Act step. The cycle always starts with the Plan step and Act step

closes the cycle. Do and Check phases can have multiple iterations while different possible solutions are tested. (Mindtools 2018) There are four processes in Continual Service Improvement: Service Review, Process Evaluation, Definition of Continual Service Improvement Initiatives and Monitoring of Continual Service Improvement Initiatives. (Certguidance 2018e)

Table 1. ITIL Roles and Responsibilities. (Certguidance 2018f)

Service Strategy	Service Design	Service Transition	Service Operation	Continual Service Improvement
IT Steering Group	Service Design Manager	Project Manager	IT Operations Manager	Continual Service Improvement Manager
Service Strategy Manager	Service Catalogue Manager	Change Manager	IT Operator	Process Architect
Service Portfolio Manager	Service Level Manager	Change Advisory Board	1st Level Support	Process Owner
Financial Manager	Service Owner	Emergency Change Advisory Board	2nd Level Support	
Demand Manager	Capacity Manager	Configuration Manager	3rd Level Support	
Business Relation-ship Manager	Availability Manager	Release Manager	Incident Manager	
Strategy Analyst	IT Service Continuity Manager	Test Manager	Major Incident Team	
Finance Analyst	Information Security Manager	Knowledge Manager	Service Request Fulfillment Group	
Demand Analyst	Supplier Manager	Application Developer	Problem Manager	
	Risk Manager		Access Manager	
	Compliance Manager		Service Desk Manager	
	Enterprise Architect		Technical Analyst	
			Applications Analyst	

Table 1 shows the different roles and responsibilities for each of the five modules in the ITIL Service Lifecycle. The RACI (Responsible – Accountable – Consulted – Informed) model is often used in the organizations to define the accountability and responsibility of each role. (Certguidance 2018f)

2.2 Service Catalogue Management

As mentioned in chapter one, Telia Company has multiple Service Catalogues in different IT units which is against the ITL best practices. The purpose of the Service Catalogue Management is to produce and maintain a single Service Catalogue for all services that are running in the production environment, and for services that are prepared to be run in the production environment. The Service Catalogue needs to be available for everyone who needs to access it. (The Stationery Office 2007b: 60) The Service Catalogue is a part of the Service Portfolio. Besides the Service Catalogue, the Service Portfolio includes a Service Pipeline which contains the services that will be implemented into production later, and Retired Services which contains the past services that have become obsolete. (Global knowledge 2018)

There are two kinds of Service Catalogues: Business Service Catalogue and Technical Service Catalogue as shown in Figure 3.

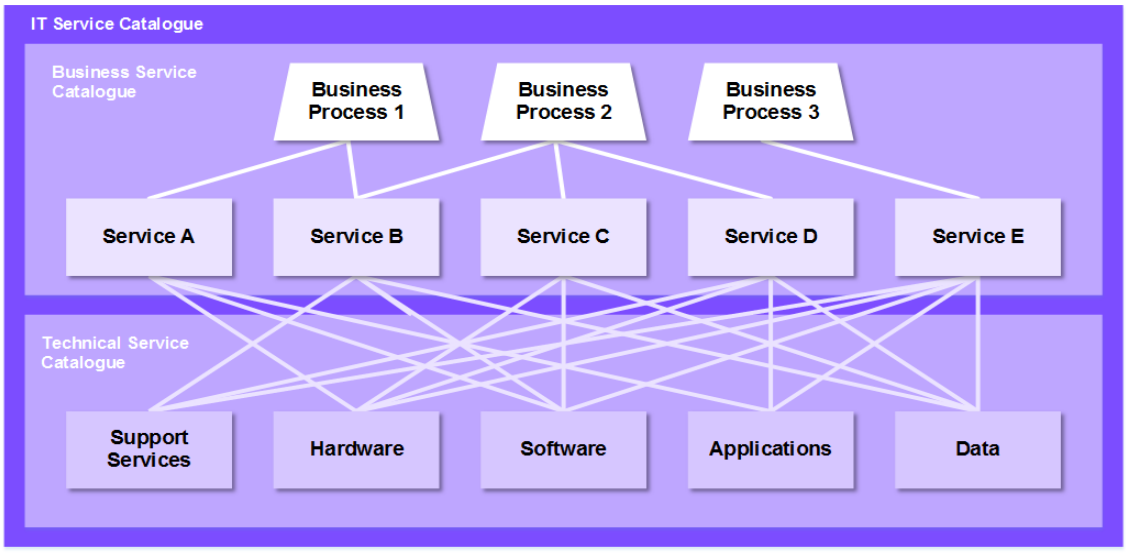


Figure 3. The Business Service Catalogue and the Technical Service Catalogue. (Radek Klein 2015)

Figure 3 shows the relation between the Business Service Catalogue and the Technical Service Catalogue. (Radek Klein 2015) The Business Service Catalogue contains all the customer-facing IT services and the relationships to the business processes. (MyITstudy 2013) The Business Units use this Service Catalogue, so it should be written using non-technical language whenever possible. (Radek Klein 2015) The Technical Service Catalogue is meant for the IT Organization. It has technical details of the IT services and relationships between the supporting services. (Certguidance 2018g) The main KPI's of the Service Catalogue are the percentage of the services recorded to the Service Catalogue of all the services, and number of deviations between the Service Catalogue information compared to real-world situation. (The Stationery Office 2007b: 64)

3 Current state analysis

This chapter analysis the current status of IT service performance monitoring at Telia Company, evaluates the different monitoring tools Telia Company has and describes the tool selection process.

Telia Company is well capable of monitoring the performance of its infrastructure and applications. Two interviews were conducted which verified this. The first meeting was with the server operations team. The conclusion of the meeting was that the servers and other network components have been monitored “forever”, meaning as long as anyone remembers. An infrastructure monitoring is a vital part of server operations team daily tasks and this process has been finetuned over the years. (Interview with Server Operations team, 2017). The second meeting was with the application team. The key finding of the meeting was that the applications/systems have been monitored roughly from 2006 but the services are not monitored. During 2006 the first application monitors were introduced to the sonera.fi portal. They included sonera.fi front page measurement, sonera.fi Omat Sivut Login measurement and webmail measurement. (Interview with Application team, 2017). The sonera.fi portal was the portal for Telia Company’s Finnish customers when the company was still called TeliaSonera. After the name change in March 2017 the portal has been called telia.fi. Omat Sivut is the restricted part of the sonera.fi portal for Telia Company’s customers. Omat Sivut contains different services such as bill archive and possibility to upgrade the broadband subscription.

What Telia Company is lacking is the ability to monitor performance of its services end-to-end. An interview with business unit representatives pointed out that this is highly needed. Like mentioned in the previous chapter, it’s not enough anymore to know how an individual system is working but instead business is interested to know how the critical business processes and services are working.

