SQUARE PEG COMMUNICATIONS

Technical Memo

DPLT Use Cases

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Summary

The IsatData Pro (IDP) Physical Layer Tester (DPLT) is implemented on the SPCI Multi-Channel Platform (MCP). The application is therefore referred to as DPLT on MCP, or DMCP. The term DPLT may also be used to refer to the DMCP in a generic sense.

This memo summarizes some use cases for the DPLT, including:

1. Basic physical layer testing
2. Comprehensive physical layer testing
3. Protocol testing
4. Simple network emulation / interworking
5. Full network emulation / interworking
6. Production test

1 Introduction

This document presents some use cases for the IsatData Pro (IDP) Physical Layer Tester (DPLT) as implemented on the SPCI Multi-Channel Platform (MCP).

The product is referred to as DPLT on MCP, or DMCP. The term DPLT may also be used to refer to the DMCP in a generic sense.

1.1 Background

IsatData Pro (IDP) is a low-data-rate tracking, monitoring, and messaging service originally developed and deployed by SkyWave Mobile Communications. IDP delivers a significant increase in capability over other services already in the market. Near real-time messages of up to 10,000 bytes to the device, and up to 6,400 bytes from the device, serve the increasing demand for higher data speeds in machine-to-machine (M2M) solutions. In comparison, other global M2M services currently on the market offer data connectivity at just 270-340 bytes per message.

IDP supports a wide range of security and location-based services in the fast-growing M2M market: from tracking and in-cab messaging for commercial transportation and government fleets, transmitting telemetry information from oil & gas distribution equipment, to remote management and control of fixed assets.

As part of Orbcomm's purchase of SkyWave, Inmarsat acquired the IDP network equipment and the rights to use and evolve the IDP air interface. Inmarsat subsequently contracted Square Peg Communications Inc. (SPCI) to develop test tools to facilitate the testing and type approval of IDP Mobile Terminals (MTs), including the IDP Physical Layer Tester on MCP (DMCP) and associated scripts for executing Mandatory Test Requirements (MTRs).

1.2 Capabilities And Test Facilities

The DMCP implements the communication channels and other facilities required to execute the IDP MT Physical Layer and Network Protocol MTR scripts. It provides the capabilities of introducing selectable channel impairments into the transmitted signals and of analyzing the technical characteristics of the received signals. The DMCP interfaces to the MT at L-band. With appropriate scripts, the DMCP can also generate and analyze messaging traffic locally.

The physical layer qualification tests for an IDP MT are performed by test scripts executing on a DMCP. The DMCP employs the same hardware platform as SPCI's BGAN tester (BPLT on MCP, or BMCP). Much of the application software is common with the BMCP and other PLT products, including scripting and signal analysis facilities.

The IDP physical layer test scripts operate within an infrastructure based on that used by the BGAN UT Mandatory Test Requirement (MTR) scripts, which execute on the BPLT and which are used by manufacturers of BGAN mobile terminals to perform similar qualification tests. The infrastructure includes facilities for:

- controlling and monitoring the MT, using a defined messaging protocol over a maintenance interface.
- communicating with a user-furnished equipment controller to employ external test equipment such as a spectrum analyzer or signal generator.
- specifying the test parameters and pass/fail criteria for each test.
- logging the measured values or other information obtained during a test.
- logging the overall results of a test.
- running individual tests or groups of tests.

The DMCP is capable of performing physical layer tests without the involvement of the protocol stack within the MT. This requires the MT to support a maintenance interface by which the DMCP can control the MT, e.g., to command the transmission of bursts with specified frequency, power, and timing.

The DMCP also supports protocol testing or network emulation under the control of local scripts or an external protocol tester, similarly to other PLT products.

The DMCP implements a subset of the IDP MPC/ESE interface such that the DMCP can be used with the MPC for interworking testing.

