

Development of the Standard Application Program Interface (API) for Open FA controller in Japan

Shigeru UENO *,Hideaki.INOUE**,Shinichiro.CHINO***,Yoshihiro.HOSHINO****
and Masayoshi UNEME*****

*Technical Research Institute of JSPMI Higashikurume city, Tokyo,Japan

**FANUC Ltd, Yamanashi, Japan

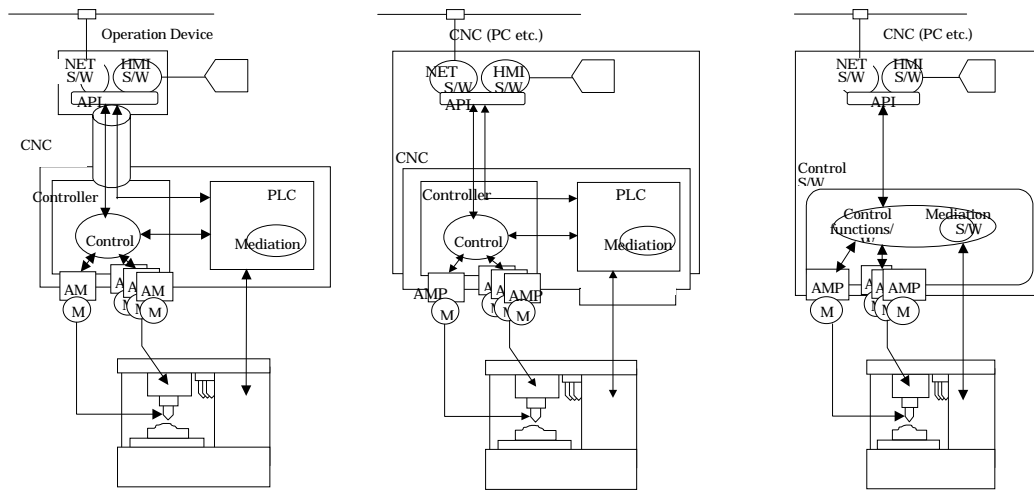
***Mitsubishi Electric Corp., Itami, Japan

****, MAKINO Milling Machine Co.ltd, Atsugi, Japan

*****, MORI SEIKI Co.ltd, Nara, Japan

Introduction: Although an open architecture controller system has been told that it would become next generation controller system in FA area 1)2), there still are few manufacturers who introduce it in precision machining system. The reason is fully depending upon the lack of its standard systems and standard API. JOP (Japan Open System Promotion Group) has been conducted the CNC API standardization for three years. The specification of the API set PAPI (Principal Application Program Interface) has defined and becomes new Japanese standard. This paper describes its development concept and its test results. PAPI is consisted from two group API sets such as Basic API and Extended API. Also it is classified into three categories such as API for CNC, for servo systems, and for applications. It has about 90 functions of C languages, and supports standard services for Human-Machine-Interface (HMI) of NC, such as system control / manual operation / program management. The developed API has implemented into two existing different manufacturer's CNC system, and operated simultaneously by the single server PC that installed third vender's HMI.

Basic concept: It is a critical points to specify the meaning of an open architecture NC system. So that before starting its detail developments, the development group has discussed its classifications. Finally they agreed upon its basic points as follows. That is; this API should be developed for three types of open controllers such as 1) PC +proprietary NC type, 2) PC + NC card type and 3) Software NC on PC+I/O card type, as proprietary NC system still keep its strong position in the machine tool manufactures field. Figure 1 explains the configuration of these three types CNC systems. In the type 1), The controller is the existing CNC, which consists of the motion controller, and PLC. Setting from the API includes those processed directly by the motion controller and those passed to the PLC. Commands passed to the PLC are mediated with input information from the panel, etc. Type 2) consists of specially designed NC board, which includes PLC functions. API processing methods are similar to the type 1). Type 3) is so called software PC based controller. The controller is made according to an open agreement. In general, almost all basic processing is realized in the software on the PC.



Type 1.

PC + Proprietary CNC

Type 2.

PC + NC Board

Type 3.

Software NC on PC + I/O

Figure 1. Existing CNC Configuration Type

CNC Model (CNC Function Block): PAPI offers the functions, which construct the HMI for the CNC model as shown in the Figure 2. This figure explains the function model of existing CNC system. Basically, Open architecture APIs should cover all kinds of information connections between the indicated functions. However, it may rather complicate and some of them has a difficulty to standardize at this moment. The major requirements are to monitor and control the total CNC systems, and not to modify its own servo conditions at the real time mode. So, the development target has concentrated into HMI functions.

