# AD\ANTECH Enabling an Intelligent Planet

## Advantech AE Technical Share Document

Date	2017/12/22	SR#	1-3306640533						
Category	■FAQ □SOP	Related OS	N/A						
Abstract	How to use DNP3 protoco	How to use DNP3 protocol to inquire tag from ADAM-3600							
Keyword	TagLink Studio, DNP3, pro	otocol, service							
Related		ADAMA 2000							
Product	ADAIVI-3000	ADAM-3600							

#### Problem Description:

This document demonstrates how to use DNP3 protocol to inquire tag from ADAM-3600 as DNP3 Server step-by-step. The concept of DNP3 and terminology are also introduced in this document.

#### Answer:

The system architecture with DNP3 protocol is illustrated as bellow drawing.



ADAM-3600 acts as DNP3 *Server*, which would allocate one Database and could be inquired by DNP3 *Client* (Simulation PC) by LAN port.



Each session includes 1 Server ID and 1 Client ID. ADAM-3600 supports 4 sessions as DNP3 Server.



#### Settings in TagLink for DNP3

<b>1</b>		Advanted	h TagLink Studio			_ <b>—</b> X
Project Help						۵ ()
Create Open Close Save Project Project	Ject Export To mload SD Card Deploy Option	IS Export tags to Excel				
Project Configuration	D DNP3 Outstation(NewDevice)*	x				
NewProject3     NewDevice-11.0.0.4	Apply 🗶 Discard					
ia 📥 Data Center	Channel					
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	Binary Input Number(BI): 4	Analog Input Numb	er(AI): 0 Counte	r Number(CNT): 0	Show/Hidden All	
Connectivity	8 Sinary Output Number(BO): 4	Analog Output Nun	nber(AO): 0 Double	bit Input Number(DBI): 0		
E-leg System	Session1					
	DNP3 Point	Assign Class	TagName	Event High Limit	Event Low Limit	Event Deadband
	• BI,000	Class 1		0	0	0
	BI,001	Class 1		0	0	0
	BI,001 BI,002	Class 1 Class 1		0	0 0	0
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- 1. Double click on "DNP3 Outstation"
- 2. Use the default port as 20000
- 3. Select Session
- 4. Enable this session
- 5. Server Address is for iRTU ADAM-3600. We set it as "4" for Server.
- 6. Client Address is for simulation PC. We set it as "3" for Client.
- 7. Set the number of I/O Tags you want to monitor
- 8. In this demo, we use DO to control the tag value.

<u>5</u>		Advantech	TagLink Studio 🔣 s	elect Tag	x		×
Crate Open Close Seve Project Project Project Project Downkiz Project Project Project Project Downkiz Project Configuration      NewProject3     MexPolexcs11.0.0.4     Deat Center     On NP3 OutStation     Ou	Export To d SD Card Show Tag Import Tags Ex from Excel D DNP3 Outstation(NewDevice)* x Apply Discard Channel Port Number: 20000 Session Status: 2 3 4 Sessions Session Lett: Session 1 V Enable 12 St	Advantech	ter Address:3	elect Tag         #BATCH_WRITE_Boal           # #BATCH_WRITE_Boal         #DEVICE_ERROR_Boal           # BOARDOALL         BoardIOALL           BoardIOALL         BoardIOALL           BoardIOALL         BoardIOALL           BoardIOALL         BoardIOALL           BoardIOALL         BoardIOALL           BoardIOAL         BoardIOALL           BoardIOAL         BoardIOAL           BoardIOAL         BoardIOAL		More Parameters	×
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	DNP3 Point	Assign Class	TagNam	e Event High L	imit Even	t Low Limit Event Deadband	
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	BI,001	Class 1	BoardIO:DI.2	0	0	0	
	B1,002	Class 1		0	0	0	1
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	BO,000	Class 1	BoardIO:DO.0	0	0	0	
	PO 002	Class 1	Double click to odt	0	0	0	1
	BO 003	Class 1		0	0	0	1
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- 9. Select the I/O Tags you want to monitor. Press OK.
- **10.** Apply for the configuration changed.

