



ADAPT OVERVIEW AND MODULE DESCRIPTION

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REPORT SUMMARY AND DISTRIBUTION**SUMMARY:**

This document provides an overview of the Aircraft Data Acquisition, Processing and Tracking (ADAPT) system which has been developed by Celeris Aerospace Canada Inc. for the acquisition, validation, processing and dissemination of data obtained from aircraft structural health monitoring programs.

The ADAPT system is a Web-capable, modular client server application that has been developed using the Microsoft .NET technology. Its modular structure allows it to be readily interfaced with any structural health monitoring recorder and provide immediate warnings with regard to harsh or unusual usage of individual or multiple aircraft. In addition, the ADAPT system is also capable of accumulating long-term usage data that can be used for trend analysis and/or fatigue and damage tolerance analysis.

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ADAPT Overview and Module Description

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GLOSSARY OF TERMS

ADAPT	Aircraft Data Acquisition, Processing and Tracking
AOG	Aircraft-on-Ground
FLAP	Field Level Analysis Program
FTP	File Transfer Protocol
IP	Internet Protocol
NAT	Network Address Translation
PCMCIA	Personal Computer Memory Card International Association
PDA	Personal Digital Assistant
SHMS	Structural Health Monitoring System
VPN	Virtual Private Network

1 INTRODUCTION

The Aircraft Data Acquisition Processing and Tracking (ADAPT) System is a Web-Based system designed specifically for the acquisition, validation, analysis, reporting and tracking of aircraft structural health monitoring data. It provides current, reliable and accurate data based on actual, as opposed to assumed, operational usage thereby allowing fleet operators to make informed decisions pertaining to the structural health of their aircraft

The system utilizes the Microsoft .NET architecture to securely capture and disseminate data obtained from geographically dispersed aircraft operating anywhere in the world. It has both the capability to alert operators of structural incidents requiring immediate inspection/maintenance intervention, as well as accumulating data for longer term fatigue and damage tolerance analysis.

Data trend capabilities allow operators to manage the structural health of their fleets by rotating aircraft between roles. The ADAPT system also facilitates proactive fleet management thereby maximizing aircraft operational availability and minimizing the risk of “unanticipated” problems or Aircraft-on-Ground (AOG) situations occurring.

2 ARCHITECTURE

ADAPT is designed around a modular client-server architecture so that it can be readily integrated with existing or related structural health management systems. It can easily be interfaced with any structural health monitoring recorder and structural analysis program thereby allowing users to protect and/or build upon their investment infrastructure. Current/pending ADAPT modules are depicted in Figure 1. Future plans include the addition of modules to interface ADAPT with inspection and maintenance software.

ADAPT has also been structured to interface with/utilize readily available and established third party database and graphing tools. This capability helps to minimize development costs and the number of additional pieces of software that have to be mastered to fully exploit the ADAPT system. System requirements and third party software requirements are specified in Sections 2.1 to 2.3.

