iRobot Product Line (not to scale)

**HRD Robots**

![HRD Robots Image]

**G&I Robots**

- LANdroids
  - 210 Negotiator®
  - 310 SUGV
  - 320 SUGV
  - 510 FasTac™
  - 510 PackBot®

- 710 Warrior®
- 1KA Seaglider™ Transphibian
- 15A Ranger™

[Image of iRobot logos]
Disruptive Technologies Timeline

Massive disturbances occur with the introduction of disruptive technology. Life before and after a disruptive technology is fundamentally different.
Disruptive Technologies Timeline

Fire
60000BC
Lead position – brand and installed base

• Well over 5 million home robots sold
• Currently sold in over 45 countries around the world and expanding

• Over 3,500 PackBot and SUGV robots sold
• Customer base: Army, Navy, USMC and USAF…plus > 15 allied countries worldwide
Thank you for all of your support.

ET2 Jose Ferreira

you have saved lives today!

Burlington, MA
PackBot #129
Killed In Action
Iraq
Today’s Robots Make a Difference

Key Benefits

• **Increased Mission Success**
  – Greater ability to engage NLOS

• **Improved Survivability**
  – Reduces friendly casualties by >50%
  – Significantly reduces IED casualties

• **Increased Lethality**
  – Increases enemy kill rate by 50%

• **Reduced Collateral Damage**

Robots provide increased SA & ability to engage NLOS, increasing mission success

Source: Results from One Semi Automated Forces Simulator (1SAF) SIM model for SUGV tactical operations in both offensive and defensive scenarios
Advancements Will be an Evolutionary Process

Today

Semi-Autonomous Robotic Teammates

Tele-operated Robotic Tools

Autonomous Robotic Organizations

5+

10+
Today Robotic Tools Perform Important But Limited Tasks

- Established CIED, ISR, and tunnel exploitation missions.
- Emerging capability in MOUT.
- One to one controller/robot relationship.
Network Infrastructure & Information Sharing Capabilities

• Today’s two-node (operator:robot) network.

• Multiple-node networks currently in test, but not required for robots to deliver capability today.

• Operator gets raw data from robot, e.g., speed, orientation.

• Robots require constant and detailed control from operators.

• While this works, occasionally comms limitations, e.g., bandwidth, reduce number of robots that can be simultaneously tele-operated in same area.

Today’s controller and OCU.
Operator Duty-Cycle

- Autonomy
- 80:20
- 20:80
- EOD → Infantry
“Crossing the Chasm” by G. Moore, Harper Business Essentials
Technology Advances Will Grow Role Of Robots

Increased Role of Robotics in Battlefield Missions

- Robotic Tools
- Robotic Teammates
- Robotic Organizations

Enabling Technologies

- Remote Operated
  - Sensing & Behaviors
  - Organizational Integration

- Network Infrastructure & Information Sharing
  - Single Point-to-Point
  - Many-to-Many
  - Cloud

Legend:
- Today
- Next Horizon (5+ years)
- Horizon After Next (10+ years)
Next Time Horizon – Robotic Teammates

• 5+ years.
• Limited scope autonomy or semi-autonomous operations.
• Move away from dedicated operators.

Limited Scope Autonomy Makes Robots Force Multipliers
Progression and Enabling Technologies

• Localization, mapping, navigation.
• Assistive autonomy.
• Natural language, gesture, and speech.
• Information sharing between humans and robots.
• Advanced power and power management.
• Encoding of basic TTPs.
• Basic team behaviors.
Enabling Technologies, Networks, Information Sharing

- Everything and everyone connected to the network.
- Real time sharing of information at many levels of abstraction – data, decisions, conclusions, hypothesis, etc. Human C&C will also have evolved.
- On the robots -- mission-level autonomy – not just encoding TTPs but equipping robots with ability to plan to achieve goals.
- Sophisticated perception and understanding algorithms enable robots to understand much of the world around them.
- Collective learning so robot performance improves with experience and learning is shared between robots via network.
- Long duration power sources plus power scavenging and generation.
- Combining intelligence on the robot with intelligence that is “in the network.”
The Robot Industry

- Home
  - Mowing
  - Mop
  - Vac

- Health
  - Security
  - Hospital
  - Long term care
  - Home care

- Military
  - UGV
  - UUV
  - UAV

- Industrial cleaning
  - Wet
  - Dry

- Toys

- Farming

- Energy & Utility
  - Mining
  - Oil & Gas
Europe - 1950

(Population: 349.8 million)
Europe - 2000

(Population: 451.4 million)
Europe - 2050

(Population: 401 million)
Add a million years of independent healthy living for our customers.
“Robot Enabled” Care

• Enablers
  – Robots
  – The Network
  – Cloud-based applications

• Pros
  – Access to most specifically qualified Doctors and tools
  – Leverages Dr’s time
  – Easier to monitor quality of care
  – Leverages Patient’s home and caregivers
  – Patient can usually stay put
The Checkerboard Illusion

Here, the human visual system infers the color of the checks in the world, not the gray value in the image.

The illusion reflects the successful design of the visual system, not a quirky failure.
Thank You

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