

行政院國家科學委員會專題研究計畫成果報告

整合性高速網路通訊軟體工程之研究設計(III)

A study of an object-oriented CASE for ATM(III)

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一、中文摘要

由於新的網路技術如非同步傳輸模式、無線通訊的快速發展，我們需要一套更有效率的方法來發展網路軟體。我們先前已建構一套 OOATM 架構和相對應的程式庫，這套方法運用物件導向的方式來設計與實作 ATM 通訊協定。使用此架構來描述或發展程式可運用其所提供的類別達到再利用的好處。

視覺化程式設計是一種能讓使用者用多面相方式來描述程式，它能使設計程式的過程較輕鬆以能減少描述時所需付的代價。而使用物件導向的技術較容易達成這個目標。在這篇報告中將介紹我們發展的視覺化物件導向通訊協定發展環境 (VOOPDE)。

VOOPDE 包含一個圖形介面通訊協定狀態圖的編輯器、一個通訊協定資料單位編輯器、一個通訊協定程式碼產生器。圖形介面通訊協定狀態圖的編輯器提供一操作與顯示介面方便通訊協定的描述。通訊協定資料單位編輯器提供一個以 bit 為單位的圖形編輯器，用以編輯 PDU 格式與編碼方式。通訊協定程式碼產生器產生一組以 OOATM 模式為基礎的類別程式碼。這些類別組成通訊協定的基本骨架。使用這些工具不僅能減少規格描述的費事工作，也可半自動地產生 C++ 程式碼，所以它可確實使通訊協定實作較為輕易。

關鍵詞：傳輸協定，物件導向、非同步傳輸模式、程式規格、再利用、視覺化程式設計。

Abstract

Rapid development for network

software such as ATM and wireless data communication networks, needs more efficient networking software design methods. We have constructed an OOATM [Yan96] model and a corresponding C++ library for object-oriented design/implementation of ATM protocol machines. OOATM model explores the potential for producing reusable software modules by discovering the underlying generic class structures and behavior. Applying OOATM model to specifying/ coding does improve reuse for protocol implementation since each object specified has a corresponding (also easy use) category of class(es) and methods.

Visual programming [Burnett95] [Shu88], referring to any system that allows the user to specify programs in a multi-dimensional style, is intended to ease the programming process and reduce the efforts of specification. Object-oriented method is a better model to adapt visualization technique. In this report, we present a Visual Object-Oriented Protocol Development Environment (VOOP DE) based on OOATM model and the techniques of visual programming to facilitate the implementation of communication protocol.

The VOOPDE include a graphical protocol state diagram editor (PSDE), a PDU specification editor and a protocol code generator. The graphical protocol states diagram editor provides well-designed edit and display facilities that ease protocol specification. The PDU editor provides a bit-by-bit graphic editor to specify the PDU format (message coding format). The protocol

code generator generates a set of classes based on the OOATM model and the associated C++ library. The classes are a skeleton of the protocol implementation. Applying these tools not only can reduce the effort of specifications but also can generate C++/object code semi-automatically to ease protocol implementation.

Keywords: Protocol, Object-oriented, ATM, Program specification, Reuse, Visual programming