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<u>8</u>			Α	dvantech iRTU Stud	io			- 2	x
Project Help								Â	১ 🕕
Create Open Close Save Project Project Open Close Common Close Common Common Close Close Common Close Clos	Export To stad SD Card	Show Tag Count							
Project Configuration «	D DNP3 Outs	tation(NewDe	vice) × 🛃 IO Tag(N	ewDevice-BoardIO)	🔒 Network Settin	g(NewDevice)			
DNP3test     NewDevice-15     Data Center     V/0     Description	DNP3 Channel	Outst	ation					Apply Cancel Change	e
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System Tag Galculation Tag Galculation Tag Calculation Tag Calculation Tag Calculation Tag Calculation Tag Calculation Tag DNP3 Outstation DNP3 Outstation DNP3 Outstation DNP3 Outstation Calculation DNP3 Outstation Calculation C	Session's Session List: Se ✓ Binary Input ✓ Binary Output Session1 DHP3 Point BI,000 ► AI,000		NewDevice-15	Reconnecting	10.0.0.20		100%	Event Deadband	
- © Time Sync Setting		E Reboot					Download Close		

11. Download to iRTU. DNP3 service will start automatically after downloading.

#### Settings in Simulation PC as DNP3 Client

In simulation PC, download and install software **Axon Utility**, which supports DNP3 protocol.

(http://www.axongroup.com.co/axongroupen/axon\_descargas.php.)

There are many options of software to choose, but we use Axon Utility to do the following demo.

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Axen	Axon Test Simulator and analysis to Brother Aven Test DN.pdf Brother Aven Test ES.pdf Manual Aven Test - 20156/73/4730/002.pdf User Galde Aven Test - 20156/73/4730/002.pdf Intg_ATV3 8.2 8 eve Whate New Aven Test - AT42VII, En, Ex.pdf	ol of protocola Version: V3 8 4 Version: V3 8 4 Version: V3 8 122 4 Version: V3 8 122 4 Version: V3 8 2 8 (0009) <b>\$</b>	Date 2014.07.21 10.24.29 2014.07.21 10.26.04 2015.06.26 12.18.47 2015.07.26 2015.07.26 2015.08.20 18.53.26 2015.10.19 16.44.03	]

For Axon Utility, it may need registration to get permission of installation.

Registration Dialog	
	Yon ean mu fhis application in freeware mode which is restricted in functionality. Excitation Info- D: <u>1FFUB47UPEF5E80AU05005E560B57532492</u> Senial: OK Buy the locence Buy Freeware Running
	Full Running

We could run Freeware License version after installation.

### Enabling an Intelligent Planet

Using the Freeware version may need to wait to start. After the waiting, you may see below image.

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File Edit Views Tools Help		
Project Explorer I ×	Commands     Trace     SignalEditor     Viewer       Layers     Image: Commands     Image: Commands     Image: Commands       Image: Children Commands     Image: Commands     Image: Commands     Image: Commands       Image: Children Commands     Image: Commands     Image: Commands     Image: Commands	* X
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- **1.** In project Explorer, right click on "DNP3" in the "Client" zone.
- 2. Choose "Add DNP3".

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File Edit Views Tools Help		
Project Explorer 🛛 📮 🗙	Commands Trace SignalEditor Viewer	x
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Ready		

3. After add DNP3, a random given name will show up, ex. "Cervera".

4. Scroll down in Properties, edit "Link Address" as "3" (Client) and "Server Link Address" as "4" (Server).



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File Edit Views Tools Help		
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Ready		2

5. Double click on "Tcp" in "Connections". Edit the IP same as the IP of ADAM-3600.

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File Edit Views Tools Help	)						
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Digital Output		name	status	Time Stamp	Quality	item	BinaryDataType C
		Cervera Unknow.Binary 0	False	2017/12/18 14:01:12.256 *	Online	0	Binary 1
		Cervera Unknow Binary 1	False	2017/12/18 14:01:12.256 *	Online	1	Binary 1
IEC 60870-5-104	=	Cervera_Unknow.Binary_2	False	2017/12/18 14:01:12.256 *	Online	2	Binary 1
i∎□[→ Slave		Cervera_Unknow.Binary_3	False	2017/12/18 14:01:12.256 *	Online	3	Binary 1
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		C:\Users\john.sun\Documents\AxonTestProj	ects\Project-1\dnj	p3master.aer Saved			-
Ready							

6. Edit the scan time in Properties. In "Scan Static", edit "Loop Scan Time Poll" as "2000" milliseconds. It makes the Client to inquire data every 2 seconds.