1.3 Definitions And Acronyms

The following acronyms may be used herein:

AIU	ATC Interface Unit
ATC	Ancillary Terrestrial Component
AWGN	Additive White Gaussian Noise
BB	Bulletin Board
BER	Bit Error Rate
BGAN	Broadband Global Area Network
BMCP	BPLT on MCP
BPLT	BGAN Physical Layer Tester
COTS	Commercial Off-The-Shelf
CU	Channel Unit
DMCP	DPLT on MCP
DPLT	IsatData Pro Physical Layer Tester
DSP	Digital Signal Processing / Digital Signal Processor
EC	Equipment Controller
ESE	Earth Station Equipment
FL	Forward Link
GB	Global Beam
GPIB	General Purpose Interface Bus
GPS	Global Positioning System
HW	Hardware
ICD	Interface Control Document
IDP	IsatData Pro
IP	Internet Protocol
LES	Land Earth Station
M2M	Machine-to-Machine
MCP	Multi-Channel Platform
MPC	Message Processing and Network Operations Center (the processing hub of the IDP system)
MSS	Mobile Satellite Service
MT	Mobile Terminal (an IDP Mobile Terminal consists of a Modem plus a Mobile Application)
MTR	Mandatory Test Requirement
NRE	Non-Recurring Engineering
OEM	Original Equipment Manufacturer
OI	Operator Interface
PC	Personal Computer
PLT	Physical Layer Tester
PLT-H	Physical Layer Tester – High Speed platform
PLT-M	Physical Layer Tester – MCP platform
RF	Radio Frequency
RL	Return Link
SC	System Configuration
SDM	System Definition Manual
SIP	System Information Packet
SPCI	Square Peg Communications Inc.
SW	Software
TBA	To Be Agreed
TBC	To Be Confirmed
TBD	To Be Determined
TCP	Transmission Control Protocol

2 Basic Physical Layer Testing

Figure 2-1 shows a basic DMCP configuration that can be used for physical layer tests that don't require wideband spectral measurements or high-level, wideband, or out-of-band interference.

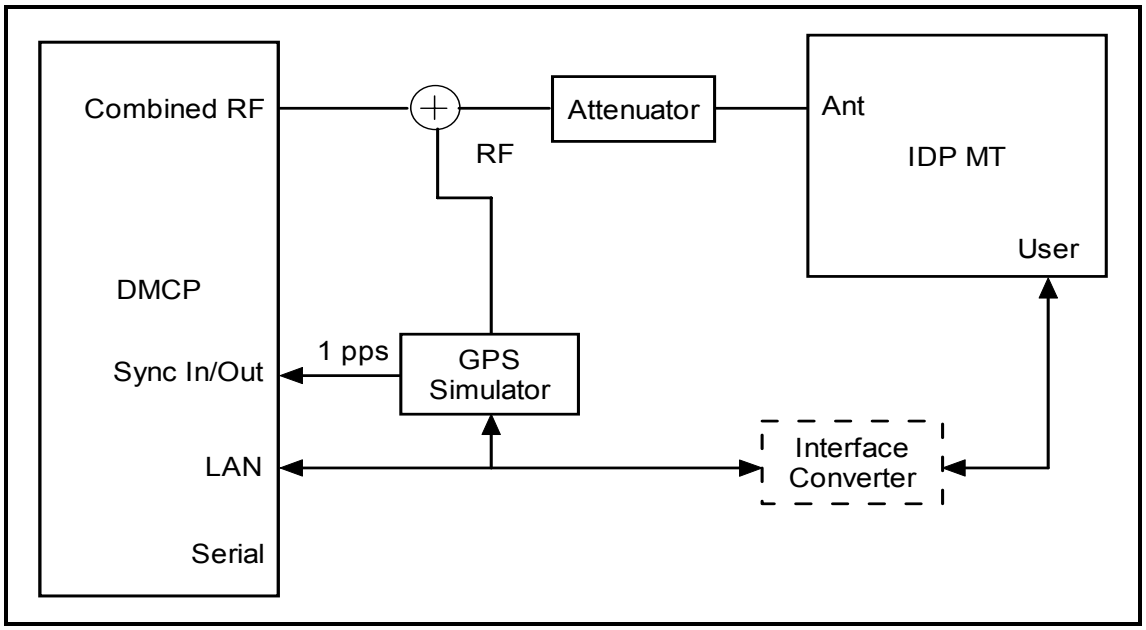

Figure 2-1 Basic Physical Layer Test Configuration

This configuration supports physical layer tests such as:

- transmitter parameters
- transmit carrier frequency accuracy and stability
- transmit phase noise
- modulator performance
- receiver acquisition in the presence of channel impairments
- receive packet error rate in the presence of channel impairments

The GPS simulator provides timing and location information to the MT at RF and to the DMCP via Ethernet. It also provides a discrete 1 pps pulse to the DMCP for precise timing synchronization.

