ROS Enabled Communications Between Smartphones & Robot Swarms

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Report Documentation Page

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Agenda

- Situation/Objectives

- Background

- System Architecture

- Future work

Situation

- Sharing information
  - Need to share information bi-directionally military and non-military organizations
    - Current operations in Afghanistan
    - HADR
      - NGO's
      - Local government
  - US military has no organic capability to share info
  - Communications must occur outside military networks
- Robots
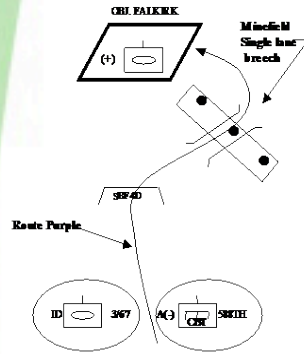 - Becoming more prevalent on the battlefield
  - Mostly "tethered" operations

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Objectives

[http://en.wikipedia.org/wiki/File:Afghanistan__American_Soldiers_FOB_Baylough.jpg]

- Implement a swarm of robots controlled by a Smartphone.

- Share information gathered by the swarm based on the commander's need-to-share policy

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FVI components

Discrete valuing of information

Phase / Unit	Phase I (move to LOD)	PhaseII (SBF4D)	Phase III (Breech)	Phase IV (Seize obj)
D/3/67 Armor	Occupy positions along LOD	Move to SBF4D	Suppressive fire on objective	Pass through minefield to seize obj
A/3/67 Armor	Occupy positions to feint attack on right flank	Execute feint attack on right flank	Execute feint attack on right flank	Execute feint attack on right flank
B/3/67 Armor	Occupy positions as battalion reserve	Be prepared to assume main attack	Be prepared to assume main attack	Be prepared to assume main attack
A(-)/588th Engineers	Occupy positions behind D/3/67	Move forward behind D/3/67	Execute single-lane minefield breech	Suppressive fire on objective from SBF4D
Artillery	Execute Fire Plan	Suppressive fire on objective	Suppressive fire on objective	On order shift fires behind objective

