

## Approach to Solving the Problems with IP-based Telephone Systems in the Field

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### Abstract

This article introduces a protocol analysis-support tool for Internet protocol (IP) based key telephone systems called the  $\alpha$ -Command Analysis Support Tool developed by the Technical Assistance and Support Center, NTT EAST, to solve problems with such systems in the field. This is the sixty-second article in a series on telecommunication technologies.

*Keywords: packet capture, key telephone system, command analysis*

### 1. Introduction

The Network Interface Engineering Group at the Technical Assistance and Support Center (TASC), NTT EAST, provides technical support to identify the cause of problems in the field not only plain old telephone services provided by the public switched telephone network, but also related to Internet protocol (IP) services, such as FLET'S Hikari fiber-optic broadband service. By carrying out on-site investigation, we will be able to determine the causes of problems and provide appropriate countermeasures. Recently, problems in the field have become more diversified because the telephone systems have shifted to IP, and more valuable services using wireless terminals and cloud resources have been introduced. This article introduces our efforts concerning problems related to IP services and, in particular, proposes a tool for handling problems with key telephone systems.

### 2. Efforts concerning problems with IP services

Capturing and analyzing IP packets are effective for investigating the causes of problems with IP services.

TASC has developed packet capture devices, as shown in **Fig. 1**. We also developed various tools for analyzing communication protocols and commands, measuring the amount of traffic and bandwidth, analyzing unauthorized accesses, or decoding voice data. These tools can be easily used by service personnel in the field and support their investigation for determining the causes of problems.

### 3. Development of analysis-support tool for key telephone systems

#### 3.1 Background

Problems that occur in the field are diversifying because of the widespread use of cloud services and multi-functional equipment. Customer networks have also become complex due to the integration of several services, such as telephony and Internet. Thus, it is sometimes difficult to determine the causes of problems that occur only occasionally. In such cases, investigation is mainly conducted by interviewing customers, and only preventive measures, such as replacing equipment and/or wiring, are carried out by service personnel.

Regarding problems with key telephone systems,

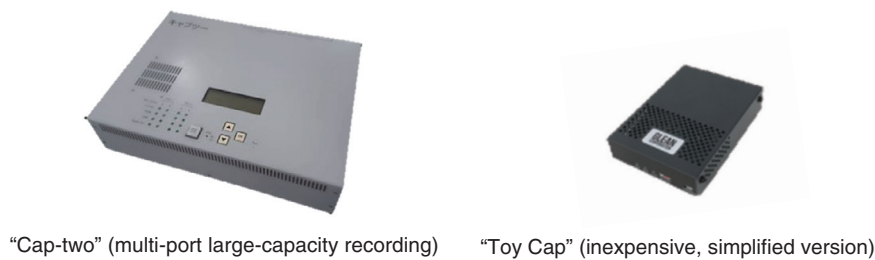
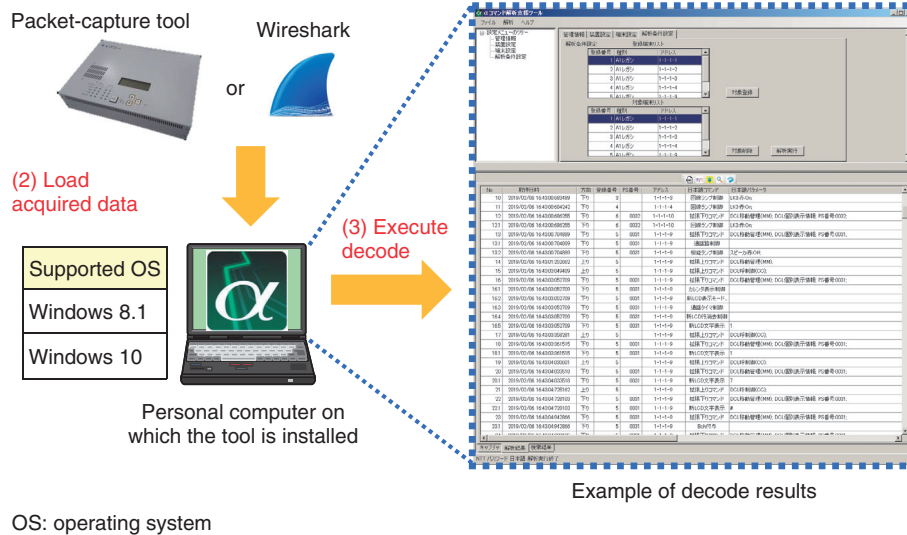


Fig. 1. Packet-capture tools developed by TASC.

(1) Acquisition of IP-packet data by using a capture tool, etc.

Fig. 2. Using  $\alpha$ -Command Analysis Support Tool.

factors related to such problems exist not only in the system but also in usage (such as incorrect telephone operations), and such combined factors may lead to a longer investigation. Given these circumstances, we developed the  $\alpha$ -Command Analysis Support Tool for monitoring exchange commands between the master equipment unit of the key telephone system and telephones.

