Articles

A Verification Platform of Failure Resistance Evaluation for Wide-Area Distributed Systems

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Summary:

It is efficient to repeat disaster prevention drills periodically to preserve disaster resiliency. However, it is difficult to make many deliberate faults manually in the same time as simulating a disaster or gathering logs and event notifications of the system. For automating a part of drills, a platform of failure resistance evaluation with an SDN technology is proposed. This paper introduces the activity of a disaster prevention drill, as well as the design and implementation of the platform. It further shows the effectiveness of the platform.

Key words:

Failure resistance, Failure tolerance, Software Designed Network, Wide-area distributed systems, Disaster prevention drill

JEL Classification: C6, C 63, C8, C81, D 8

1. Introduction

A part of us has proposed a distributed storage architecture for a widely distributed virtualization infrastructure [1].

Another part of the team has proposed network disaster prevention drills. So there is an activity to verify the resiliency of ICT systems and its management systems of some organizations against disasters with injections of intensional fault to the existing ICT systems [2].

The purpose of this activity is to check the following points of the systems and to improve the situation if they have some subject.

- the ICT systems behave properly on getting faults
  - the systems can get faults and can aware to the managers
  - the systems can use the stand-by system if they have redundancy
- system managers behave properly to recover the system

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There are some problems in such drills because most of the operations have been performed manually [3]. A major problem is that faults must easily be injected manually, such as for example lost optical contacts by hand or one line description in CLI of network equipments.

In this research, we propose an SDN based platform for verify disaster resiliency of systems to emulate simultaneous faults according to a disaster scenario.

2. Platform of Software Designed Disaster Emulation

Firstly we describe a classification of network failures that the platform should emulate in this section. Secondly, we describe the design and implementation about the platform.

2.1. Requirement to the platform

To determine the requirement of the architecture, we had analyzed network failures to classify into some categories. Table 1 shows our classification of network failures, which describes what function should be implemented in platform.

2.2. Design and implementation of the platform

We have established that the platform is based on SDN technology, or Software Designed Network technology, to perform suitable functions. Originally SDN was used for building networks without physical restrictions of the network equipments. We use such the SDN flexibility for injecting planned failures. This allows programmable disaster emulation with repeatability.

We have adopted onePK, or One Platform Kit, which is a SDN platform provided by Cisco Systems. This kit prepares C, Java and Python languages to control Cisco IOS routers and switches.

Furthermore, onePK cannot build all communication controls but partially overrides existing routing protocols.

Table 1. Classification of network failure

category	factor	symptoms	function
control, operation, software	restriction	congestion	delay and n% packet loss
			shaping
	illegal route	routing loop	routing table override*
		routing flap	
		unreachable	
equipment	total failure	total down	IF down※
	partial failure	partial down	
	overload	loss	N% loss
		delay	ms delay
line	cable cut	lost	IF down※, 100% loss※
	equipment failure		
	concentration	congestion	delay and n% loss
			shaping
environment	housing broken	total loss	IF down※, 100% loss※
	lost power		
	air conditioner down		
		partial lost	

※functions implemented in the prototype system.

therefore it is easy to restrate original situation when a drill is over completely.

Moreover onePK has an API of communication to EEM, or Embedded Event Manager, therefore the platform is possible to gather monitoring information, such as SNMP traps and Syslog messages.

2.3. Evaluation

To evaluate the prototype system, we measured the time to process for an \ interface down" failure. Table 2 shows the result that is a mean time of 10 times of the same IF down process, and the time includes RTT 16.1ms between a target router and the controller of it.

The result shows the processing time is short enough to emulate disasters instead of handy control.

Table 2. The processing time details of onePK command

process	time (ms)
open session	1290.25
Order of Interface down	35.07
close session	18.53

3. Conclusion

In this paper, we describe a newly proposed architecture for emulation of disasters on existing networks in operation. Moreover, we describe a design of a platform of the architecture, its implementation, and evaluation of it. This platform makes examinations disaster prevention drills easily therefore the examined networks would be more resident.

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