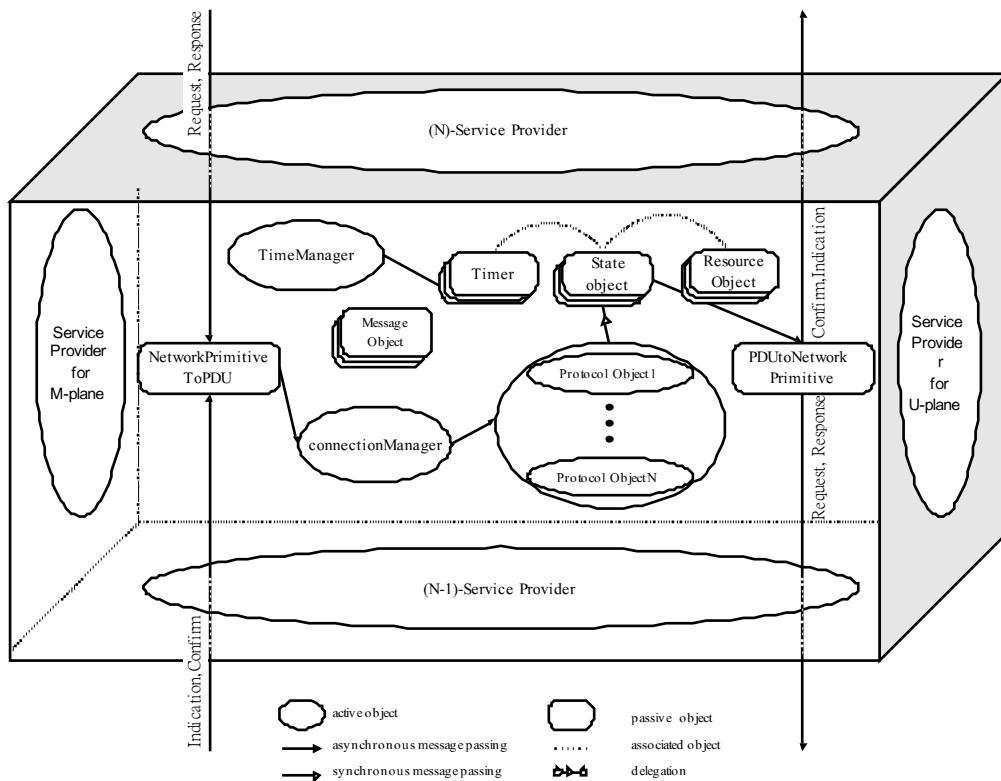
二、緣由與目的

Visual Programming 最近幾年來越來越普遍，其中一個原因為圖形方面相關的硬體技術使得使用者與電腦間可經由 **graphics** 來溝通。透過具體與合適的圖形可以使得使用者更容易與電腦溝通。一般而言 **Visual Programming** 可以看成由一些有意義的 **graphics** 和 **graphical components** 來建構程式的過程。

直接用文字來描述物件及其間的關係遠比用圖形(**Graphics**)來的困難，換句話說，用 **VISUAL PROGRAMMING** 的技術來撰寫物件導向規格似乎比用文字語言容易。如果能夠運用 **Visual Programming** 技術

來撰寫 **protocol specification**，不但可以減少 **specification** 時的 **efforts**，也應可以幫助撰寫者更容易表現出 **protocol** 中各個 **protocol state** 間的關係使得 **protocol specification** 更方便 **maintain**。

我們於計劃的前兩年時發展了一套物件導向模式 **OOATM Model**(如圖一)，我們也已製作一套相對應的 **C++** 程式庫。由於在 **OOATM Model** 中每一 **object** 有一對應的 **class(es)** 及其 **method(s)** 目錄，應用 **OOATM Model** 來設計或撰寫 **ATM PROTOCOL** 機器的程式確實可以改善再利用。這些我們歸納整理出來的 **objects** 與 **classes** 讓我們決定設計一些相對應的 **graphical components** 並訂定一些 **graphical components** 間相互的關係的 **rules** 加以規範，以達成使用 **graphics** 的方式撰寫 **protocol specification**，即所謂的 **Visual Programming**。利用這種 **graphical components** 和 **objects** 對應關係，我們可以進一步分析這些 **graphical components** 和 **C++ library** 的關係進而設計一個 **Code Generator**，能將 **Visual specification** 自動依據 **C++ library** 的 **classes** 轉譯成 **C++ program Code**。再進一步我們整合這些工具發展一套通訊協定發展環境幫助使用者實作通訊協定。