The MT is shown as being controlled by the DMCP over an Ethernet interface, using an interface converter if required (e.g., if the MT has only a serial interface). This is compatible with the operation of the existing BGAN Physical Layer MTR scripts.

Note: Use of the IDP Physical Layer MTR scripts assumes that the MT implements the DPLT/MT interface. This is not implemented on existing SkyWave/Orbcomm products.

3 Comprehensive Physical Layer Testing

Figure 3-1 shows a DMCP test configuration that includes additional user-furnished test equipment for use in performing the IDP Physical Layer MTRs. The equipment shown is typically required, although the power meter may not be required if the analyzer is sufficiently accurate.

The test equipment is controlled by a user-furnished Equipment Controller (EC), which communicates with the DMCP over Ethernet. This allows functions such as injecting out-of-band interference to be performed automatically by the MTR scripts rather than requiring manual intervention. Using the EC makes the operation of the test equipment transparent to the MTR scripts.

The EC can also control the routing of RF signals as required, e.g., to switch the MT output to the DMCP, the spectrum analyzer, or the power meter. This is user-specific and must be handled transparently by the EC.

The IDP PL MTR scripts use the same messaging protocol with the MT and the EC as the BGAN PL MTRs, with modifications as required to handle the IDP channel types and other IDP characteristics.

The EC could perform the required translations to accommodate an MT that does not implement the standard DMCP/MT interface. In this case the EC would appear as the MT to the DMCP, and would communicate with the real MT using an appropriate interface.

If no special interfaces are required it may be possible for the user to implement the EC as an application running on the DMCP host concurrently with the DMCP application.