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File Edit Views Tools Help								
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EC 6087 Clone Devic	e	vera_Unknow.BinaryOutputStatus_0	False	2017/12/19 13:27:16.537 *	Online	0	Analog	5
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Bave Properties		vera_Unknow.BinaryOutputStatus_2	False	2017/12/19 13:27:16.537 *	Online	2	Analog	5
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Constantions								
Properties 4	<							
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▲ Scan Events								
Class123 True								
Loop Scan Event 20000								
▲ Scan Static		< III b						•
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⊿ Startup	1 2 1							
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Loop Scan Time Pooll		P3MasterPlugin Cervera Running		Contra				<b>^</b>
	Ax	DR. 1951.DWP3.Master.Runtime.DNP3Mas	merileviceRuntime	e Connectea Disconnect Convers				
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	DN	ar Statestert tugint Cervera is onnihig						
Ready								

- 7. Right click on the random name of DNP3 Client. Run it.
- 8. After running, you may switch to "Viewer" to check the status.

55		Advantech	TagLink Stu	dio	x
Online Help					۵ ()
Add Search Clear Password SSH Device - Device Setting Console Online	e 				
Online Device «	Contine Monitor(NewDevice) ×				
Online Device     172.16.12.111	ADAM-3600-C2G				L Sign Out
[4]NewDevice - 11.0.0.4	N Tags	Tag Name	BoardIC	:DO.1	Tag Value 1
	M I/O Status 🔻				<b>√</b> Submit
	(Main) ADAM-3600-C2G	Тад	Value	Quality	Timestamp
	SIGUT) ADAM-3018	BoardIO:DI.2	0	Good	Mon Dec 18 2017 14:10:49 GMT+0800 (台北標準時間)
	I System Information	BoardIO:DI.3	0	Good	Mon Dec 18 2017 14:10:49 GMT+0800 (台北標準時間)
	Configuration	BoardIO:DI.4	0	Good	Mon Dec 18 2017 14:10:49 GMT+0800 (台北標準時間)
		BoardIO:DI.5	0	Good	Mon Dec 18 2017 14:10:49 GMT+0800 (台北標準時間)
		BoardIO:DI.6	0	Good	Mon Dec 18 2017 14:10:49 GMT+0800 (台北標準時間)
		BoardIO:DI.7	0	Good	Mon Dec 18 2017 14:10:49 GMT+0800 (台北標準時間)
		BoardIO:DO.0	0	Good	Mon Dec 18 2017 14:10:49 GMT+0800 (台北標準時間)
1		BoardIO:DO.1	1	Good	Mon Dec 18 2017 14:10:49 GMT+0800 (台北標準時間)

9. For demonstration to monitor the value, you may change the DO 1 Tag value manually from 0 to 1 in TagLink.



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File Edit Views Tools Hel	р							
Project Explorer	Ψ×	Commands Trace Connect	ions - TcpConne	ctions Viewer				×
Master	~	Status						
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Digital Input		name	status	Time Stamp	Quality	item	BinaryDataType	C
		Cervera Unknow.Binary 0	False	2017/12/18 14:11:16.184 *	Online	0	Binary	8
Digital Output	E	Cervera_Unknow.Binary_1	False	2017/12/18 14:11:16.184 *	Online	1	Binary	8
		Cervera_Unknow.Binary_2	False	2017/12/18 14:11:16.184 *	Online	2	Binary	8
		Cervera_Unknow.Binary_3	False	2017/12/18 14:11:16.184 *	Online	3	Binary	8
EC 60870-5-104		Cervera_Unknow.BinaryOutputStatus_0	False	2017/12/18 14:11:16.199 *	Online	0	Analog	8
🖶 📃 🔁 Slave		Cervera_Unknow.BinaryOutputStatus_1	True	2017/12/18 14:11:16.199 *	Online	1	Analog	8
		Cervera_Unknow.BinaryOutputStatus_2	False	2017/12/18 14:11:16.199 *	Online	2	Analog	8
Connections	-	Cervera_Unknow.BinaryOutputStatus_3	False	2017/12/18 14:11:16.199 *	Online	3	Analog	8
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Time contrined use 1000	^							
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Scan Events								
Class123 True								_
Loop Scan Event 20000	E	•		III				•
<ul> <li>Scan Static</li> </ul>								
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10. After the value is changed, you may monitor the status of BinaryOutputStatus from False to True in "Viewer".