Computable model of CDR's intent
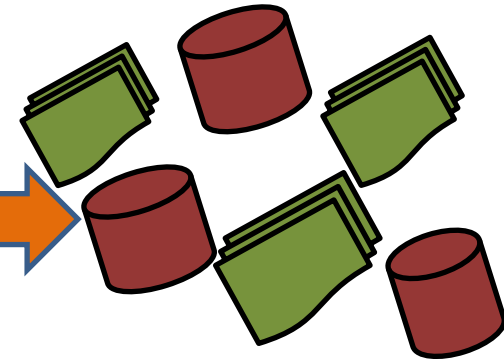
Adaptive, cloud-based communications architecture
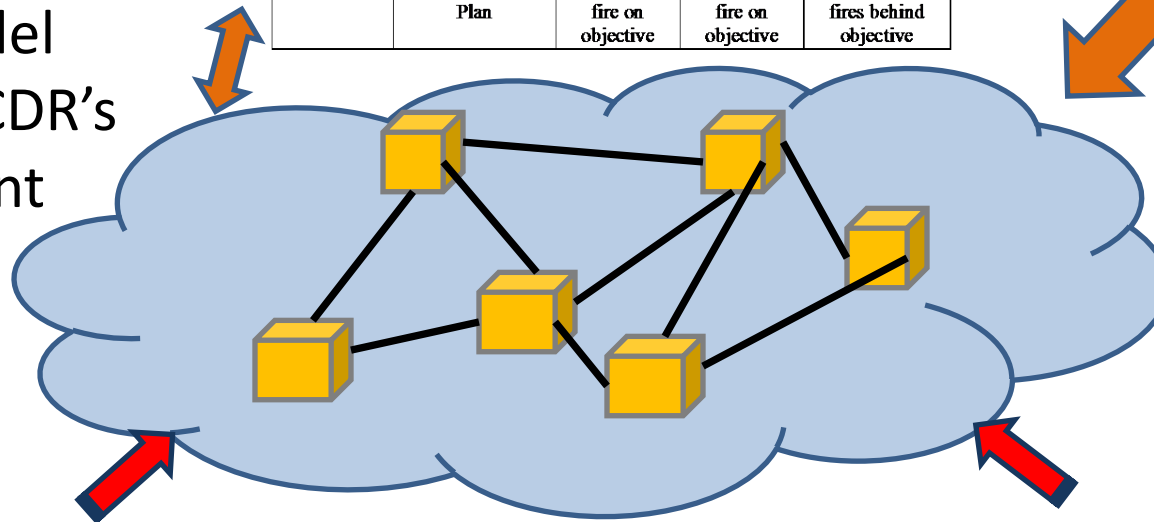
Need to Share extension to Bell-Lapadula
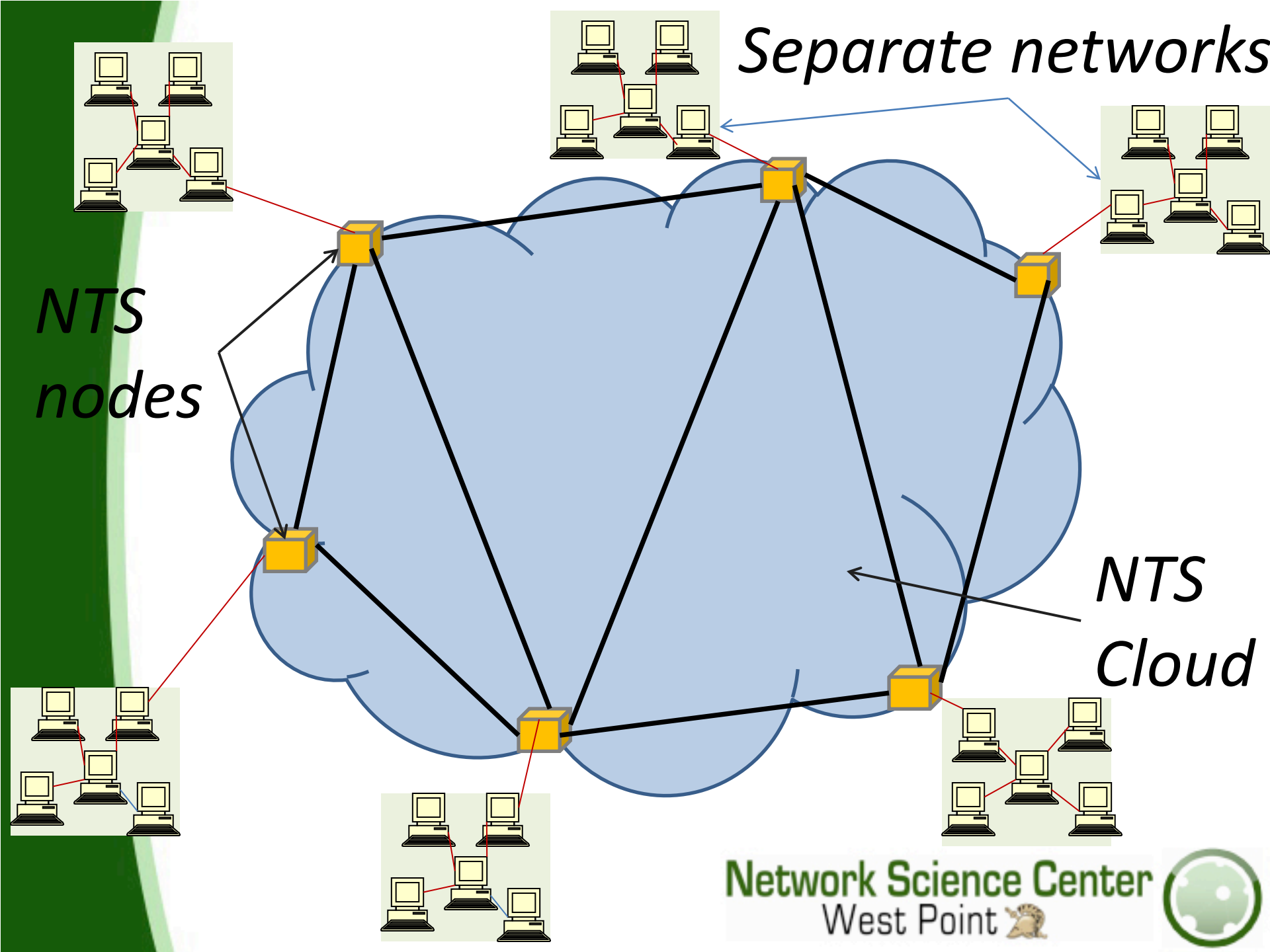
Formal result