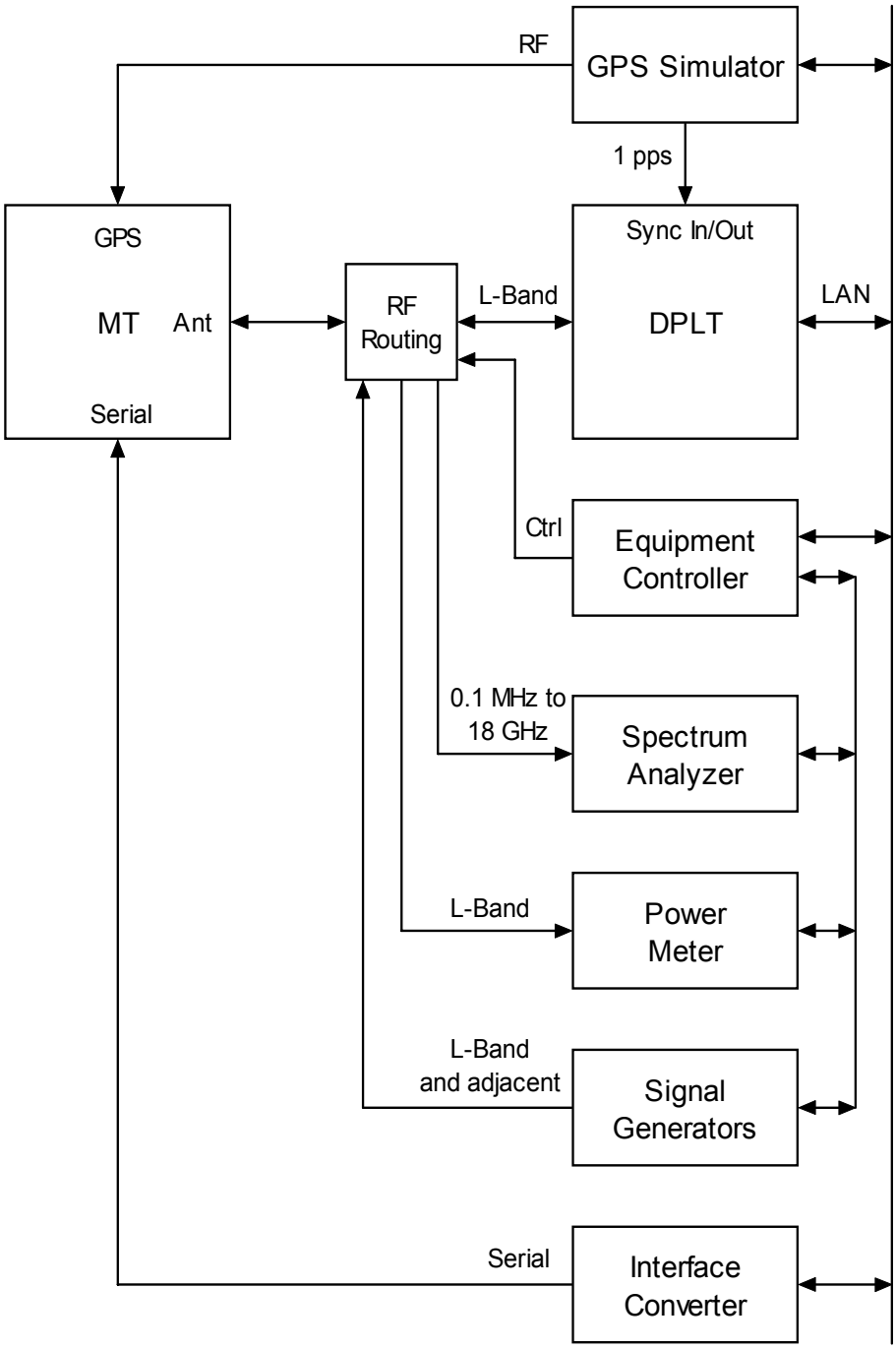

Figure 3-1 Comprehensive Physical Layer Test Configuration

4 Protocol Testing

Figure 4-1 illustrates a configuration that can be used for protocol testing, i.e., verification of MT compliance with the IDP network layer protocol specifications.