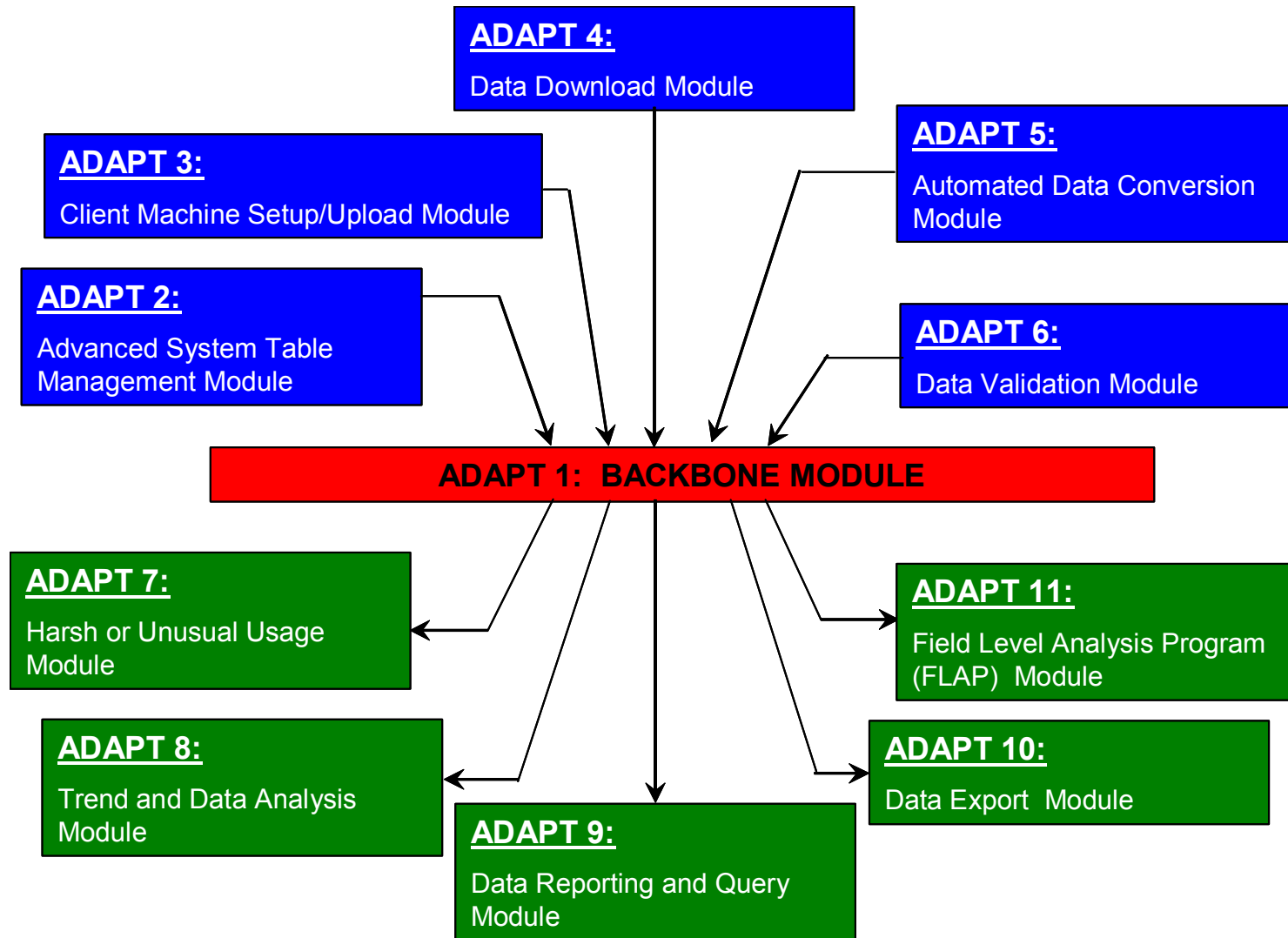


Figure 1: Schematic Diagram of ADAPT Modules

2.1 Required System Hardware and Software Configuration

The minimum system hardware and software configuration required for the ADAPT system is defined in Sections 2.1.1 and 2.1.2.

If desired, all system hardware and software can be procured by Celeris Aerospace Canada Inc. on behalf of their clients. The costs of procuring system hardware and software will be in addition to the cost of the ADAPT modules.

2.1.1 ADAPT System Hardware

- Windows® compatible CPU: Intel Pentium4 at 2.4 GHz or faster
- Minimum 512MB RAM memory upgradeable to 1GB RAM
- Floppy drive
- Monitor
- Keyboard
- Mouse
- Disk Drives (arranged in RAID 5 array):
 - One (1) SCSI controller
 - Three (3) SCSI hard drives, each 30GB or larger
- DVD/CD-ROM drive:
 - Read capability: DVD and CD-ROM
 - Write capability: CD-ROM
- Ethernet 10/100 compatible network adapter
- Tape Drive:
 - Capacity: 60MB or larger with at least 5 tape cartridges
 - Tape backup software
 - Media: At least 5 tape cartridges
- Uninterruptible power supply (UPS):
 - 700 VA or better
 - Compatible automatic shutdown software
- Network Firewall:
 - Network Address Translation (NAT)
 - IPSec Virtual Private Network (VPN) access
 - Protection against Denial-of-Service attack
 - Stateful IP packet inspection

2.1.2 ADAPT System Software:

- Operating System: Windows 2003 Server Standard (preferred)
 - Windows 2000 Server Standard (alternate)

Note: Windows 2000/2003 server contains the Internet Information Server (IIS) web server that is required to implement the ADAPT application as an Internet application.

- Database Software: SQLServer 2000 Standard

- Anti-virus Software with automatic updates of virus definitions and virus detection engine

2.2 IP Addresses

For the purpose of acquiring data via the Internet, ADAPT requires an addressable external IP address which may or may not be associated with a dedicated domain name.

While safe and secure data transfer and interrogation access are an integral part of the ADAPT system, the system can be customized to operate on a corporate intranet using a dedicated internal IP address. The intranet has to be capable of being accessed by all anticipated users.

2.3 Third Party Software

In addition to the System Software specified in Section 2.1.2, the third party run-time software components specified in Table 1.

If desired, all third party software can be procured by Celeris Aerospace Canada Inc. on behalf of their clients. The costs of procuring the third party software will be in addition to the cost of the ADAPT modules.