### Terminology

There are several terms defined in DNP3, and we introduce it one-by-one as belows.

For data inquiry, there are 2 terms "Static" and "Event" are used in DNP3.

"Static" represents current value of the monitored data.

"Events" are associated with something of significance happening. User can define events, such as measured value changes, a measurement whose value crosses one threshold, and analog input changing by more than its **deadband**.

There are two methods commonly used for detection of analog input events based on a **deadband**.

- **Fixed Deadband:** If the absolute value of the difference between the present value of an analog input point and the value that was most recently queued as an event for that point exceeds the deadband value, then an event is generated for that point.

 Integrating Deadband: The difference between the present value of an analog input point and the value that was most recently queued as an event for that point is integrated over time. An event is generated when the absolute value of the integral exceeds the deadband value.

Event includes following information, Type of event (analog input, binary input, etc), Value, Point Index, Time when event occurred, Class assignment.

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DNP3 uses the concept of "Classes" to organize static data and events into several categories:

- Class 0: Static data
- Class 1,2,3: Events

The points of most data types may be assigned to one of the four classes.

If a point is assigned to **Class 0**, the point's *present value* shall be reported by the outstation in its response to a **Class 0** poll.

If a point is assigned to one of the event classes (**Class 1, 2, or 3**), the outstation shall store and report events for that point, and the point's present value shall also be reported by the outstation in its response to a **Class 0** poll.

tog beside stearbaces	-				
[20] Running Counters	0	0	Online	27Nov17 06:17:18.159 (invalid)	Events reported in Class 3
[21] Frozen Counters	0	0	Online	27Nov17 06:17:18.160 (invalid)	Events reported in Class 3
[30] Analog Inputs	0	0	Online	27Nov17 06:17:18.160 (invalid)	Events reported in Class 2
[30] Analog Inputs		0	Online	27Nov17 06:17:18.161 (invalid)	Events reported in Class 1
[30] Analog Inputs	2	0	Online	27Nov17 06:17:18.161 (invalid)	Events reported in Class 2

For example, if you want to monitor one specific Analog Input, you may classify it into Class 1. As a result, whenever the Client wants to get the specific data from Analog Input, it may poll from class 1, instead of polling all data. If the Client polls data from class 3, as the above image shows, the data of *Running Counters* and *Frozen Counters* will be reported.

Classifying the event data is one bandwidth-efficient way to update a Client each data, which we call **Event Poll**. Setting the Client to poll a Server frequently for a given amount of time, especially when the number of events generated in Server is low, using classes for events can make Server returns much less data than if the Client had to retrieve all data on every poll cycle.

Integrity poll is a combined poll of Class 0, 1, 2, and 3.

The setup of classes in Server can allows ADAM-3600 be configured in different classes and report Class 1, 2 or 3 spontaneously, which is called **unsolicited responses**.

DNP3 uses **Group** to indicate different data types. For example, Group 1 is Binary Inputs, Group 10 is Binary Outputs, and Group 30 is Analog Inputs. TagLink has followed DNP3 definition for each Group. User can view the configuration in "More Parameters" in TagLink.

