MULE: Multifunctional Utility/Logistics and Equipment Vehicle

Presented by:
Geoff Gwaltney
Senior Research Engineer
Keweenaw Research Center
gdgwaltn@mtu.edu
(906) 487-3177

Photo: US Army, Future Combat Systems
The Vision: Future Combat Systems (FCS)

FCS program is a joint, networked, system of systems that uses advanced communications and technologies to integrate the soldier with “families” of manned and unmanned platforms and sensors.

Photo: Global Security.org
What is a MULE?

The Multifunction Utility/Logistics and Equipment Vehicle (MULE) is an mission configurable, *unmanned, semi-autonomous* ground platform that provides transport of equipment and/or supplies in support of dismounted maneuver forces. It will also be capable of being armed in the role of support to dismounted infantry in close and air assault.

The MULE provides mobility sufficient to maneuver with the dismounted FCS force within an operational area, and is towed to the operational area by a larger vehicle. The MULE provides semi-autonomous navigation, possibly including automated loading/unloading of selected supplies.

*Photo: Global Security.org*
In Plain English....

- The *MULE* is a follower
- The *MULE* is unmanned
- The *MULE* is semi-autonomous (remote control, tele-operated, etc)
- The *MULE* has high mobility so it can “go where the soldier goes”
- The *MULE* has high utility to help carry the load of the individual soldier
- The *MULE* can communicate with the soldiers and the other systems of the FCS via a network
- The *MULE* can be a weapons platform
- The *MULE* can be a power station: Battery recharging and power generation
- The *MULE* is towable and air transportable
- The *MULE* has integrated sensing: day/night thermal, infrared, forward-looking, chemical-biological, etc
MULE Variants

FCS has defined three MULE vehicle variants, or TYPES. MULE TYPES I and II will utilize a common basic mobility platform. Type III may require modifications to the basic platform:

- TYPE I: Transport
- TYPE II: Air Assault
- TYPE III: Countermine
### MULE Requirements

**Vehicle Requirements:**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross Vehicle Weight (GVW)</td>
<td>5000 lb</td>
</tr>
<tr>
<td>Payload</td>
<td>1926 lb (2400lb goal)</td>
</tr>
<tr>
<td>Transportability (3 units minimum)</td>
<td>USAF C-130 Roll-on/Roll-off Transportable</td>
</tr>
<tr>
<td>Range</td>
<td>62 miles on-road, 31 miles cross-country</td>
</tr>
<tr>
<td>Fuel Sustainment</td>
<td>3 days of high-intensity operation without refueling</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-60 to 140 degrees F</td>
</tr>
<tr>
<td>Power Generation</td>
<td>Must generate exportable power, capable of interfacing with the Land Warrior Battery System</td>
</tr>
<tr>
<td>Wearout</td>
<td>No assemblies/components requiring replacement in less than 9300 miles or 2 years of operation</td>
</tr>
</tbody>
</table>
# MULE Requirements

## Vehicle Mobility:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Requirement</th>
<th>Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hard Surface Speed</td>
<td>32 mph</td>
<td>56 mph</td>
</tr>
<tr>
<td>Complex Terrain Speed</td>
<td>5 mph</td>
<td>13 mph</td>
</tr>
<tr>
<td>Dash Speed</td>
<td>0 to 30 mph in less than 12 seconds</td>
<td>--</td>
</tr>
<tr>
<td>Towing Speed</td>
<td>28 mph</td>
<td>--</td>
</tr>
<tr>
<td>Approach/Departure Angle</td>
<td>15 degrees</td>
<td>--</td>
</tr>
<tr>
<td>Grade Climbing</td>
<td>60%</td>
<td>--</td>
</tr>
<tr>
<td>Side Slope Traverse</td>
<td>40%</td>
<td>60%</td>
</tr>
<tr>
<td>Vertical Obstacle (Step Climbing)</td>
<td>20 inches</td>
<td>28 inches</td>
</tr>
<tr>
<td>Gap Crossing</td>
<td>28 inches</td>
<td>40 inches</td>
</tr>
<tr>
<td>Water Fording Depth</td>
<td>30 inches</td>
<td>50 inches</td>
</tr>
<tr>
<td>Turning Radius</td>
<td>16.5 feet (curb-to-curb)</td>
<td>--</td>
</tr>
</tbody>
</table>
MULE Design Team

- Alternative Fuels Students
- Full-time KRC Engineers
- Part-time KRC Student Employees
- Army Research Lab (ARL) Engineers
MULE Core Areas

- Chassis and Suspension
- Mission Equipment Package
- Powertrain
- Controls and Communication
- Sensor Suite
Existing *MULE* Concepts?

Some may meet *MULE* requirements, some may NOT!
MULE Information Sources

• US Army, Future Combat Systems (FCS)
• Boeing, Lead Systems Integrator for FCS
• Defense Advanced Research Projects Agency (DARPA)
  http://www.darpa.mil
• Global Security Military Ground Systems, FCS/UGV
  http://www.globalsecurity.org/military/systems/ground/fcs.htm
• Lockheed Martin, Ground Vehicle Systems
  http://www.missilesandfirecontrol.com/our_products/groundvehicle.html
• Rod Millen Special Vehicles, Unmanned Ground Combat Vehicle
  http://www.rodmillen.com/special.htm
• iRobot Government and Industrial Robots, FCS SUGV
  http://www.irobot.com/governmentindustrial/