Based on the above-mentioned meetings following requirements were set for the service monitoring tool:

- Ability to monitor critical business processes end-to-end throughout different systems
- Ability to send alerts via email in case of an incident

- Ability to send Key Performance Indicator (KPI) reports automatically to selected stakeholders

3.1 Tool Evaluation

The management of Telia Company had decided that there's no budget to purchase a new tool for Service Catalog monitoring and there's no time to implement a new free source software, so a tool already in-house must be used. That made the selection process much simpler since there aren't so many different monitoring tools available within Telia Company. In the following sections these tools are introduced.

3.1.1 Nagios

Nagios is an open source software by Nagios Enterprises, founded in 2007 in Minnesota. Nagios monitors networks, infrastructure and systems. (Nagios.com. 2017). Nagios is divided into five different modules:

1. Nagios Log Server is an application for analysing and searching log data.
2. Nagios Network Analyser is a solution for analysing network data.
3. Nagios Fusion is a tool for visualizing health of the organization's network.
4. Nagios Core is the "base" component for Nagios. It does the monitoring, alerting, reporting, even handling etc.
5. Nagios XI is built on top of the Nagios Core to meet today's demands for infrastructure monitoring. It supports hundreds of third-party addons. (Nagios.com, 2017)

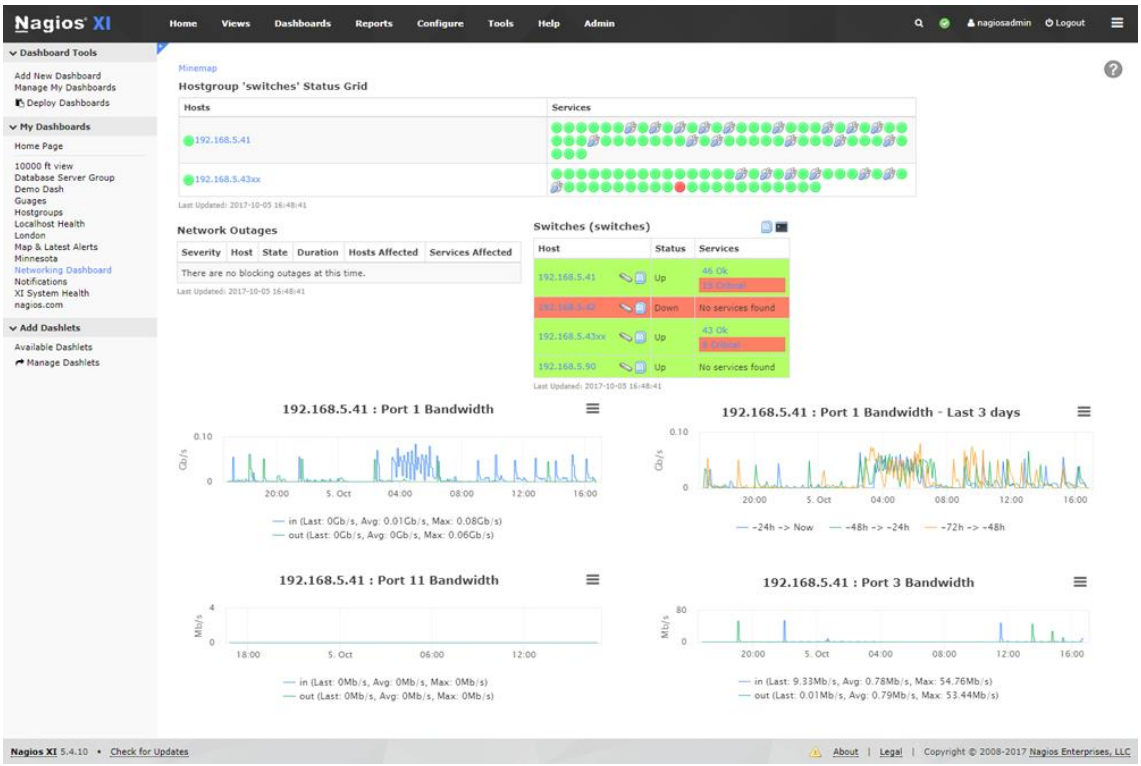


Figure 1. Nagios XI dashboard (Nagios.com, 2017)

Figure 1 shows an example of Nagios XI dashboard. Although it's possible to monitor applications with Nagios, it's more of an infrastructure monitoring tool and it's not very competent tool for service monitoring.

3.1.2 Splunk

Splunk Inc was founded in 2003 by Michael Bauam, Rob Das and Erik Swan. The company is based in San Francisco but have operations in multiple countries around the world. (Splunk.com. 2017). Splunk Inc has six different tools, but Telia Company has only one of them, Splunk Enterprise. Splunk Enterprise is a tool for searching, analyzing and monitoring machine-generated big data. (Data Center Knowledge 2017). TechTarget defines machine-generated data or machine data as follows: "Machine data is digital information created by the activity of computers, mobile phones, embedded systems and other networked devices." (TechTarget 2017) Splunk is very capable tool for monitoring machine data but it lacks the ability to monitor IT services and business processes end-to-end.

3.1.3 HP BSM

Business Service Management (BSM) is a tool by Hewlett Packard Enterprise (HPE). Originally the tool was developed by Mercury Interactive and was called Topaz before HP acquired the company in 2006. HP first named the tool to Business Availability Center (BAC). Later they renamed it to BSM and yet later renamed it again to Application Performance Management (APM). Telia Company is using rather old version of the software and that's the reason why it will be referred as BSM, not APM.

BSM consist of three main modules:

1. HPE Sitescope is an agentless monitoring tool for performance and availability monitoring of IT infrastructures, for example, servers, operating systems, network devices, network services, applications, and application components. (HPE 2016: 19)

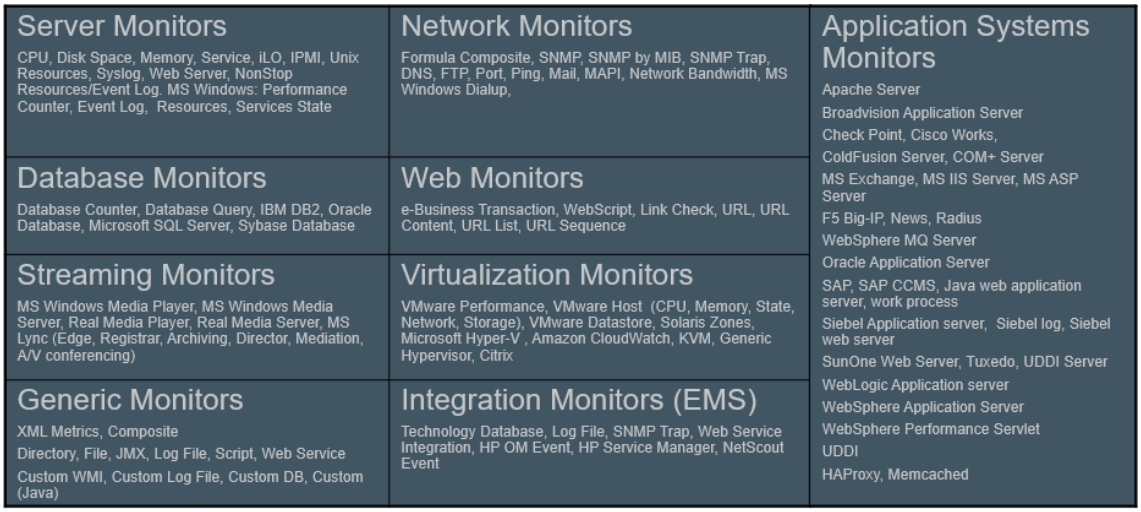


Figure 2. Sitescope protocols (HPE 2016:21)

