# SOFT PVCS IN AN ATM NETWORK

Analysis of the benefits of using Soft PVCs,
including the use of a proprietary solution for
protection-switched SPVCs

January 23, 2001

Liz Rice
Liz.Rice@dataconnection.com

Data Connection Limited
100 Church Street
Enfield
EN2 6BQ
United Kingdom
http://www.dataconnection.com

# Table of Contents

# 1 Introduction

This white paper describes the use and advantages of conventional Soft PVCs (SPVCs) in an ATM network.  It goes on to describe Data Connection's proprietary approach to providing protected SPVCs for protection switching redundancy.

Data Connection's DC-ATM family of products provides solutions for the components of an ATM stack, including SVCs, PVCs and SPVCs.  Section 5 gives a brief description of how SPVC management fits into the DC-ATM architecture.

This paper refers throughout to SPVCs, but the same principles apply for SPVPs.

A glossary of terms and a table of references are provided at the end of the paper.

# 2 SPVCs in an ATM network

## 2.1 Background

An SPVC through an ATM network consists of PVCs at the entry and exit to the network, connected by an SVC. At the entry and exit devices, (referred to as the originator and target) the PVC is cross-connected to the SVC. This is specified by the ATM Forum in the PNNI SPVC Addendum, and is illustrated in figure 1.

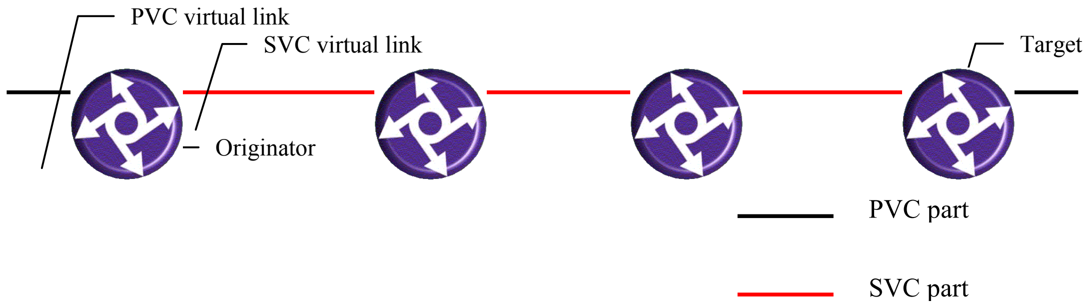



**Figure 1: A Soft PVC**

The specification for SPVCs is an Addendum to the PNNI specification, and according to the strict definition the Soft PVC IEs can only be signaled over PNNI signaling interfaces. However, in practice many OEMs implement SPVC support over UNI or IISP interfaces.

## 2.2 Configuration

The SPVC Addendum specifies a set of MIB tables that are used to configure an SPVC. These are used in conjunction with the AToM MIB tables as follows.

- At both the originating and target devices, the administrator configures an entry in the atmVcl table for the PVC parts. These are referred to in this paper as PVC VCL entries.
- At the originating device, the administrator configures a Soft PVC entry. This identifies the local PVC VCL by interface, VPI and VCI, and specifies the ATM address of the terminating device. It typically also defines the VPI and VCI of the PVC VCL to be used at the target, although this is optional (see section 2.5).

- At the target device, the administrator configures one or more target addresses to be used for reaching SPVC targets on a given interface. In a PNNI network, these addresses are advertised so that the SVC part can be routed from the originator to the target.

When the SPVC entry at the originator is activated (by setting the operational status field in the MIB row active) this causes the originator device to issue a SETUP to the target ATM address. The SETUP message includes an SPVC IE containing details of the specified target VPI and VCI.

When the SETUP reaches the target device, this is matched to the PVC VCL entry by VPI and VCI. Assuming the call is successful, a CONNECT message is returned to the originator to complete the connection.

## 2.3 Matching traffic parameters

In the AToM MIB, PVC VCL entries refer to traffic descriptor rows to describe the traffic parameters for the connections. SVCs carry similar traffic parameter information in the signaling protocol messages.

At the SPVC initiator, the SVC is typically signaled with traffic parameters corresponding to the PVC VCL at the initiator.

At the SPVC target, the incoming SETUP traffic parameters may not match the traffic parameters associated with the target PVC VCL. It is up to the target device to accept or reject the connection, but many OEMs allow some flexibility in how exactly the traffic parameters need to match. (Data Connection's SPVC implementation allows the OEM to customize the matching algorithm.)