Module ID	Description	Third Party Software	Comments
ADAPT 1	Backbone Module	<ul style="list-style-type: none"> ifoundtime Persistence Manager Runtime Solution Partners Inc. Menu Control 	
ADAPT 2	Advanced System Table Management Module		
ADAPT 3	Client Machine Setup/Upload Module	<ul style="list-style-type: none"> Recorder Manufacturer memory read program 	
ADAPT 4	Data Download Module	<ul style="list-style-type: none"> Dart Communications Power TCP Secure FTP for .NET 	
ADAPT 5	Automated Data Conversion Module	<ul style="list-style-type: none"> Recorder Manufacturer Engineering Units Conversion Program 	
ADAPT 6	Data Validation Module		
ADAPT 7	Harsh or Unusual Usage Module		
ADAPT 8	Trend and Data Analysis Module		
ADAPT 9	Data Reporting and Query Module	<ul style="list-style-type: none"> Appropriate Graphics Plotting Software Runtime Module 	May vary according to file customization
ADAPT 10	Data Export Module		
ADAPT 11	Field Level Analysis Program Module	<ul style="list-style-type: none"> Recorder Manufacturer Engineering Units Conversion Program Appropriate Graphics Plotting Software Runtime Module 	

Table 1: Required ADAPT Third Party Software Components

3 FUNCTION AND CAPABILITY OF ADAPT MODULES

The capabilities of the ADAPT modules encapsulate over twenty years experience with the acquisition, validation, processing and dissemination of aircraft structural health monitoring data. Consequently, the basic configuration will address the requirements of many aircraft operators. However, the nature of structural health monitoring programs is such that depending on the scope and nature of the program, different levels of customization may be required. Celeris Aerospace has designed the ADAPT modules so that they can be readily adapted to accommodate individual client customization as required.

3.1 ADAPT 1: Backbone Module

The backbone module provides the basic structure that links the various ADAPT modules together. As such, this is a mandatory component that has to be implemented as part of any ADAPT module application. The basic module contains:

- The Basic ADAPT .NET framework;
- Rudimentary System Management tools that allow basic setup of users and aircraft etc. More advanced system management requires that the Advanced System Table Management Tool to be acquired;

3.2 ADAPT 2: Advanced System Table Management Module

The ADAPT System contains a significant collection of system tables. This module manages the system configuration and provides complete accountability / traceability of the flight data back to any factor that could influence the data. Capabilities encapsulated in this module include:

Organization:

- Define Organizations (fleet operators, support contractors, oversight agencies, etc.)
- Define aircraft Fleets within Organizations
- Define Aircraft within Fleets

Security:

- Define Authorized Users within Organizations
- Define functional Roles defined within the ADAPT application
- Assign Roles to Authorized Users as necessary
- Define Actions (activities) defined within the ADAPT application that require permissions to execute

- Assign permission to Roles to execute specific Actions
- Assign Authorized Users permission to update data on specific Aircraft

Instrumentation:

- Define Recorder Model definitions
- Track individual Recorder Models
- Track installation of Recorders to Aircraft
- Track software upgrade installation on Recorders
- Track the Channel Configuration setup on each Recorder

Validation:

- Define Validation error messages

Maintenance

- Define Maintenance Actions (severity and response times)
- Assign Maintenance Actions to Validation Errors
- Designate Authorized User to receive Maintenance Actions for each Aircraft

Analysis:

- Track software upgrades on Recorder File Translation software used to convert and scale each recorder file upload to engineering units
- Track software upgrades on ADAPT software used to import each translated Recorder File
- Track software versions of DADT Analysis software used to analyze flight data

3.3 ADAPT 3: Client Machine Setup/Upload Module

ADAPT resides on a server which receives data over the Internet/Intranet recorded by a structural health monitoring system. Typically, data is downloaded from a recorder using the recorder manufacturers proprietary download software onto a removable storage device such as a PCMCIA card, Read/Flash Card. This in turn is read by either a laptop or Personal Digital Assistant (PDA) which extracts the recorded data in a proprietary and compressed binary format. The data is then in the position to be uploaded to the ADAPT system.

To facilitate the data transfer and subsequent validation of data to the ADAPT server, a Client Machine Setup/Upload Modules has been developed. This module has to be customized in conjunction with the recorder manufacturer and hence will vary according to both the manufacturer and recorder type used for a particular program. Modules for a number of structural health monitoring manufacturer/type configurations have been developed and/or are in the process of being developed. The basics function of this module is to set up and configure the client device to interface with the ADAPT system by:

- Installing a customized dynamic FTP control that is compatible with secure ADAPT data transfer protocols; and
- Configuring the permissions on the client machine to ensure data can be transferred between the client machine and the ADAPT server.

3.4 ADAPT 4: Data Download Module

The data download module is the complimentary module to the client machine setup/upload module (Section 3.3) that resides on the server. Once again, the basic structure of the ADAPT module will require some customization to accommodate different structural health monitoring system manufacturer/model types. Modules for a number of structural health monitoring manufacturer/type configurations have been developed or are in the process of being developed. The basic function of this module is to:

- Receive data that is uploaded to the ADAPT server in a compressed format;
- Validate a successful data transfer through parity and other appropriate checks; and
- When appropriate, initiate the automated data conversion module.