Figure 2 shows the wide range of different protocols SiteScope supports. (HPE 2016: 21)

2. HPE Real User Monitoring (RUM) is a passive monitoring tool that captures what the real users do in the system/service. Passive monitoring means that user traffic is captured and analysed. Upside of passive monitoring is that it monitors a real user traffic and it doesn't generate extra traffic on the network, but it requires traffic in the system or it cannot collect any data. This can be a problem during

night-time for example. Also, there might be security concerns since passive monitoring captures all the packets in the network. (Cotrell 2001).

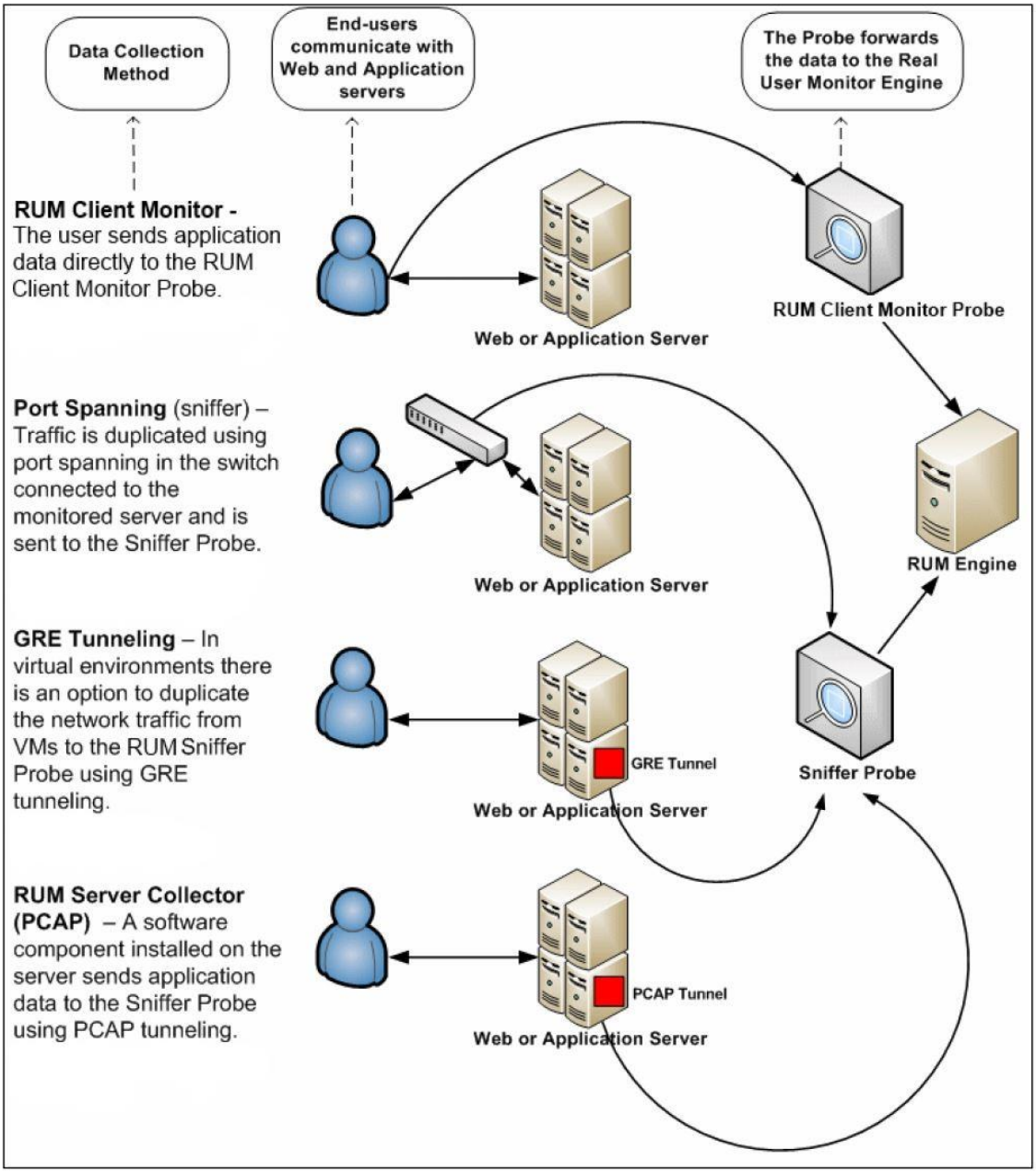


Figure 3. RUM probes data collection methods and data flow (HP 2015:28)

Figure 3 shows how HPE RUM is collecting data and the two different probes used. (HP 2015: 28). The Sniffer Probe is connected to a switch on the Switched Port Analyzer (SPAN) port, sometimes called a mirror port depending on the switch manufacturer. When end-user traffic goes through the switch all the traffic will be mirrored to the Sniffer Probe which will send the data to RUM Engine. (HP 2015:29).

The Client Monitor Probe collects end-user user experience data. Contrary to Sniffer Probe that collects data by mirroring switch traffic, the Client Monitor Probe gets data directly from the end-user's internet browser or mobile device. (HP 2015:34). A JavaScript snippet is installed to the monitored Hypertext Markup Language (HTML) page. The snippet collects performance data on the end-user's machine and sends it to the Client Monitor Probe. The probe forwards the data to the RUM Engine. (HP 2015:35).

3. HPE Business Process Monitor (BPM)

   HPE BPM is an active monitoring tool. Active, sometimes called synthetic, monitoring uses scripts that emulate the actions what the users would do in the system. Active monitoring enables proper 24/7 monitoring since it doesn't require users in the system in order to collect data, therefore being ideal solution for Service Level Agreement (SLA) monitoring. Active monitoring can make the incident management more proactive compared to passive monitoring. When an incident happens in the system, passive monitoring solutions require number (depending on the alert threshold) of real users to face the issue before an alert is triggered. This can take a long time when traffic in the system is low. Active monitoring solutions run the scripts continuously at regular predefined intervals, for example every five minutes, and the alert sending delay after an incident can be controlled by setting the alert threshold based on the criticality of the system. This may lead to faster reaction to the incident and can reduce the Mean Time To Repair (MTTR).