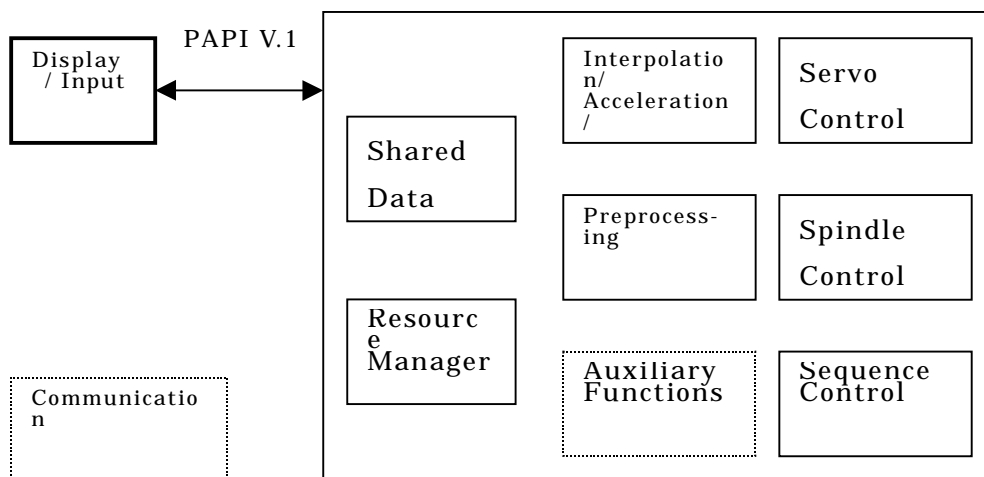


Figure 2. CNC System Function Block Diagram

According to the function blocks, it was classified into three categories with their functional characteristics. Category one is called as CNC system APIs that include Display, Input, Resource manager and Communication. Category two is called CNC Devices APIs that is consisted from Interpolation, Acceleration, Deceleration, Servo control, Spindle control and Sequence control. The final one, category three is called CNC Application APIs that include Shared data and Preprocessing (NC programming).

Figure 3 explains the relations between the category and target CNC systems. The horizontal axis indicates three possible types of CNC systems. Also it indicate the processing speed that required in PC system. In case of PC +proprietary NC type, processing speed in the PC does not required so much. On the contrary, fully software based CNC may be requested high data processing rate. The vertical column explains classified API category that will apply to the all kind of CNC systems. PAPI ver.1 covers major CNC system APIs, and some of CNC application and CNC device control APIs are also supported . Remained area are provided for the future extension.