## 2.4 Dynamically-allocated target PVCs

The OEM may choose to implement the target device such that it can dynamically create a PVC VCL entry for the VPI/VCI specified on an incoming SPVC SETUP message. This reduces the amount of configuration required at the target device, although it is important to consider how the neighboring device beyond the target will learn about the existence of this PVC (and this is beyond the scope of this white paper).

By implication, if the SPVC is deactivated, the dynamically created PVC VCL entry should be automatically removed. If this does not happen, the resources used by the PVC VCL entry cannot be re-used. However, the OEM may choose to implement a timeout so that the target VCL entry remains in place for some amount of time, in case the SPVC is failing only temporarily.

## 2.5 Wild-card PVC entries

The SPVC entry at the originating device may be configured without specifying a VPI/VCI. This allows the target device to select any available PVC VCL entry on the interface, subject to the traffic-matching criteria.

This can be used in conjunction with proprietary IEs to select the target according to other criteria. For example, a proprietary IE might be used to carry information about the application using the SPVC; this information could be used at the target device to select any PVC VCL entry that supports this application.

## 2.6 Retrying failed SPVCs

At the originating end, the SPVC entry can be configured to retry on failure.

If the SPVC entry is configured to use a wildcard VPI/VCI at the target, it learns what VPI/VCI is being used on a successful CONNECT response. In this case, if the SVC part fails and the SPVC entry retries activation, it should specify this VPI/VCI.

The intention of this is that after temporary failure, the SPVC should re-use the same PVC VCL entry at the target, and hence the same instance of an application at the target. The end user applications may be written such that they are able to recover after a temporary failure (where the length of time which is considered "temporary" is entirely defined by the behavior of the applications).

This implies that if the target dynamically creates the target PVC VCL entry, then the originating SETUP message should explicitly specify the VPI/VCI rather than using a wild-card identifier. Consider the following example if both dynamic target creation and wild-card target VPI/VCI are permitted.

- An SPVC is set up specifying a wild-card PVC VCL entry. The target device picks VPI/VCI 0,50 for the dynamically created entry.
- The SPVC fails temporarily, and the PVC VCL entry (0,50) is deleted.
- While the first SPVC is temporarily inactive, a second SPVC is setup to the same target, again specifying a wild-card PVC VCL entry. At the target device, (0,50) is currently unallocated, so the second SPVC is connected to this PVC VCL entry.
- The first SPVC is retried, and as described above, the SETUP message carries the VPI/VCI (0,50) as used when the SPVC was previously active. However, this VPI/VCI is already in use and the SPVC must be failed.

As this example shows, this defeats the purpose of specifying the same VPI/VCI when retrying an SPVC. To avoid this scenario the target device should not dynamically allocate VCL entries for wild-card target VPI/VCIs.

# 3 Advantages to using Soft PVCs

An SPVC can be used in place of an SVC. This allows devices without signaling capabilities to be connected into an ATM network without the need to configure PVCs throughout the network. This confers several benefits, as described in this section.

## 3.1 Reduced administration

The PVC does not need to be configured administratively at all points through the network. The only management required is at the entry and exit devices; the SVC part of the SPVC is signalled automatically.

## 3.2 Better use of network capacity

The SVC part of an SPVC can be brought up and down administratively from the initiating side. This means that when the VC is not required, the SVC part can be brought down and hence the resources used for the VC are released. This is particularly advantageous in a device such as a DSLAM where a large number of PVC-connected devices may be configured, but only a subset is likely to be active at any time.

However, care needs to be taken with this approach, because the network may not have the bandwidth or buffering resources to enable all the configured SPVCs to be activated simultaneously.

## 3.3 Automatic re-routing around network failure

An SPVC can be configured to retry in the event of failure. This allows the SPVC to recover around network failure automatically, as the SVC part is re-routed automatically (using PNNI or other routing methods) around the failed device or link.

# 4 SPVCs in protection-switched networks

In a protection-switching environment, a VC is duplicated so that in the event of the primary path failing, a backup route can take over. Data Connection's proprietary approach to protection switching SPVCs cross-connects one PVC link to two SVC links, as shown in figure 2.

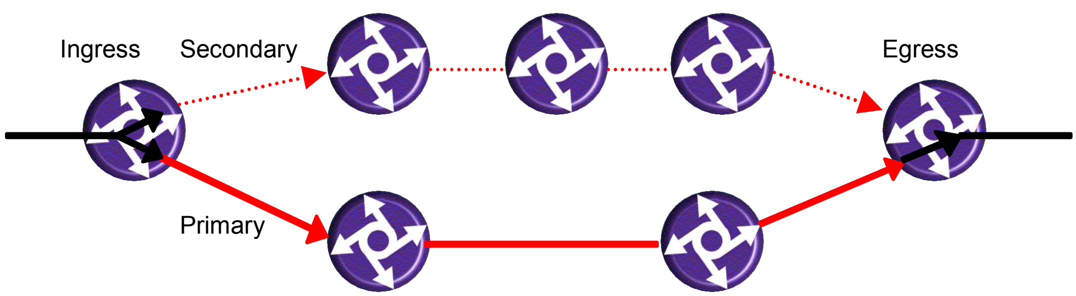



**Figure 2: Protection-switched SPVC**

At the ingress point, the PVC is cross-connected to two SVC links. At the switching fabric layer, this is much like setting up a point-to-multipoint connection. Cells are transmitted over both primary and secondary links.