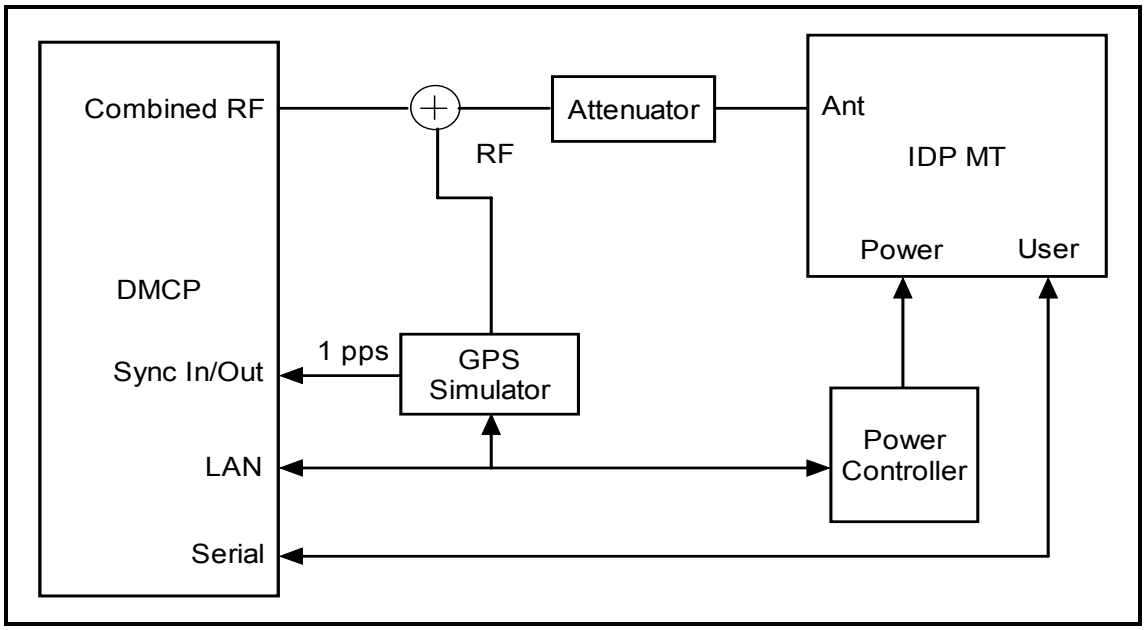

Figure 4-1 Protocol Test Configuration

Scripts executing on the DMCP verify the network layer compliance of the MT using a closed-loop system whereby the scripts can send and receive messages, and perform other common functions, using the AT interface of the MT. The MT runs in its normal operational mode; i.e., the protocol tests operate on the MT as a black-box.

5 Simple Network Emulation / Interworking

Figure 5-1 illustrates a configuration that can be used for basic network emulation. The MT runs in its normal operational mode.

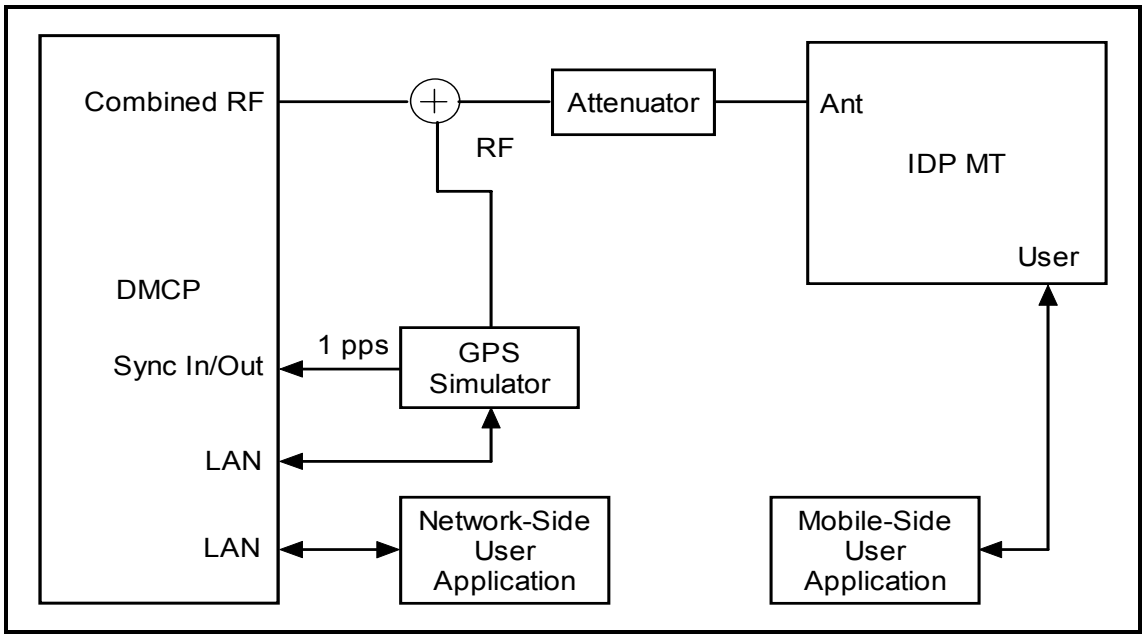

Figure 5-1 Simple Interworking Test Configuration (direct connect)

In this configuration, the network emulation is implemented in the DMCP scripting language. Scripts are initially available for:

- MT registration
- to-mobile data transmission (script prompts user for data)
- from-mobile data transmission (script displays received data)

Additional functionality can be scripted as desired. In addition, the scripts can be modified to route to to/from an external network-side user application rather than to/from the GUI.

Note: As shown in Figure 5-2, the direct RF paths between the DMCP and the MT, and the GPS and the MT, can be replaced with radiated paths using a suitable anechoic chamber and antennas.