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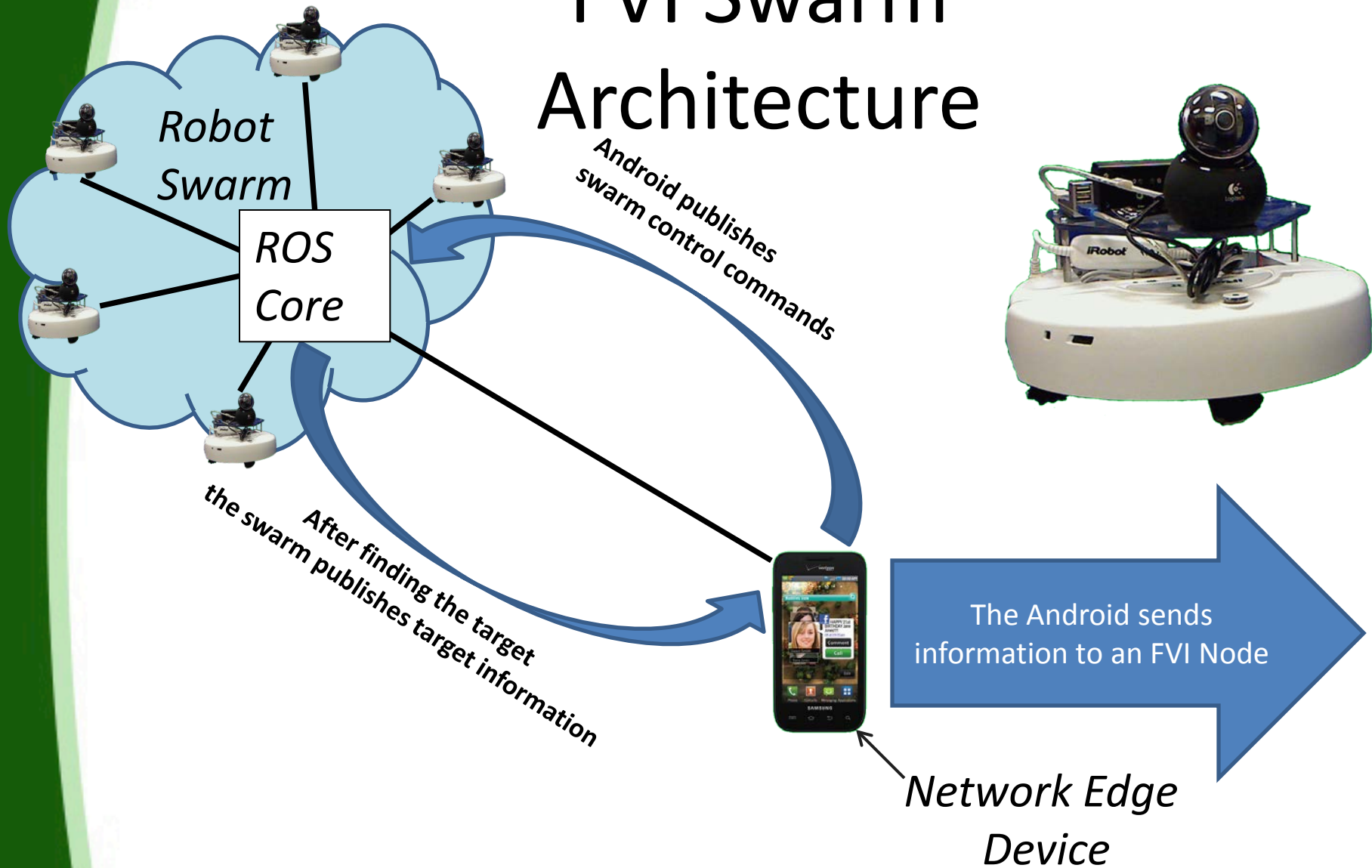West Point

Separate networks

NTS
nodes

NTS
Cloud

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FVI Swarm Architecture

Robot Swarm

ROS Core

Android publishes swarm control commands

After finding the target the swarm publishes target information

The Android sends information to an FVI Node

Network Edge Device

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FVI Swarm Features

- Small, lightweight device for Soldiers
- Ability to control a single robot or entire swarm
- Ability to receive **and share** information [text, photo, streaming video] from robot
- Familiar interface with Smartphones