   The monitoring scripts are run from Windows/Linux servers with BPM software installed. The servers are called BPM probes.

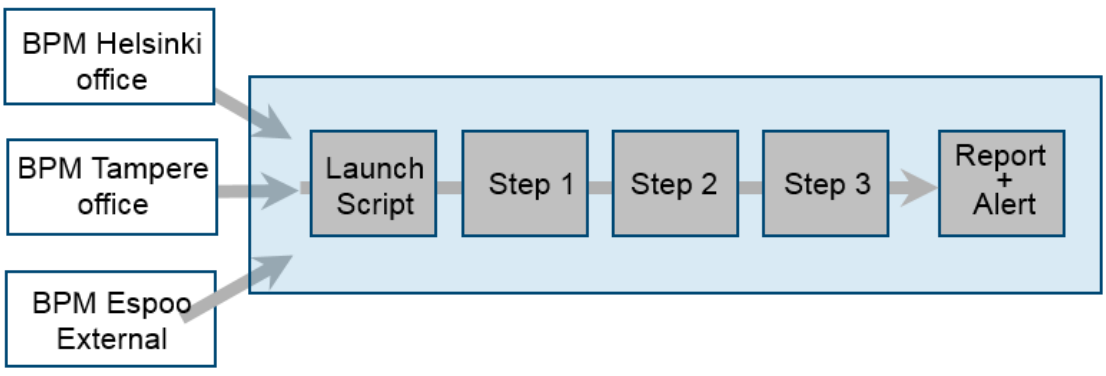


Figure 3. BPM example (HP 2009:8)

Figure 3 shows an example of the BPM probe placement. If the company has offices at multiple locations, a probe or probes can be placed in all office networks to simulate end-user experience from those networks. This is beneficial when monitoring company's internal systems. BPM probes can also be placed in the external network to simulate end-users using company's services for its customers.

Downside of active monitoring is that it doesn't monitor what real users are doing in the system/service, but instead it monitors predefined actions what the users are assumed to do in the system. Also, active monitoring generates traffic to the network and load to the monitored systems. The amounts are not very significant though.

3.2 Tool Selection

A meeting was held with different stakeholders from IT units and Business units to analyse the monitoring tools available and make the selection. Since Splunk is not capable of monitoring IT services it wasn't considered as an option. Nagios is capable of application monitoring, but it's more of an infrastructure monitoring tool and for that reason it was dropped out from the selection process at early stage.

When analyzing different BSM modules, SiteScope was dropped out for the same reason as Nagios. It's more of an infrastructure monitoring tool and not suitable for this kind of purpose. The stakeholders rated both RUM and BPM as potential candidates. The tools work with different principals and both have good features but also some downsides. It's possible to monitor business-critical services with both tools, but what was in favor to BPM was the fact that it provides constant monitoring data 24/7 despite whether or not there are users in the service. The stakeholders put much value on that in this specific use case and the selection was done. BPM inside BSM is the monitoring solution that will be used.

4 Service Measurement Creation

This chapter describes how the monitored services were selected and follows the measurement creation process followed by an example of a BPM script. It also explains the alert configuring and setting up the reports.

Now that the tool was selected the next step was to define which services should be measured. This was done with the help of the Business Unit representatives. A list of the most business-critical services was received from the business and four services were selected from the list where the service measurement creation would begin. The selected services were: Purchasing Mobile Subscription via Avaaja Mobile, Purchasing Yritysinternet via B2B eShop, Creating a Repayment Contract via Omat Sivut and Valokuitu Activation.

Telia Company has multiple BPM probes in Finland and Sweden. The selected business processes are Finnish services and are using Finnish portals, so BPM probes from Finland were selected to do the monitoring. The BPM probes Telia Company currently have are virtual servers running Windows 2012 R2 operating system. The probes are in data centers in different locations in Finland and Sweden. Telia Company used to have BPM probes also behind ADSL connections from different service providers, but the broadband connection was too unreliable. The subscriptions had occasional downtimes, not often but even a short downtime was enough to ruin the availability figures for the measurements with high SLA target level.

HPE BPM scripts are recorded with Virtual User Generator (VuGen) tool. The software is part of HPE Loadrunner tool but can be installed separately without other parts of Loadrunner.

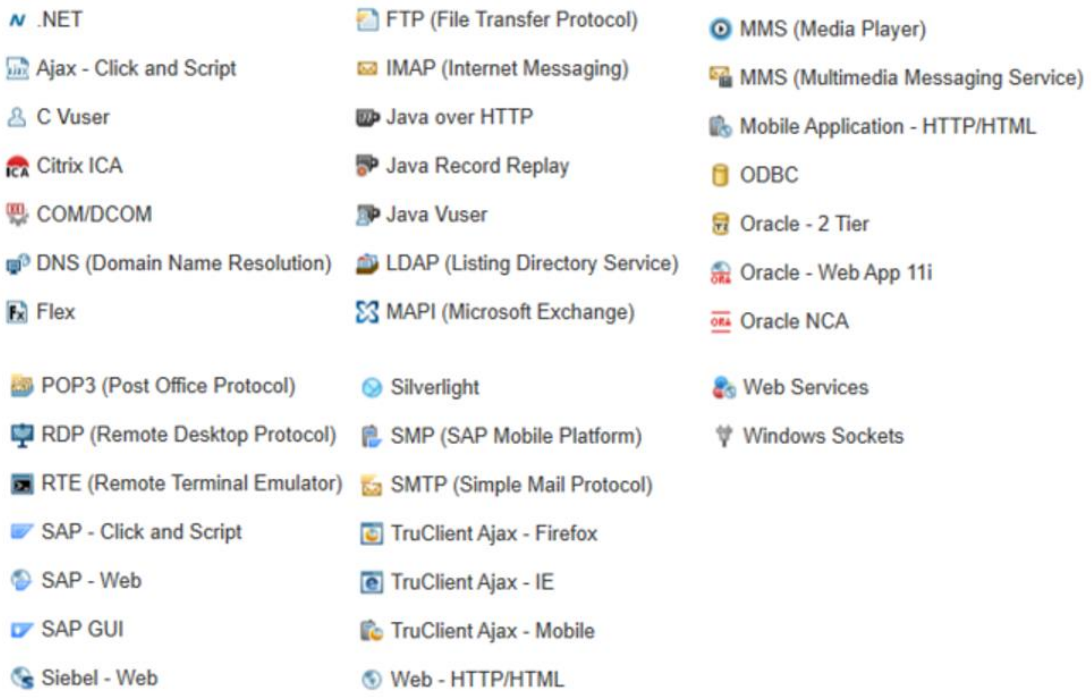


Figure 4. VuGen supported protocols (HPE 2016:17)

Figure 4 shows the wide spectrum of protocols that can be used for recording a VuGen script. (HPE 2016: 17). BPM can monitor traditional Web applications, but also non-Web environments such as SAP, Oracle and Citrix. The selected business processes navigate through web portals, so a protocol accordingly must be selected.

