Discussion

This document details a streaming UDP protocol between and OCU and a Robotic Asset. The stream is intended to simplify the command and control signaling used to steer a UGV that is guided by a Kairos Pronto4 Series4 or Pronto4 Uomo. Since these are early versions of this document, it is expected to change throughout implementation and testing

This message can be sent to the robotic asset for command of the vehicle and received by the OCU for status of the vehicle. This message is not intended for telemetry reporting from the vehicle.

It is expected that the Shared Link protocol will b e used to read and report the value of shared variables from the Robotic Asset. Additionally it is expected that the robotic asset will beacon its details such as IP address, name, and other details. Further information about SharedLink or the Kairos Beacon protocol can be found in:

> SharedLink_TeleopOnly_ICD_1_0_15.pdf

Ethernet Detail

The UDP message is transmitted over Ethernet at a 10hz rate. The Port used is 7201. Below is a list of other related ports for Kairos Autonomi products.

Kairos Ports		
	4000	Shepherd Transmit Port
	4xxx	Shepherd Receive Port
	1901,1902	Identification Beacon
	7101	Command Line
	7001	EStop Beacon
	7201	Streaming protocol
	3794	JAUS

Protocol Detail

Each of the unique elements of the UGV Motion Image are detail below. The Protocol is an assembly of required and optional fields. Once the UDP message has been assembled, it is then send to the intended device over common UDP messaging.

> Field Seperator
> |
>
> 0 Message Header
> Single Character
> #
>
> 1 Message Version

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Decimal Value
Unitless
Starts at 1.0

2 Vehicle Name
Name assigned to vehicle
12 character string

3 Message Type
CMD   - Command sent to Robotic Asset
STS   - Status sent back from robotic asset to OCU

4 Session ID
Unique Key returned from Robotic asset for this session
String
XXX is a default session ID that is accepted only for login or to initiate operation sequence.

5 Sequence
Incrementing number per message
Unsigned Long
unitless
Decimal Value

6 Time stamp
Ms from midnight time of day
Unsigned Long
ms
Decimal Value
0-86,400,000

7 Steering
Field Header S
Steering angle to achieve
Signed Long
Degrees
Likely range +-450

8 Throttle
Field Header A
Throttle position to achieve
Unsigned Integer
Percentage
0-100%

9 Brake
Field Header B
Brake position to achieve

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Unsigned Integer
Percentage
0-100%

10 Transmission
Field Header G
Transmission Gear to achieve
0 – Unitialized
1 – Park
2 – Reverse
3 – Neutral
4 – Common Drive
5 – Low Gear

11 Vehicle Speed
Field Header V
Speed to Achieve when using speed control
Decimal Value
Mph

12 System States
Field Header X
Values Mapped, comma delimited
Estop = 1 / Non-Estop=0
Paused = 1/Non-Paused
Enable =1 / Disable=0
Manual=0 / Auto=1
L1 State 0=off, 1=on
L2 State 0=0ff, 1=on
Reserved 6
Reserved 7

13 System Sequence
Field Header Y
Values Mapped, comma delimited
Initiate Operation Sequence = 1 (Teleop On)
Initiate ShutDown Sequence = 1 (Teleop Off)
Start Sequence = 1
Steering Cal Sequence = 1
Transmission Shift Sequence = 1
Reserved 5
Reserved 6
Reserved 7

14 System Modes
Field Header Z
Values Mapped, comma delimited

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Progressive Steering Disable = 1
Progressive Braking Disable = 1
Velocity Speed Control Enable = 1
Reserved 3
Reserved 4
Reserved 5
Reserved 6
Reserved 7

15 Checksum
Field Header C
Simple 8 bit addition of characters in message
Unsigned integer
Represented as decimal value
"XXX" is always accepted as checksum

CRLF
0x0D, 0x0A
Message terminator

This list of rules govern the creation of a properly formatted and accepted message. The message is intended to be human creatable and readable with common data equipment and software. Protections are created in the protocol to eliminate misdirected messages, buffered messages and out of sequence messages.

Message Formatting Rules
Fields with a field header may or may not be present
Fields without field headers must be present
Messages without a checksum field are invalid and must be discarded
Messages with the universal checksum XXX must be considered checksum valid
There is NOT a beginning or ending field separator
Messages are terminated with a CR LF pair
Field usage is determined by message version

Message Sequencing Rules
Message must be proper addressed with vehicle name
Message must have a proper agreed upon key
Message type must be correct for content, CMD to robotic asset, STS to OCU
Message sequence must advance for each message
Message rate is 10hz
CMD and STS messages do not necessarily have the same sequence numbers
CMD and STS messages do have the same session ID
Session ID is established by the robotic asset.

Message Control Rules
Message rate is monitored on both ends
Message sequence is monitored on both ends

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Message rate and sequence out-of-bounds errors may pause system

The following is an example of the message formatted as sent from the OCU to the robotic asset. The reverse of this message could have easily been send back to the OCU.

#|1.0|VEH_MHAFB1|CMD|123|45|56837|S,0|A,0|B,100|G,1|X,0,1,0,0,0,,,|Y,0,0,0,0,0,,,|Z,0,0,0,,,,|C,XXX|

#	Header
|	Delimiter
1.0	Message Version
VEH_MHAFB1	Vehicle name
CMD	Command Message to Robotic Asset
123	Session ID
45	Message Sequence
56837	Time stamp, ms from midnight
0	Steering Angle, Steering Wheel Centered
0	Throttle Percentage, 0%
100	Brake Percentage, 100%
1	Transmission state, 1=Park
Vehicle State	No Estop, No Pause, Enabled, Manual
Vehicle Sequence	Not initiating or shutting down, No Start, No Steering Cal, No Shifting
Vehicle Mode	Progressive Steering, Progressive Braking, No Speed Control
XXX	Default Checksum

Revision History

As changes are made to the protocol and this document they are recorded here for historical and version tracking purposes. Note that there is a version of this document and a version of the protocol. Both types of changes are listed below. Changes are listed in the right column or in the lines below the tracking detail.

Date	Initials	Protocol	Document	Changes
1/18/2020	GATJR	V1.0	V1.00.00	Initial protocol effort and this document
2/10/2020 outside Kairos	GATJR	V1.0	V1.00.01	Added more detail and examples, first release
4/4/2020	GATJR	V1.0	V1.00.02	Added missing velocity in example Corrected reversed order of name and type Added Ethernet and port detail

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Date	Initials	Protocol	Document	Changes
4/5/2020	GATJR	V1.0	V1.00.03	Spelling and formatting. Remove 2s compliment from checksum

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