### 3.2 Overview of functions

This tool can decode various information, such as communication commands ( $\alpha$ -command), from IP packets sent between the master equipment unit and telephones of the “ $\alpha$  series” key telephone system sold by NTT EAST and NTT WEST. By inputting the IP-packet information acquired by packet-capture devices or other software to this tool, the  $\alpha$ -command

sequence, parameters, telephone operations executed by the user, content of the telephone displays shown at those times, and operation details of the master equipment unit are outputted as analyzed results. Based on this output, it is possible to understand the system status when a problem occurred. The usage of this tool is illustrated in **Fig. 2**.

This tool also has the following functions for supporting detailed data analysis.

- “Save as CSV”: Save the analysis result displayed in the tool as a comma-separated value (CSV) file. Depending on the user’s preference, other tools that can handle the CSV data can be used to edit the analysis results.
- “Jump to”: Specify a date and time in minutes and seconds within a large amount of data and spot the data at the time the problem occurred.

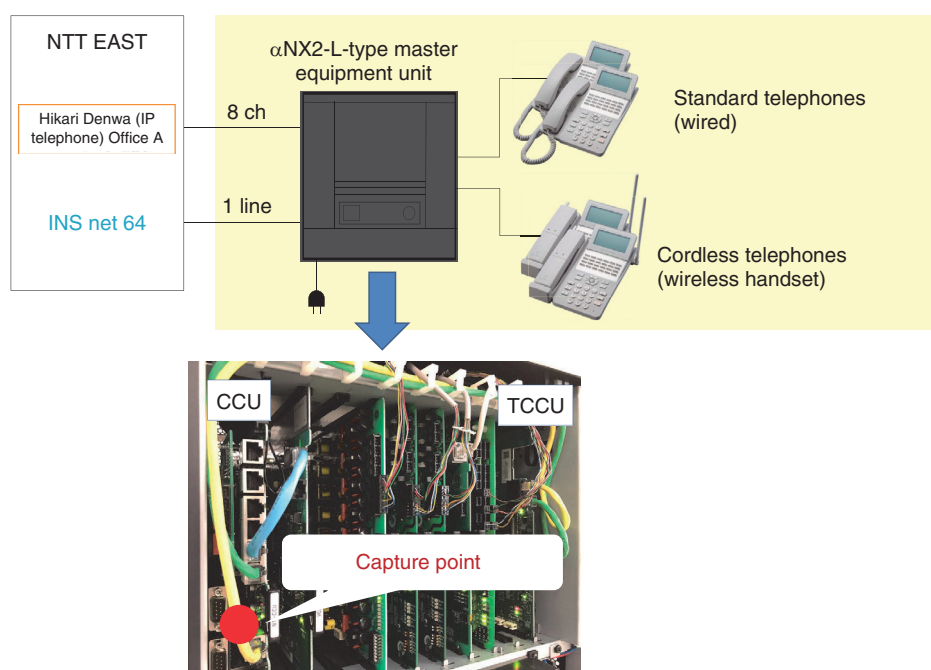


Fig. 3. Capture point.

- “Search”: Search by specifying the telephone equipment (by extension number or process identifier (PS) number) or a specific  $\alpha$  command.

#### 4. Example cases of our analysis-support tool

##### 4.1 Summary of problem and capture points

A customer who uses cordless telephones (NX2- $\langle 24 \rangle$  CCLBTel- $\langle 1 \rangle$ ) with an  $\alpha$ NX2-L-type master equipment unit reported that a telephone rebooted when making outgoing calls. Although the on-site service personnel replaced the master equipment unit and a telephone, the problem persisted; therefore, TASC investigated the cause of the problem by capturing IP packets in cooperation with the service personnel. During that investigation, to detect the problem reported by the customer, IP packets were captured at the point shown in **Fig. 3** (TCCU port of communication control unit (CCU)) with the packet capture device Cap-two (see Fig. 1).

##### 4.2 Occurrence status of problem and analysis results

During the capture period (about one month), we received five notifications of the problem from the customer, and the captured IP packets were analyzed using the  $\alpha$ -Command Analysis Support Tool focus-

ing on the times that the problem occurred. The operation details of a certain telephone (extension number 203) when the problem occurred are listed in **Table 1**. From the analysis results, the problem reported by the customer occurred when the *kana* (Japanese syllabary)-search function of the phonebook was used. With this in mind, we executed the same number-search operation to reproduce the same problem with the same model telephone at our laboratory. This clarified the conditions under which the problem occurred.

- (1) Press the “Phonebook” button and start kana-search operation in the phonebook.
- (2) Press the “Dial” button three times or more and pinpoint the call destination by kana search.
- (3) Press the down-scroll button in the phonebook and select the call destination.
- (4) Perform operations (1) to (3) in less than one second.