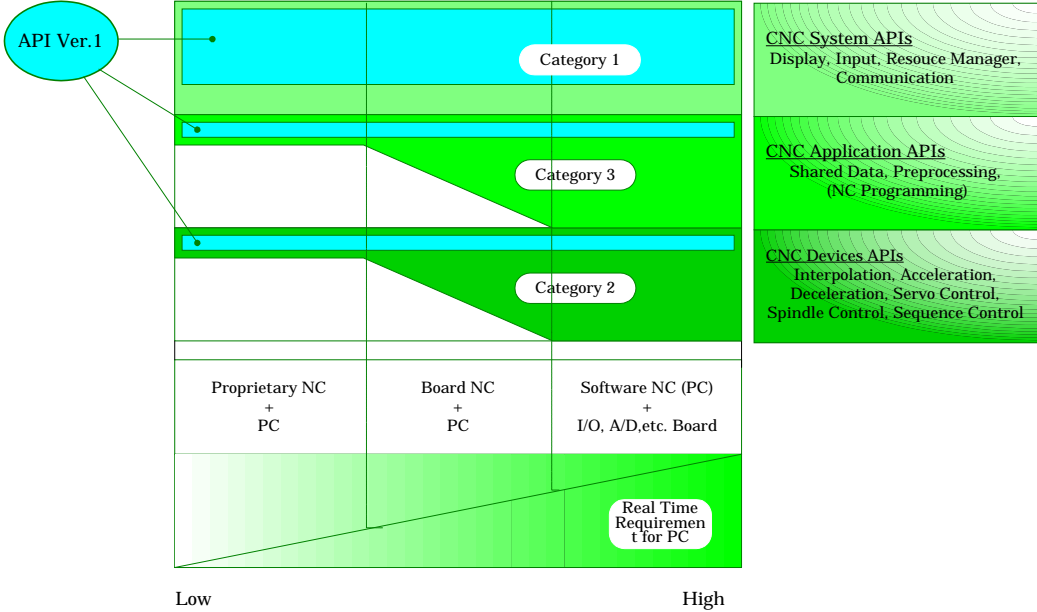


Figure 3. Category of CNC system and APIs

PAPI is consisted from two types APIs. The first is called “Basic API” and second is called “Extended API”. The "basic API" is defined to be mainly the set of functions that provide functions for monitoring the state of what is to be controlled and for managing the program parameters. .And "extended API" is defined to be mainly the set of functions that provide functions for operating what is to be controlled such as “start”, ”stop” and “operation mode change”. Numbers of provided functions are 95, for the Basic; 49, and for the Extended;46.

Demonstration of developed API: To check its performance, the developed API has implemented into two existing different kind of CNC systems that are manufactured by MITSUBISHI Electronic Corp., and FANUC LTD., Basic control HMI has developed by Tokyo University Mitsuishi Lab. students. All system has installed in Windows NT system. Figure 4 shows the total configurations demonstrated at Mechatro-tech Japan in Nagoya, Oct.13-16, 1999. The aims of demonstration were to show that PAPI is actually implementable in commercial NCs, to show how PAPI is effective to realize a custom HMI, and to show that PAPI is also useful for the communication with upper level controllers. The demonstration results were quite successful, that connected two NC system could operate by the same HMI, and also could communicate with higher level controller that provides production-scheduling software. This result indicate that developed PAPI has a good ability and affinities with existing CNCs.

PAPI Demonstration at Mechatro-tech Japan '99 in Nagoya, Oct. 13 - 16

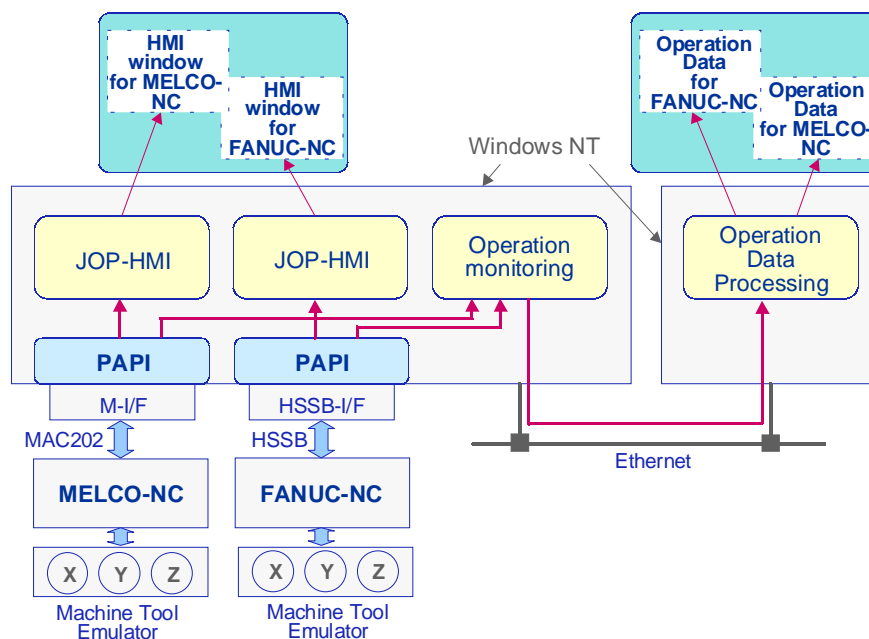


Figure 4. Demonstration Configuration in Mechatro-tech Japan 99

Reference

- 1) Requirements of Open, Modular Architecture Controllers for Applications in the Automotive Industry, Version 1.1, (1994), Chrysler, Ford, GM
- 2) Open Architecture Controls for Precision Machine Tools, Bradley N. Damazo et al, Proceedings of ASPE Spring Topical Meeting on Mechanisms and Controls for Ultra precision Motion, April 6-8, 1994, Tucson, AZ, pp.26-31.