VuGen offers two protocols for recording web applications, Web - HTTP/HTML and TruClient - Ajax. They both work in similar fashion. When recording is started, an Internet browser (either Internet Explorer or Mozilla Firefox) is launched. The person who records the script will navigate through desired measurement “path”, meaning the steps the measurement should do, with a browser and VuGen will record the script in the background. Web - HTTP/HTML protocol is older of the two and it’s best suitable for older web applications. TruClient - Ajax is relatively new protocol in VuGen and it’s designed for modern web applications. Since the selected business processes are done from portals that use modern web technologies, TruClient - Ajax protocol must be used.

4.1 Purchasing Mobile Subscription via Avaaja Mobile

Purchasing Mobile Subscription via Avaaja Mobile is one of the critical business processes that should be monitored. It goes through the Dealeri portal which is a portal for the dealers working in Telia shops across Finland. When a customer purchases something from a Telia Shop, such as broadband subscription, mobile subscription, phone or other device, a dealer will enter the order to the Dealeri portal where it will be forwarded to Telia Company's backend systems. This particular business process is one of the core business processes for Telia Company. It simulates a situation where a customer comes to a Telia shop and wants to buy a new mobile subscription.

A meeting was called with the system manager of Dealeri portal and business representative of that business area to agree the specifications for the measurement. It was agreed that the measurement should login to Dealeri portal and then follow the same "path" how the actual dealer would navigate in the system when ordering a mobile subscription for the customer. The detailed measurement steps were planned and while planning, two obstacles were identified that made the script recording impossible.

Firstly, after logging in to Dealeri portal with a username (mobile number) and a password the dealer will get a Short Message Service (SMS) message with a pin number he/she needs to type in to the page. BPM script cannot read SMS messages from a phone which was a clear obstacle for creating the measurement. The solution was invented by the system manager. It was possible to hard code one specific test number to Dealeri portal. When login is done with that number, the pin code would always be the same and it never changes. An action point was given to the system manager to configure the change to the system.

Second more minor obstacle was that in the Dealeri system a person is searched by a social security number. However, there weren't any test social security numbers available in the system that could be used for the monitoring purpose and for security reason it's not feasible to use someone's own social security number, because the number can be seen in the measurement alerts that is sent to a wide audience. There are test companies with test company codes in the system, however, so it was decided to simulate a corporate customer mobile subscription purchase instead of a consumer customer. A new subscription type was selected what the measurement will use because the mobile subscription offering is different for corporate and consumer customers.

After the test mobile number with a static pin code was configured to the Dealeri portal, the script was recorded with VuGen's Truclient Ajax - Firefox protocol using the steps defined earlier. First, the measurement logged in to the portal using the test number and a static pin code, then navigated to the page where a new mobile subscription is ordered. The next step was to search the test company with the dummy company code configured to the system. After that a mobile subscription type Telia Sopiva Pro and a package Sopiva Pro N were selected. Because this business process simulates ordering new mobile subscription, in a real-life situation the dealer would give a new sim card to the customer and type the sim card number to the Dealeri portal. There was a test sim card number in the system that could be used for this purpose. The next thing was to follow the defined measurement steps to the end, the last step being logout from the Dealeri portal.

4.2 Purchasing Yritysinternet via B2B eShop

Purchasing Yritysinternet via B2B eShop simulates a business process where Telia's end customer purchase an internet subscription called Yritysinternet from Telia's Business2Business (B2B) web shop. It was prioritized as one of the first service monitors in order to get visibility on how the purchase flow is working from the eShop. The measurement starts from Telia Company's Yrityskauppa page where the Yritysinternet product is selected. The next step is to do enquiry of availability. A post number and street address are typed, and the system will check what broadband speed options are available to that address. Availability enquiry system is a crucial component in the order flow. The same system is used in both consumer and business eShops, and if the system is broken no new broadband subscriptions can be ordered from the self-service channels which will cause a huge loss of revenue. Cruciality of the Availability enquiry system is the reason why Business Units wanted to have active monitoring to the Purchasing Yritysinternet via B2B eShop business process, so the incidents in the system are detected proactively as soon as they happen.

It was decided with the stakeholders that a post number 00100 and address Malminkatu 1 were used in the measurement script. From the Availability enquiry system point of view it doesn't matter which address is used. If the system is able to return results for one address it can return them for all addresses. After the availability has been checked

for Malminkatu 1, the portal will return two different speed options. For that address it's possible to select either 24/2 Mbit/s or 5/5 Mbit/s broadband subscription. The script will pick the 24/2 Mbit/s product to shopping basket and proceed with the order flow.

After the order flow has been followed until the point where shopping basket is viewed and "Checkout" button is clicked the measurement will stop. The reason is that the next page after the shopping basket page is authentication page. The customer will be identified using Tupas authentication. Tupas authentication is a strong authentication method where the customer's bank authenticates the customer. One limitation of the BPM monitoring is that it cannot monitor through Tupas authentication. Tupas authentication uses user name, password and single-use passcode from a list of passcodes and it's not possible to use single-use passcodes with the monitoring script. Before with the old version of the eShop, the authentication page was at the very end of the order flow which would have made end-to-end monitoring possible. In the current version of eShop, the authentication is in the middle of the order flow so it's not possible to monitor the order flow truly end-to-end with the selected tool, but this was accepted by Business since the most critical parts of the order flow were being measured.

4.3 Creating a Repayment Contract via Omat Sivut

Creating a Repayment Contract via Omat Sivut is a service for Telia Company's consumer customers where the customer can do a repayment contract. Repayment contract allows one to move the due date of the invoice. Repayment contract is done in Bill Archive system, which is accessed from Omat Sivut portal. The starting point for this measurement is the login page for Omat Sivut in telia.fi portal. A test account was received from Omat Sivut system manager that could be used for the measurement purposes. After landing to the Omat Sivut login page the test credentials were used to login to Omat Sivut, and from that page "Invoices and Messages" page was opened. Invoices page shows the invoices generated for the customer. When hovering mouse over an invoice more options appear where one can mark the invoice as read, pay the invoice or move the due date of the invoice. The script will select the last option, and a page opens where the customer can do a repayment contract, in other words move the due date of the invoice. In this page the script will do a text check to verify that the repayment contract page has opened correctly. After that the script will logout from the service. The script

will not do the last step in the process and accept the repayment contract. This is because if the script makes the repayment contract no more repayment contracts can be made to the same invoice. That would cause the next script iteration to fail because the service would return an error message saying that the invoice already has a repayment contract and no additional repayment contracts can be created.

4.4 Valokuitu Activation

Valokuitu Activation is a service for people moving to an apartment that has Telia Company's fibre broadband connection but haven't activated their internet connection yet. When a person moves in to the apartment, connects his/her computer to the ethernet plug for the first time and opens a browser, he/she is automatically redirected to a page where he/she can activate the internet connection. In many cases the slower broadband connection is included in the maintenance charge of the property and the customer can choose between the slower free subscription and the paid faster subscription.

