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# **RSComPro: An Open Communication Protocol for Remote Sensing Systems**

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# Introduction

In order to improve wind velocity measurement techniques with multiple remote sensing instruments it is advisable to centralize their coordination within a distant 'master' computer. The master computer should be able to communicate with the instruments by an exchange of data packets using any type of network, since this allows a flexible deployment of the instruments and master computer for measurement campaigns.

Having in mind a possibility to coordinate divers range of remote sensing instruments (e.g., lidars, sodars, radars, etc.), the communication between the master computer and instruments should comprise a general set of commands sent from the master computer to instruments, their responses to commands and their actions on



commands. Data packets, which encapsulate the commands and responses, should be small enough to allow an uninterrupted and fast coordination of instruments even in the case of mobile networks such as GSM.

Based on all these recommendations we have developed the Remote Sensing Communication Protocol (RSComPro) for the simultaneous coordination of multiple remote sensing instruments through a UDP/IP and TCP/IP network.

# **RSComPro Implementation**

RSComPro is an open communication protocol [1]. Hierarchically the protocol belongs to the application layer of the TCP/IP stack (Figure 1).

The protocol defines commands sent from the master computer to remote sensing instruments (Table 1 and 2), responses to commands, actions on commands, possible alarms from abnormal behavior of the remote sensing instruments, and the packet structure for each command (e.g., Table 3), response (e.g., Table 4) and alarm.

RSComPro has been already applied for the development of the long-range WindScanner, a system of three coherent pulsed Doppler scanning lidars (i.e., Windscanners) coordinated by the master computer [2]. Currently, two long-range WindScanner systems exist, and they are operated by DTU Wind Energy and ForWind. Both system comprise the same type of lidars, which have been developed jointly by Leosphere, DTU Wind Energy and IPU [3].

Network

		Command	Code	
		GoHome	2100	
		GetGPS	2200	
		GetCompass	2300	
Command	Code	GetConfiguration	2400	
WhoIsThere?	1100	GetPosition	2600	
Abort	1200	SetPosition	2700	
Jnlock	1300	GetScenario	2900	
Stop	1400	SetScenario	3000	
GetStates	1500	Measure	3100	
sBusy?	1600	GetData	3200	
Shutdown	1700	Wipe	3300	
Reset	1800	GetCapabilities	3400	

Table 1. UDP commands

Figure 1. TCP/IP stack

# Table 2. TCP commands



### Table 3. RSComPro packet for the command GetGPS

<packet Client="Košava" PckNo="1.3" Cmd="2200" Alert="0"> <time>124520.50</time> <date>141212</date> <lat>554137.8778N</lat> <long>120513.5359E</long> <alti>40.091042</alti>

	.7182818284) <sup>θ</sup> ογιτυθιοποδόγηξικλ DTU – det bli	'r til noget Syste Koshava	m Danmarks Tekr	niske Universitet	Connected
	-!	Master Comp	uter Software	**	EXIT
Identification		Communicati	on Messages		
Last IP		Last TC	P Message		
192.168.1.83	<pre><packet <="" client="Koshava" td=""><td>PckNo="1.3" Cmd="270 ned</td><td>0" Alert="0"&gt;</td><td></td><td></td></packet></pre>	PckNo="1.3" Cmd="270 ned	0" Alert="0">		
TCP_Port					ا ماله
1024	Last UDP Message				
Last Status	<pre><pre><pre><pre><pre><pre><pre>characterize</pre><pre>characterize</pre><pre><pre><pre><pre><pre><pre><pre>&lt;</pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre>				
-	() puckets				
GPS Info	Compass Info	States		Positions	
Last GPS Date	Last Compass Heading	Last OS Time & Date		Last Azimuth	
22/01/2013	360.2*	03:40:13 22/01/2013		0	
Last GPS Time	Last Compass Pitch	Last Free Ram	Last Free Hdd	Last Elevation	
03:40:13	0.1*	4 Gb	500 Gb	0	Ĩ
ast GPS Latitude	Last Compass Roll	Last Busy State	Last Locked State		
4° 22' 42.94'' N	-0.1*	No	No	refresh Go Home	Refresh All
st GPS Longitude	Last Compass Temp	Last GSM Signal	Last WiFi Signal	Azimuth	
20° 14' 57.47'' E	24°C	None	None	0	Send To All
ast GPS Altitude				Elevation	
132 m				0	Nb Systems
refrech	refrech		freeh	cond chest	3
rerresh	retresh	re	resn	send shoot	LIDP Port

### Figure 2. DTU Wind Energy's master computer software

# Reference

The protocol has been implemented in the WindScanner Client Software (WSC), which runs each WindScanner in the system [2]. Also, based on the protocol two master computer software (MCS) have been developed, one by DTU Wind Energy (Figure 2) and the another one by ForWind.

<msg></msg> </packet>

Table 4. RSComPro packet for the response on GetGPS command

# **Future Outlook**

We hope that RSComPro will be widely accepted by the remote sensing community, and that other individuals, research groups and companies would join us in future developments and applications of the protocol. This would allow the coordination of different types of remote sensing instruments from a single master computer (Figure 3), and thus it would form a basis for the further advancement of our understanding of the atmospheric flows.

[1] Vasiljević, N., Lea, G., Courtney, M., Schneemann, J., Trabucchi, D., Trujillo, J-J., Unguran, R., & Villa, J-P. (2013). The application layer protocol: Remote Sensing Communication Protocol (RSComPro). DTU Wind Energy. (DTU Wind Energy E; No. 0017(EN)).

[2] Vasiljević, N., Lea, G., Courtney, M., Mann, J., & Mikkelsen, T. (2013). The long-range WindScanner system – how to synchronously intersect multiple laser beams. EWEA 2013, Vienna, Austria

[3] Bradley, S., & Mikkelsen, T. (2011). *LIDAR remote* sensing. International Sustainable Energy Review, 5(3, LIDARS Supplement), 2-7.





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