圖一： The model of OOATM communication protocols

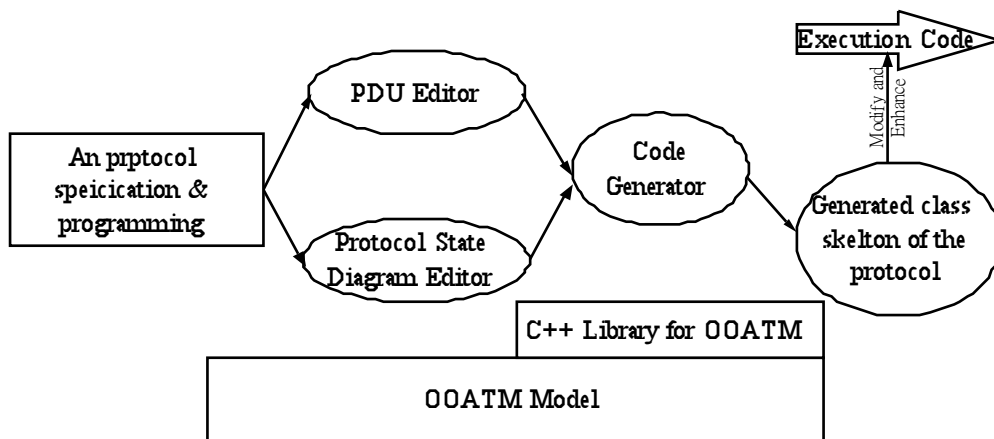


Figure 1. The Architecture of the VOOPE

三、結果與討論

The VOOPE includes a graphical protocol state diagram editor (PSDE), a PDU specification editor and a protocol code generator. The architecture of the VOOPE is shown in Figure 1.

The graphical protocol state diagram editor provides well-designed editing, displaying facilities that ease protocol specification. Using PSDE to edit protocol state transition diagram can

enhance the understandability and readability of specification. For example, as shown in Figure 2, one uses the PSDE to edit the ATM signaling protocol [ATM Forum 95]. The round rectangles represent states and the arrow lines representing transitions.

The PSDE provides two views for a state diagram. One view provides a graph for the state diagram. User can move, resize, rename and edit a state and

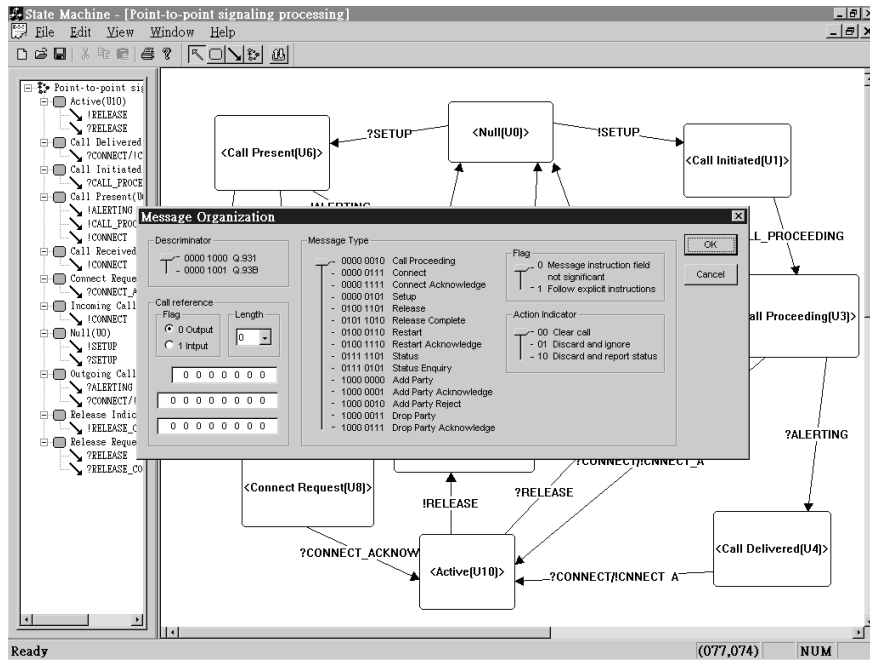


Figure 3. General Message Organization of UNI Signalling protocol

The PDU editor (as shown in Figure 3) provides a bit-by-bit graphic editor to specify the PDU format (message coding format). Figure 3 shows an example of the PDU, general message organization of UNI signalling protocol. The protocol code generator generates a set of classes based on the OOATM model and the associated C++ library. The classes form a skeleton of the protocol implementation. Using those tools can not only reduce the effort of specifications but also generate C++/object code semi-automatically to ease protocol implementation.

Conclusion and Future Work

We have proposed a Visual Object-Oriented Protocol Development Environment (VOOPDE) to facilitate the implementation of communication protocol. Applying these tools not only can reduce the effort of specifications but also can generate C++/object code semi-automatically to ease protocol implementation.

Our future study includes:

- Applying VOOPDE to the development of more complex, larger communication software
- Make VOOPED usable in a distributed environment (groupware)

Reference

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