Before the customer has activated his/her internet connection the apartment is connected to a separate closed network with no access to internet. After the customer has done the activation the subscription will be connected to another network with internet access. Because the activation process is done in a closed network it can't be monitored with the existing BPM probes because they cannot access the activation URL from outside the network. Instead a new probe was placed inside the network. When the probe is inside the network it's possible to monitor the activation process, but the lack of internet connection in the network poses another problem. The probe can run the measurements but there's no way to send the results back to BSM system. This was solved by adding another Network Interface Card (NIC) to the probe. One of the cards was connected to the closed network and the other to the internet. Then a permanent static IP route was created to the probe which defined that all the traffic going to the activation URL was directed to the NIC that was connected to the closed network. All the other traffic was directed to the NIC connected to the internet. That way it was possible to monitor the service and send the results back to BSM. After the hardware was properly set up and configured, the measurement creation was straightforward.

4.5 BPM measurement example

The performance measurement data of Telia Company's services is confidential so instead of showing the data and doing analysis of one of the above services, an example script was created for thesis purposes. Metropolia's pages were used for the following example and analysis.

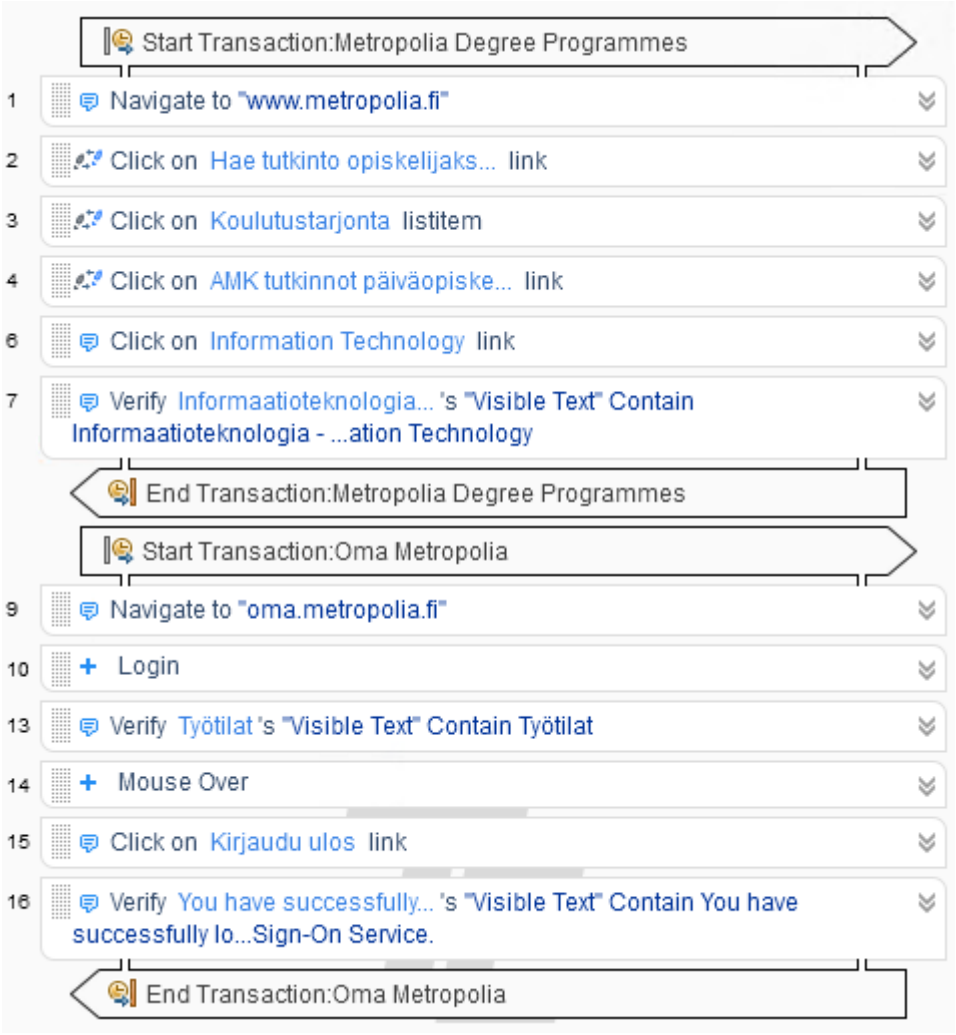


Figure 5. Vugen script example

Figure 5 shows an example of TruClient – Ajax protocol VuGen script. The script is divided to two different transactions. The first transaction, called Metropolia Degree Programmes, starts with Metropolia front page and navigates through Bachelor's Degrees page to the Information Technology page where a Verify step is done. Verify step is a text check where the script searches for a predefined text string from the page or the page source. If the step condition is set to "Contain" it means that if the text string is

found the script will move on to the next step. If the text string is not found the script run will have a “Failed” status. It’s also possible to set the condition to “Not contain”, where the script will fail if a specific word is found on the page. This can be useful when one wants to check that the page is not giving any specific error message.
The second transaction, called “Oma Metropolia”, tests that the login process to Oma Metropolia page is working. It starts from Oma Metropolia login page oma.metropolia.fi, logs in with username and password and does a text check which verifies that the “Työtilat” section of the page has loaded properly. After that the script logs out from the page and verifies that the logout was successful.

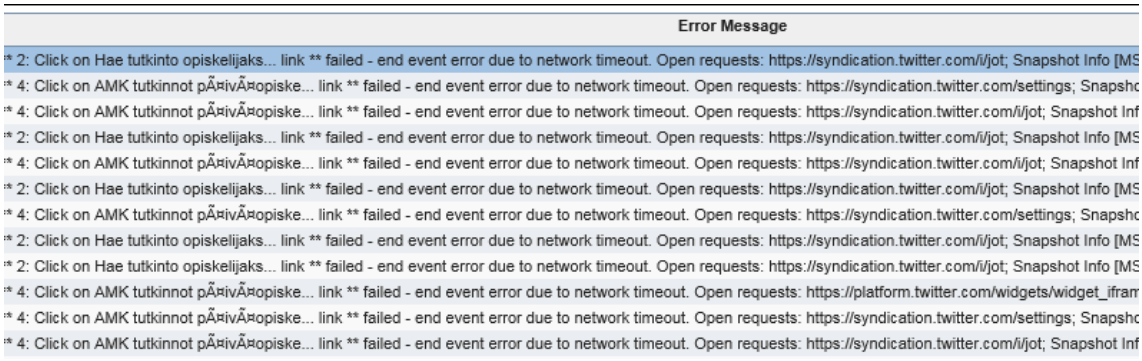
The example script was uploaded to BSM and left running for a week. The results show that there are some issues in the Metropolia pages.