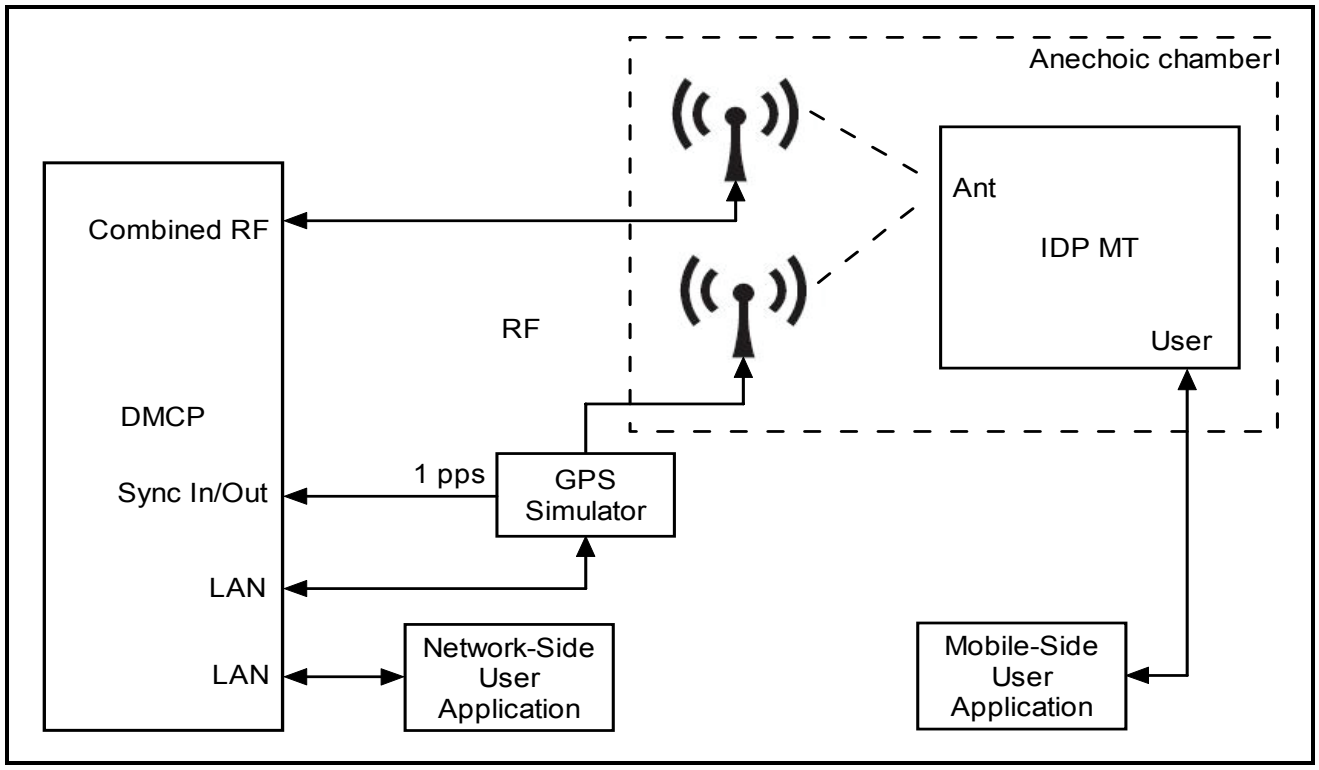

Figure 5-2 Simple Interworking Test Configuration (radiated)

6 Full Network Emulation / Interworking

Figure 6-1 illustrates a configuration that provides full emulation of the IDP network. The MT runs in its normal operational mode.