##### 4.3 Causes and countermeasures

The reported problem was caused by internal processing in the telephone, as explained below. The mechanism that caused the problem is illustrated in **Fig. 4**.

- The amount of data processed by the telephone

Table 1. Occurrence status of problem.

Date and time of customer notification (year/month/day/time)	Extension number	Telephone-operation details
20xx / x / 22 16:52	203	Phone book →3→3→*→ Phone book
20xx / x / 27 11:22		Phone book →7→7→7→7→ Phone book
20xx / x / 27 11:24		Phone book →7→7→7→7→ Phone book
20xx / x / 28 9:42		Phone book →8→6→9→ Phone book
20xx / x / 31 18:47		Phone book →7→7→7→7→ Phone book

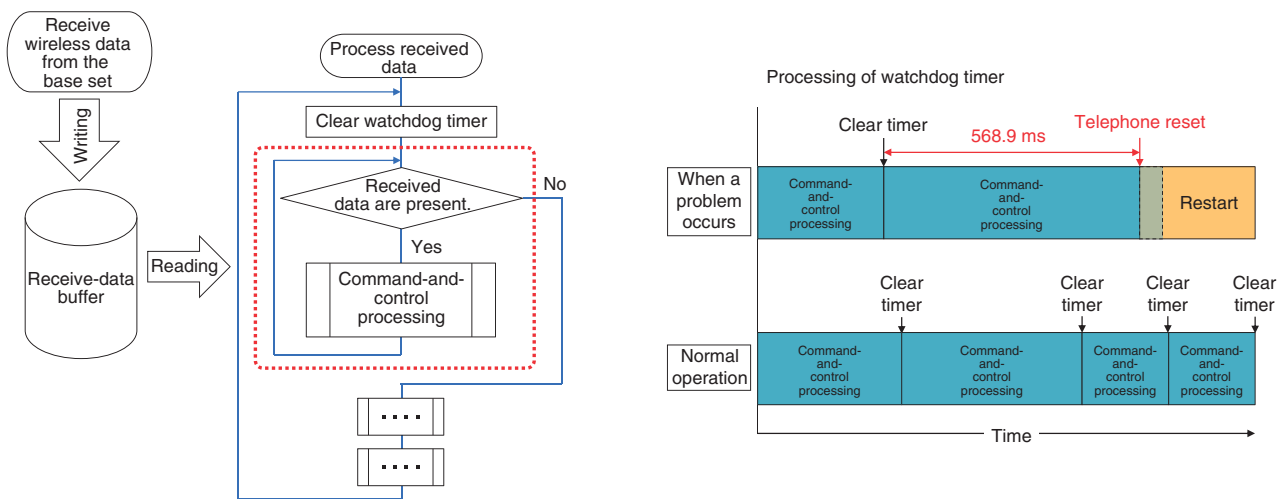


Fig. 4. Mechanism of problem occurrence (data processing in the telephone).

increased compared to that processed with previous models.

- During the kana-search operation in the phone-book, a large amount of data to be displayed on the telephone accumulated in the receive-data buffer. Although the buffered data are sequentially processed, the receive-data buffer was not emptied.
- While the telephone was processing such a large amount of data, the *watchdog timer* (568.9 ms), which detects a *terminal stack* and resets (restarts) the telephone, was activated.

Since the specifications of the telephones caused this problem, and it was impossible to change the telephone software, we took measures to change the manner in which the telephones are used. After explaining the cause of the problem to the customer, we asked the customer to take more than one second when operating the kana search to avoid this problem.

When problems occurred because a customer operated telephones in the manner described above, the only way to identify the problem had been by service personnel visually checking the operation of the telephones in question or by monitoring telephone operation with a camera or other means. However, by using the  $\alpha$ -Command Analysis Support Tool, we can reliably identify the cause without visual inspection or monitoring with cameras.

#### 4.4 How to obtain the $\alpha$ -Command Analysis Support Tool

Since September 2019, the  $\alpha$ -Command Analysis Support Tool has been downloadable from the website of TASC\* (in Japanese only). We believe that using this tool will make it possible to easily investigate

\* Currently, the tool is provided only to the NTT Group, but we are preparing to enable our partner companies to use it as well.

causes of problems and prevent unnecessary replacement of equipment, devices, and/or wiring.

### **5. Concluding remarks**

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In this article, the  $\alpha$ -Command Analysis Support Tool—which was developed as one of our technical-cooperation efforts targeting problems with on-site IP

services—was introduced. The Network Interface Engineering Group in TASC supports early resolution of problems with equipment and terminals as well as networks by using various tools to acquire and analyze data. Going forward, TASC will continue to actively engage in technical cooperation, tool development, and technology dissemination through activities such as technical seminars.