	Availability							
BT Name	(%)	1/1	1/2	1/3	1/4	1/5	1/6	1/7
-	94.49	95.17	91.94	90.93	92.88	96.53	97.35	96.53
Metropolia Degree Programmes	93.90	93.75	93.23	94.79	89.58	94.79	96.35	94.79
Oma Metropolia	95.11	96.69	90.56	86.89	96.53	98.36	98.38	98.36

Figure 6. Availability of Metropolia pages

Figure 6 shows the availability for the example script for one week. The first column, called Business Transaction (BT) Name, shows the two transactions and the row marked “-“ calculates the average of the of the rows. The second column (%) calculates the averages of the columns of the selected time period, in this case one week. The next columns are daily averages for the week. As can been seen from the picture, the weekly average for the transaction Metropolia Degree Programmes is 93,90% and Oma Metropolia 95,11%. The weekly average availability for the two is 94,49%.

It’s possible to analyse what has caused the reduction in availability by checking the error log.



Error Message
* 2: Click on Hae tutkinto opiskelijaks... link ** failed - end event error due to network timeout. Open requests: https://syndication.twitter.com/i/jot; Snapshot Info [MS
* 4: Click on AMK tutkinnot pÃ¤ivÃ¤opiske... link ** failed - end event error due to network timeout. Open requests: https://syndication.twitter.com/settings; Snapsho
* 4: Click on AMK tutkinnot pÃ¤ivÃ¤opiske... link ** failed - end event error due to network timeout. Open requests: https://syndication.twitter.com/i/jot; Snapshot Inf
* 2: Click on Hae tutkinto opiskelijaks... link ** failed - end event error due to network timeout. Open requests: https://syndication.twitter.com/i/jot; Snapshot Info [MS
* 4: Click on AMK tutkinnot pÃ¤ivÃ¤opiske... link ** failed - end event error due to network timeout. Open requests: https://syndication.twitter.com/i/jot; Snapshot Inf
* 2: Click on Hae tutkinto opiskelijaks... link ** failed - end event error due to network timeout. Open requests: https://syndication.twitter.com/i/jot; Snapshot Info [MS
* 4: Click on AMK tutkinnot pÃ¤ivÃ¤opiske... link ** failed - end event error due to network timeout. Open requests: https://syndication.twitter.com/settings; Snapsho
* 2: Click on Hae tutkinto opiskelijaks... link ** failed - end event error due to network timeout. Open requests: https://syndication.twitter.com/i/jot; Snapshot Info [MS
* 2: Click on Hae tutkinto opiskelijaks... link ** failed - end event error due to network timeout. Open requests: https://syndication.twitter.com/i/jot; Snapshot Info [MS
* 4: Click on AMK tutkinnot pÃ¤ivÃ¤opiske... link ** failed - end event error due to network timeout. Open requests: https://platform.twitter.com/widgets/widget_ifram
* 4: Click on AMK tutkinnot pÃ¤ivÃ¤opiske... link ** failed - end event error due to network timeout. Open requests: https://syndication.twitter.com/settings; Snapsho
* 4: Click on AMK tutkinnot pÃ¤ivÃ¤opiske... link ** failed - end event error due to network timeout. Open requests: https://syndication.twitter.com/i/jot; Snapshot Inf

Figure 7. Metropolia script error log

Figure 7 shows small part of the error log generated by the example script. One can see from the log that there's a Twitter component in the page that is not functioning properly and causing network timeout errors. However, the issue is most likely not visible to the end user using Metropolia pages and therefore not a serious one.

4.6 Setting up the alerts

One important part of monitoring is alerting. When the availability has decreased, or the response time has increased beyond normal level, an alert must be sent so that the situation can be verified and corrected if necessary. By default, alerts from BSM can be sent via email, SMS or Simple Network Management Protocol (SNMP) traps. There's also a built integration between BSM and the ticketing system used in Telia Company. When the alert conditions have been met, an incident ticket is created automatically to the ticketing system from BSM alert.

In the meetings with the stakeholders where the measurement specs were decided, also the alert configurations were agreed such as: To whom should the email alerts be sent and how often? Is incident ticket required to the ticketing tool and to which group should the ticket be assigned to?

4.6.1 Availability alerts

Availability alert means an alert that is sent when enough measurements have failed so that the alert trigger condition has been met. The experience has shown that it's not wise to send an alert from every failed measurement. Sometimes there can be a very short

network glitch happening right at the same time when a script is running. That will cause the measurement to fail when in reality the system/service is working fine. Creating false positive alerts must be avoided since sending an alert starts the incident process in the maintenance organizations. Also, sending false positive alerts reduces the credibility of the monitoring system in a long run. To prevent false positive alerts, a “2/5” or “3/5” alert trigger rule is implemented depending on the system/service criticality. 2/5 rule means that BSM checks five sequential measurements, and if any two of the five measurement fails the alert will be sent. Downside of the 2/5 or 3/5 rule is that when a real incident happens it takes longer for the alert to be sent out which delays the start of the incident process, which in turn increases the Mean Time To Repair (MTTR). In practice the delay is only some minutes because the measurement interval is so frequent with critical systems/services.

4.6.2 Response time alerts

Response time alert means an alert that is sent when the response time of the measurement has increased above the predetermined threshold. Response time is calculated separately for every transaction.

	Performance							
BT Name	Response Time (sec)	1/1	1/2	1/3	1/4	1/5	1/6	1/7
-	26.28	26.53	25.76	27.82	27.83	26.13	24.84	25.33
Metropolia Degree Programmes	13.41	13.56	12.85	13.65	14.03	13.71	12.95	13.15
Oma Metropolia	12.87	12.97	12.91	14.17	13.80	12.42	11.89	12.18

Figure 8. Metropolia measurement response times

Figure 8 shows an example of the response times from the Metropolia’s measurement. There’s a separate response time row for each transaction, and the first row calculates the total response time for the two transactions. The columns calculate the average response times. The column “Response time (sec)” shows the average of the whole selected time range and other columns show the daily averages.

If the response time alert thresholds are agreed before creating the measurement it may lead to invalid response time alerts because it’s hard to predict the response time threshold before the measurement is created. It makes more sense to first create the measurement and leave it running in BSM for some time. This gives a good baseline what is

a normal response time for the transaction and enables more accurate alerts to be created.

4.7. Reporting

Besides alerting, reporting is also very important side of monitoring. Alerts are mostly used by the maintenance organizations who are responsible for fixing the incidents. Reports on the other hand are most beneficial to the system managers and Business Unit representatives. They may not be interested of receiving the email alerts, but they want to know how the system is performing on a general level. This is particularly important if there's a vendor who is maintaining the system and certain service level has been agreed in the Service Level Agreement (SLA) with the vendor. Service Level Agreement is a contract between a service provider and customer. The contract has agreed KPI's, service availability for example, that needs to be monitored. BSM measurements are a good base for the SLA reporting since it provides monitoring data constantly 24 hours a day, 365 days a year.