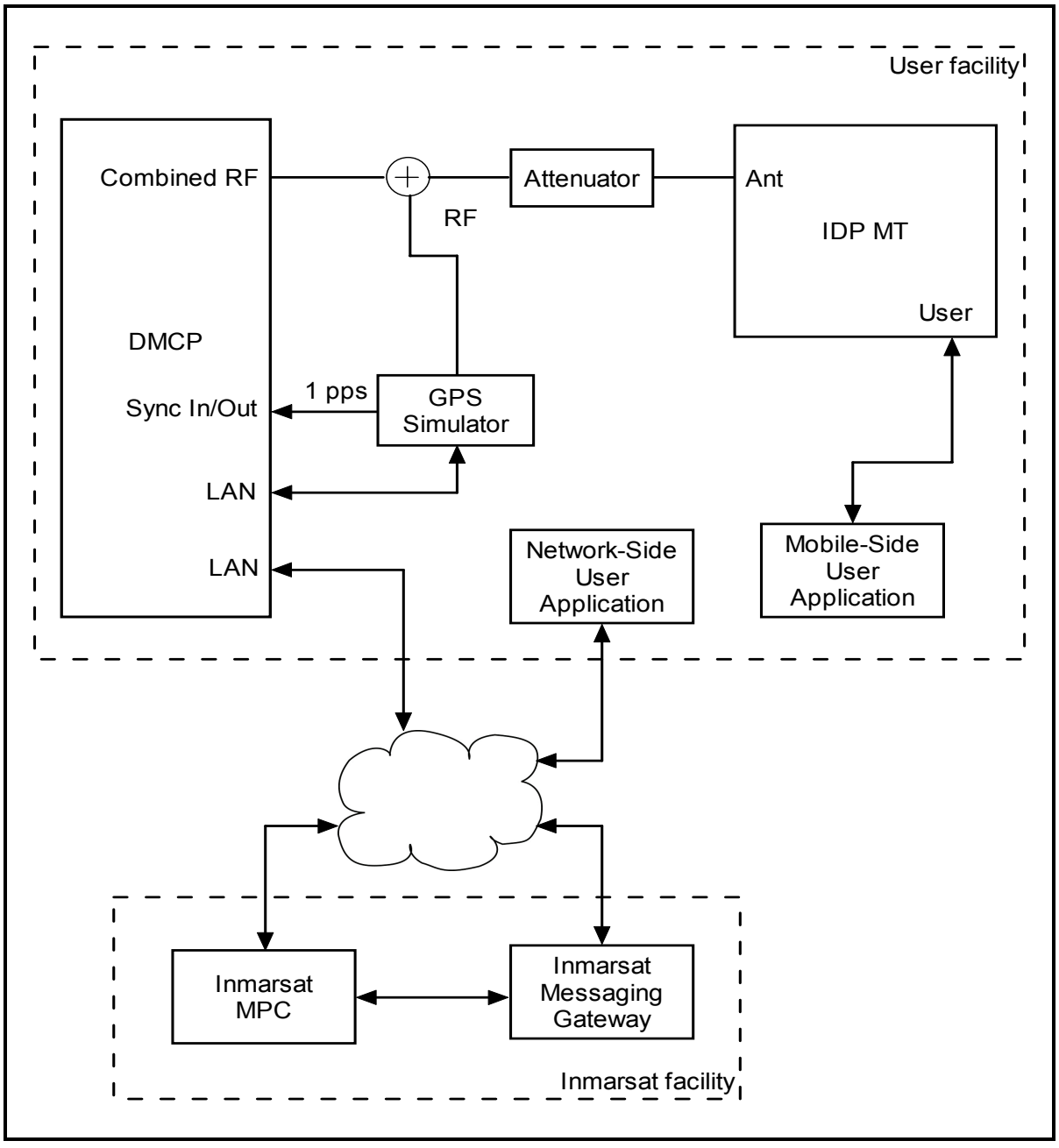

Figure 6-1 Full Interworking Test Configuration

In this configuration, the DMCP emulates the satellite link and the Inmarsat Earth Station Equipment (ESE) and connects via the Internet to an Inmarsat Message Processing and Network Operations Center (MPC) and Gateway. The user's network-side and mobile-side applications operate as they would over the real network. The DMCP and MT can also be connected wirelessly, as shown in Figure 5-2.

7 Production Test

There are a variety of equipment configurations that can be used during production testing, depending upon the desired test coverage.

The setup shown in Figure 5-2 facilitates final test, where basic interworking with the MT can be verified. Assuming a calibrated setup is used, including path loss in the anechoic chamber, this configuration can also be used to verify the transmit level from the MT and the dynamic range of the MT's receiver. The latter can make use of the Modem Rx Metrics system message, which can report C/No, channel error rate and UW error rate as seen by the receiver.

If emissions testing is required, the test setup can be augmented with a spectrum analyzer.