3.5 ADAPT 5: Automated Data Conversion Module

The compressed binary files obtained from a structural health monitoring system are generally formatted in a proprietary format. They are generally converted to Engineering Units using an SHM manufacturer's software using a proprietary conversion program. However, this processing often has to be carried out on a binary-file-by-binary file basis and can become extremely tedious especially when multiple files each containing one or more flights are involved. The automatic data conversion module interfaces with the SHM manufacturer's software to automatically:

- Convert the binary data to engineering units and parse out individual flights;
- Store the resulting data in a robust SQLServer relational data-base so that it can be accessed and queried on a parameter-by-parameter basis for analysis by the Data Validation (Section 3.6), Harsh or Unusual Usage (Section 3.7), Trend and Usage Analysis (Section 3.8), Data Reporting/Query (Section 3.9) and Data Export Module (Section 3.10); and

- Tracks changes in slopes and offsets and other related recorder configuration changes for use in data validation procedures.

3.6 ADAPT 6: Data Validation Module

The data validation module is a key module in the ADAPT system. Using extensive data validation criteria developed over a twenty year period the data validation module validates data from both an instrumentation and structural engineering perspective to ensure the ongoing integrity of the recorded data. A unique feature of this module is its ability to isolate both logical and potential errors based on the interaction between multiple parameters. Once errors are identified, the data validation module alerts appropriate personnel by E-Mail with regard to:

- Equipment errors, thereby minimizing data losses and the amount of fill-in data that has to be used in any fatigue and/or damage tolerance analysis;
- All outstanding errors together with information pertaining to remedial action that has been implemented to rectify and/or resolve them; and
- Links data errors with their associated recorded data to facilitate the rapid identification of the reason(s) for any recorded parameter anomalies.

3.7 ADAPT 7: Harsh or Unusual Usage Module

The Harsh or Unusual Analysis Module alerts appropriate personnel as to when single and/or multiple parameter criteria have been violated. This allows exceedances of any operational limits to be rapidly isolated (for example, Over-g, severe turbulence, heavy landing etc.) and appropriate remedial inspection/maintenance/overhaul actions to be implemented immediately. The criteria in the harsh or unusual usage module are user specified and can be associated with meaningful instructions such as step-by-step instructions pertaining how to carry out the appropriate action and record/report the findings of that action (eg: for example the results of an inspection)

3.8 ADAPT 8: Trend and Data Analysis Module

The trend and data analysis module allows the user to apply standard and some “ad-hoc” queries against the data on a flight-by-flight and/or parameter-by-parameter by parameter basis. Depending on the data being monitored, the data can be filtered across one or more aircraft by individual or combinations of criteria such as:

- Chronological occurrence;
- Mission Profile;
- Ranges of one or more parameters; and
- Physical Location of operation;

Presentation options include, but are not necessarily limited to parameter exceedance profiles (eg: g-level or strain exceedance diagrams), individual flight profiles and maximum and minimum parameter values experienced.

3.9 ADAPT 9: Data Reporting and Query Module

The data reporting and query module allows users to obtain formatted reports, typically in PDF format, against the data base related to anything ranging from aircraft parameter settings, recorder configurations, recorder software configuration and the standard and ad-hoc queries described in Section 3.8. Reports can be customized to provide data in corporate or regulatory agency required formats. The reports themselves can be comprised of text, plots and other appropriate information and automatically distributed via E-Mail to authorized personnel.

3.10 ADAPT 10: Data Export Module

The data export format, allows information in the database to be extracted in generic CSV formats and or structured formats such as that used by AFGROW for fatigue and damage tolerance analysis. Parameters can be extracted individually or in appropriate groupings. Once again, filters similar to those listed in Section 3.8 can be used to focus on different facets of the data.

3.11 ADAPT 11: Field Level Analysis Program (FLAP) Module

The Field Level Analysis Program (FLAP) Module is a self-contained module that can be deployed on a laptop or PC and is primarily intended for use in the Structural Health Monitoring System set-up/troubleshooting environment. FLAP provides tools that allow engineering/installation personnel to rapidly parse out individual flights and view time synchronized plots of multiple parameters on a flight-by-flight basis. Additionally, for each flight, FLAP provides the capability to filter the data by individual trigger channels and provides summaries of the maximum and minimum values attained for each parameter.

4 FURTHER INFORMATION ABOUT ADAPT

Further information about ADAPT and its application/customization to meet structural health monitoring data acquisition, validation, processing and dissemination requirements can be obtained from Steve Hall (halls@celeris.ca) or John Miner (minerj@celeris.ca) at:

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