At the egress point, the device needs to correlate the two incoming SVCs. A proprietary IE is signalled on both primary and backup SVCs to indicate that this is a protected SPVC, and that the two should be correlated. At the switching fabric layer, cells from the backup are discarded while the primary is active.

The egress point needs to detect when the primary connection fails in order to start to use cells from the backup connection. This is typically done using OAM cells (although this is outside the scope of the Data Connection implementation).

## 4.1 Routing protected Soft PVCs

To provide full protection, the primary and backup SVC parts of a protected SPVC should use distinct routes and therefore avoid having a node or link as a single point of failure. This can be achieved either by manual configuration, or by adaptations to the automatic routing algorithm that ensure that the route provided for the backup is distinct from the primary. (The Data Connection implementation supports both methods.)

# 5 SPVC Management in DC-ATM

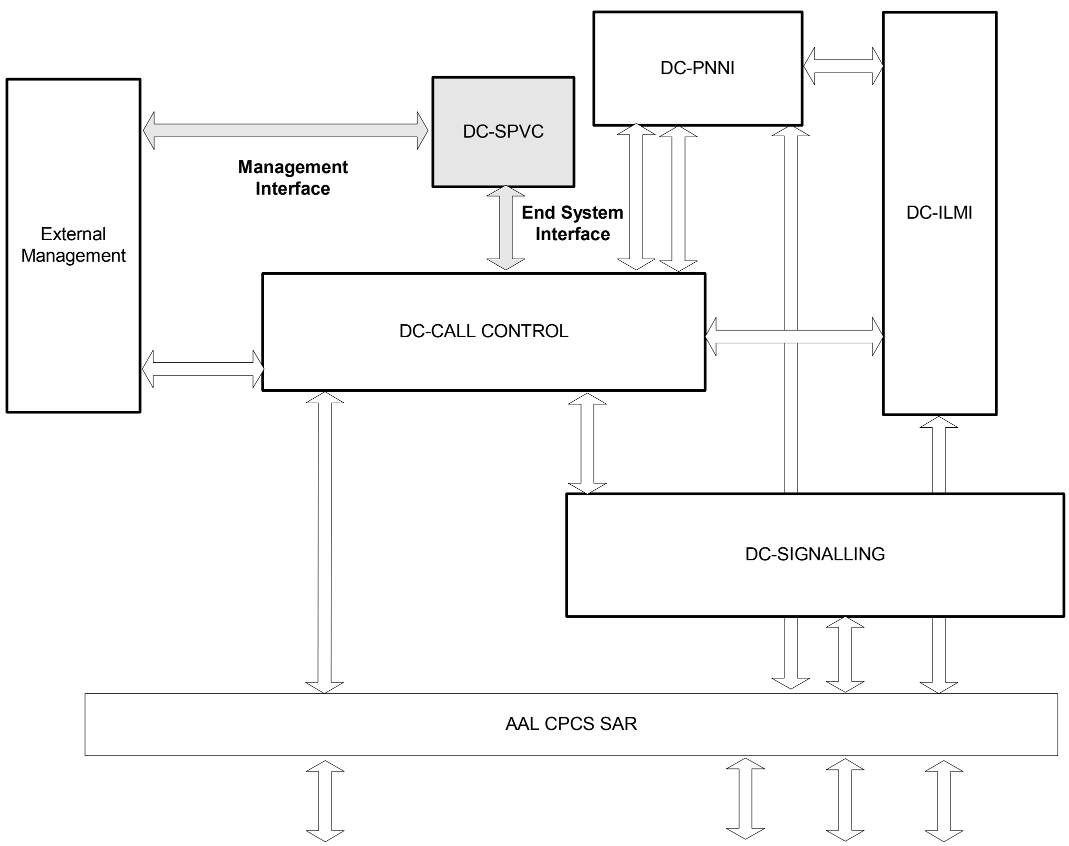
This section describes how the SPVC management is architected into the DC-ATM family of products.