		Sessions							
		Session List: Sess	sion 1 🔻 🗌 Enable L2 Si	lave Address: 4	L2 Master Addres	s: 3 Duplicate From Se	ssion1 Clear Session	More Parameters	
		Binary Input N	lumber(BI): 8	Analog Inp	ut Number(AI): 8	Counter Number	CNT): 0 S	how/Hidden All	
		Binary Output	Number(BO): 4	🗌 Analog Ou	tput Number(AO): 0	🗌 Doublebit Input M	lumber(DBI): 0		
		Session1							
		DNF	P3 Point A	Assign Class	TagName	e Event High Lir	nit Event Low Limit	Event Deadband	
		<ul> <li>BI,000</li> </ul>	Class	:1		0	0	-1	
		BT 001	Chee		Daubla cick to add	0	0		
8	DNP3 Session Advanced Pa	irameters Coi	nfiguration						x
	Default Variation Event Par	ameters Un	solicited Response	Time Syno	hronization				
	Binary Inputs(Group 1):		Variation 1 - packe	ed, without s	status 🔻	Binary Input Events(G	oup 2):	Variation 3 - with Relative Time	-
	Double-bit Binany Inputs(Group	2).	Variation 1 - nacke	ad without (	tatus 🔻	Double-bit Binany Innu	Events(Group 4):	Variation 3 - with Relative Time	
	bouble ble binary inputs(oroup		vanacion 1 puerce	cuymenoue.		bouble ble bindly slipe		Value of S Mich Readere Time	
	Binary Output(Group 10):		Variation 2 - with	Status	•	Binary Output Events(	Group 11):	Variation 1 - without Time	-
	Binary Output Command Even	t(Group 13):	Variation 1 - witho	out Time	-	Counters(Group 20):		Variation 5 - 32-Bit without Flag	
								Tomaton of or one of the second second	
	Frozen Counters(Group 21):		Variation 9 - 32-Bit	t without Fl	ag 🔻	Counter Events(Group	22):	Variation 1 - 32-Bit without Time	-
	Frozen Counter Events(Group	23):	Variation 1 - 32-Bit	t without T	ime 🔻	Analog Inputs(Group 3	0):	Variation 6 - Long Floating Point(64	-bit) 🔻
		·					·		
	Analog Input Events(Group 32	2):	Variation 1 - 32-Bi	t without T	me 🔻	Analog Input Reportin	g Deadband(Group 34):	Variation 2 - 32-Bit	
	Analog Output Status(Group 4	40):	Variation 2 - 16-Bit	t	•	Analog Output Events	(Group 42):	Variation 2 - 16-Bit without Time	-
	Analog Output Command Ever	nts(Group 43)	Variation 2 - 16-Bit	t without T	me 🔻				
	rinalog odcpac command Even	ita(oroup 45).	vanacion 2 - 10-bi	e manoue n					

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**Variation** represents different data format in one Group. For example, in Group 30, variation 1 is defined as "32-Bit integer with Flag" format, and variation 6 is "64-Bit Floating point."

Analog Inputs(Group 30):	Variation 6 - Long Floating Point(64-bit) 🔻
Analog Input Reporting Deadband(Group 34): Analog Output Events(Group 42):	Variation 1 - 32-Bit with Flag Variation 2 - 16-Bit with Flag Variation 3 - 32-Bit without Flag Variation 4 - 16-Bit without Flag Variation 5 - Short Floating Point(32-bit)
	Variation 6 - Long Floating Point(64-bit)

**DNP3** uses **Index** to distinguish different points' values if they are in the same data type. For example, there are 5 AI points user wants to monitor.

S	Session1				
	DNP3 Point	Assign Class		TagName	
	AI,000	Class 2	BoardIO:AI.0	← Index 0	
	AI,001	Class 2	BoardIO:AI.1	← Index 1	
	AI,002	Class 2	BoardIO:AI.2	← Index 2	
	AI,003	Class 2	BoardIO:AI.3	← Index 3	
•	AI,004	Class 2	BoardIO:AI.4	← Index 4	

The index 0 is given to AI.0 in TagLink automatically once user adds AI.0, and Index 1, 2, 3, 4 are given in an orderly way whenever user adds new points.

If DNP3 Client wants to inquire AI.2, he needs to set Group 30 (AI), Variation 6 (64-Bit Floating point), and index 2 in the DNP3 Client software.