BSM offers a wide selection of different report template components that can be joined together into a single report and configured to show the desired measurements. Most stakeholders are happy with a simple availability and response time alert where they can see how the system or service has been performing in the last week or month. The report sending schedule can be configured freely, but common practice in Telia Company has been to send weekly reports during Sunday-Monday night, and monthly reports during the night of first day of the month.

4.8 Service breaks

All systems need to have service breaks from time to time. It can be due to new version deployment into the production environment or some small development such as bug fixes or layout changes to the GUI. In Telia Company there's agreed common weekly maintenance window where changes can be done to the systems. When a system is taken down for a maintenance that will naturally have an effect on BSM measurements. When the measurement cannot access the system's URL it assumes that there's an incident in the system. This will cause false alarms (although the maintenance organizations should be aware of the coming service break and not start the incident process)

and decline of the availability. Although the system is down during the maintenance break and the end user would consider the system to be unavailable, it has been agreed in the SLA contract with the vendor that the service break window time shouldn't affect the availability figures. That led to a requirement from the business units that downtime during the service break window should be filtered out from BSM availability figures. This was solved using BSM's Planned Downtime feature which allows creating schedules where the measurements are on pause during the time. There's a common weekly service break window where the systems can be taken down for a maintenance. The problem was that not all the systems have service break every week and the frequency of the service breaks for an individual system is not regular. For example, it could be that a system X has two service breaks in recurring weeks and then the next service break is after three months. This irregularity made creating the automated scheduled planned downtime impossible for individual systems. Only option for creating planned downtime for individual systems would be to create the planned downtime manually in BSM for all the systems having service break that week. Because the number of monitored systems is high, this is not a feasible option since it would create an excessive amount of manual work. That's why a compromise needed to be made. It was agreed with the business and IT units that all the measurements related to systems/services that are using the common service break window are on pause during the weekly service window time. Although this leads to loss of measurement data for those systems that are not having a service break during that week, it's still acceptable considering the alternatives.

5 Conclusions and Recommendations

The fifth and final chapter summarizes what was learned during writing the thesis, gives recommendations to some of the created measurements and suggests the next steps forward.

After discussions with IT and business unit representatives it was realized that there is a real need for service monitoring. The existing infrastructure and application monitoring is a vital part of the palette, but it's not enough for today's modern Telco company. Besides monitoring performance of a single application, the company must also be able to monitor integrations between the systems and the most important business processes end-to-end.

The boundary conditions for the monitoring tool that would be used for creating the service monitoring made the selection process straightforward. A tool already in-house had to be used which limited the selection process only for a couple of tools. In a way it was a good thing since it speeded things up, but unfortunately it wasn't possible to achieve true end-to-end monitoring with the tools available in the case company. With BSM, one can only monitor the frontend part. What happens in the backend systems, when an order is submitted for example, requires a different kind of monitoring tool. However, this is a good starting point and improves the monitoring capability greatly.

5.1 Recommendations

There are couple of recommendations for the service measurements created during writing the thesis.

Purchasing Mobile Subscription via Avaaja Mobile

After Purchasing Mobile Subscription via Avaaja Mobile measurement had been running for a while a strange error was discovered. Sometimes, though rarely, the script couldn't get past the pin code page after the login phase. BSM provides a snap shot of the error,

which is a browser screen shot from the page where the error happened. In the snap shot there was no clear reason what had happened. Only the same pin code page without any error message.

An investigation was launched to identify the reason. In VuGen software it's possible to run the script selected number of iterations, meaning if the first script run is successful then VuGen proceeds to the next iteration and repeats until the number of iterations are completed or an error happens while running the script. This was a perfect way to troubleshoot the issue since it happened very seldom. The iteration count was set to one hundred and the replay started. Almost at the end of the iterations the error was finally detected. At first it wasn't clear what had just happened and couple of more iteration sets were required before the cause of the error was discovered. For unknown reason, sometimes after typing the pin code and clicking a next button the portal loads a short while and returns to the pin code page again. No error message is displayed, only the same pin code page again.

It wasn't clear did this happen to real users also or was it related to the test number and the static pin code that was used. The system manager checked if there had been similar errors earlier and there wasn't a single complain ever made by the users about the issue, and for that reason it was deduced that the issue is probably related to the test number or the static pin code.

Although the issue happened very rarely, estimation was around one or two times out of a hundred which was in line with the availability figures seen in BSM, it was enough to ruin the availability figures. If the availability target is set somewhere between 99,0 - 100%, one or two percent distortion in the availability figure was unacceptable and it was imperative to come up with a solution.

After a while a workaround was invented. Similar steps were recorded into the script where the pin code was typed, and next button was clicked in the pin code page. There's an option in VuGen to set steps as optional and this was utilized. It means that if the error happens and the page returns to the pin code page, the optional steps type the pin code and click the next button again, and after that the script resumes normally to the next step. If the error doesn't happen and the next page after pin code page is shown as it should, the script tries to locate the field where to type the pin code and where to click next from that page. Because the steps are set as optional, when the script doesn't locate

the field and button it doesn't set the run status to "failed" but moves to the next step instead.

Although there haven't been any complaints from the users, it is strongly recommended to investigate whether the error is test number/static pin code related or does it affect the real users as well.

Metropolia measurement

When the example measurement was created to monitor Metropolia's pages, it was discovered that there's an issue with the Twitter related component. Most likely the issue is not visible to the end users of Metropolia's pages and it can be that it's hasn't been detected by the IT staff either unless some advanced monitoring has been implemented internally. It is recommended that Metropolia investigates the issue and fixes the failing Twitter component.

5.2 The next steps

What should Telia Company do next in the service monitoring area? The monitoring scripts were created for the first four critical services. The scripts were uploaded to BSM and availability alerts and reporting were set up. However, the response time alerts and thresholds in BSM Graphical User Interface (GUI) were not set yet. The measurements were left running in BSM to get baseline data of the response times. The first next step should be to analyze the baseline data to see what the normal response time of the four measurements is. After the analysis the threshold for the response time alert should be decided. Whenever that threshold is exceeded, an alert will be sent to the selected stakeholders.

Response times in BSM GUI reports are color coded. Green color means "OK", yellow means "Warning" and red means "Critical". It should be analyzed from the baseline data what is the normal variation of the response times and thresholds for green, yellow and red should be set up to each measurement individually. These thresholds don't cause alerts if they are exceeded. They are merely a visual aid for the people viewing reports from BSM GUI.

The second next step could be to arrange meetings with business and IT representatives to define the next set of business-critical services and create the measurements accordingly. By repeating this step Telia Company will soon have the most important services under surveillance.

As mentioned in the beginning of this chapter, it’s not possible to monitor the whole service end-to-end with the current tool. If there are human and financial resources available, one long term next step could be to investigate the other monitoring tools in the market today to find out are there more capable tools for end-to-end service monitoring.

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