DC-SPVC provides a complete solution for configuration and management of Soft PVCs. It is responsible for issuing the signalling messages to a call control component (such as DC-Call Control) to cause the establishment of SVCs that support the configured Soft PVCs.

Soft PVCs allow the operator to simplify network configuration by providing a user with PVC links into the network, while the SVC section of the SPVC allows optimal use of network resources and the ability to route around network failures.

DC-SPVC supports in full the Soft PVC MIB Addendum to the PNNI MIB, allowing for full SNMP MIB management of Soft PVCs.

The position of DC-SPVC in the ATM control plane in context with other components of an ATM stack is shown below.



# 6 Glossary

**IE**: Information Element.  A parameter or set of parameters carried in an ATM signaling protocol message.

**PNNI**: Private Network-Network Interface.  The ATM Forum signalling and routing protocol used between network devices in a private ATM network.

**PVC**: Permanent (or Provisioned) Virtual Circuit.  An administratively-configured connection between ATM devices.

**PVP**: Permanent (or Provisioned) Virtual Path.  An administratively-configured path between ATM devices, through which Virtual Circuits can pass.

**SVC**: Switched (or Signaled) Virtual Circuit.  A connection between devices set up dynamically as a result of Signaling protocol message flows.

**SVP**: Switched (or Signaled) Virtual Path.  A path between devices set up dynamically as a result of Signaling protocol message flows.

**UNI**: User-Network Interface.  The ATM Forum signalling protocol used between user and network devices.

**VC**: Virtual Circuit.  An ATM connection, which may be signaled (SVC), provisioned (PVC) or a combination (SPVC).

**VCL**: Virtual Circuit Link.  The local end of a Virtual Circuit arriving at an interface of a device.

# 7 References

The ATM Forum's specifications can be obtained from their website at http://www.atmforum.org.

The following specifications are of particular relevance.

| | |
|---|---|
| af-uni-010.001 | ATM User-Network Interface Specification Version 3.0 |
| af-uni-010.002 | ATM User-Network Interface Specification Version 3.1 |
| af-sig-0061.000 | ATM User-Network Interface Signalling Specification Version 4.0 |
| af-pnni-0026.000 | Interim Inter-switch Signalling Protocol Specification Version 1.0 |
| af-cs-0127.000 | PNNI SPVC Addendum Version 1.0 |
| af-pnni-0055.000 | PNNI V1.0 Specification |
| af-pnni-0081.000 | PNNI Version 1.0 Errata and PICs |
| af-pnni-0066.000 | PNNI Version 1.0 Addendum (Soft PVC MIB) |

# 8 About Data Connection

Data Connection Limited (DCL) is the leading independent developer and supplier of MPLS, ATM, SS7, MGCP/Megaco, SIP, VoIP Conferencing, Messaging, Directory and SNA portable products. Customers include 3Com, Cabletron, Cisco, Fujitsu, Hewlett-Packard, Hitachi, IBM Corp., Microsoft, NCR and Nortel.

Data Connection is headquartered in London UK, with US offices in Reston, VA and Alameda, CA. It was founded in 1981 and is privately held. During each of the past 18 years its profits have exceeded 20% of revenue. Last year sales exceeded $30 million, of which 90% were outside the UK, mostly in the US, leading to the company's second Queen's Award for outstanding export performance.

The DC-ATM product family provides OEMs with a flexible source code solution with the same high quality architecture and support for which Data Connection's other communications software products are renowned. It runs within Data Connection's existing high performance portable execution environment (the N-BASE). This provides extensive scalability and flexibility by enabling distribution of protocol components across a wide range of hardware configurations. It has fault tolerance designed in from the start, providing hot swap capabilities on failure or upgrade of hardware or software.

DC-ATM is suitable for use in a wide range of devices from simple end-user devices, through edge devices right up to massively-scaled distributed switches. The rich feature set and flexible architecture gives DC-ATM the performance, scalability and reliability required for the most demanding applications.

DC-ATM integrates seamlessly with Data Connection's MPLS, SS7 and other converged network software products, and uses the same proven N-BASE communications execution environment. The N-BASE has been ported to a large number of operating systems including VxWorks, pSOS, Chorus, Nucleus, Solaris, HP-UX and Windows NT, and has been used on all common processors including x86, i960, Motorola 860, Sparc, IDT and MIPS. Proprietary OSs and chipsets can be supported with minimal effort.

Liz Rice is the Product Manager for Data Connection's DC-ATM family of portable ATM protocol products, and also has responsibility for customer support for the DC-ATM and DC-MPLS products.

Data Connection is a trademark of Data Connection Limited and Data Connection Corporation. All other trademarks and registered trademarks are the property of their respective owners.