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ROS-based Swarm Communications Architecture
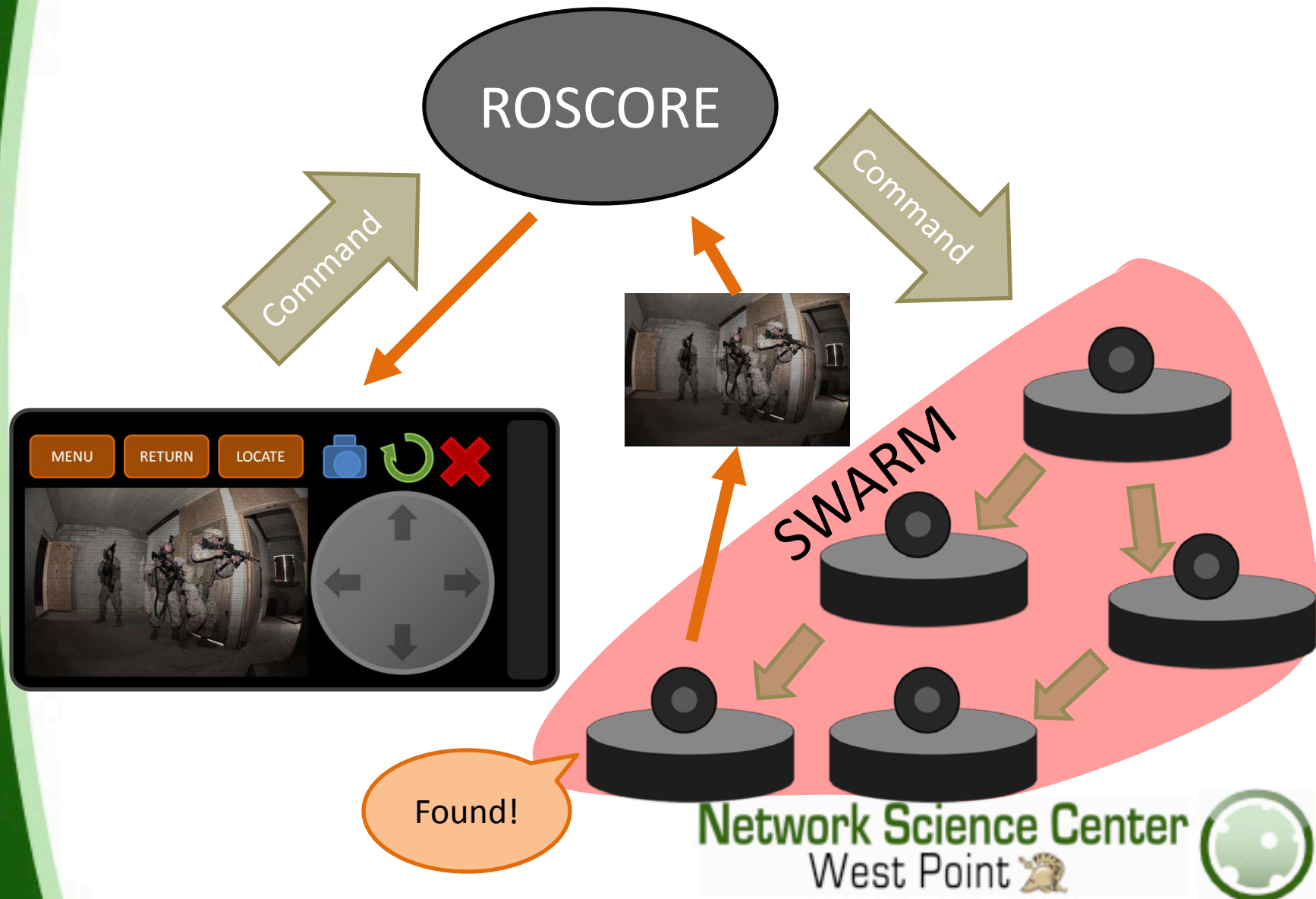
Robot
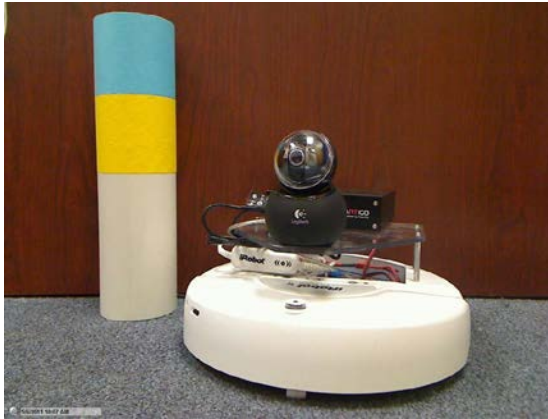
- iRobot Create – excellent for research, rapid-prototyping
- Sensors: odometry, collision detection, webcam, LRF, and wireless adapter
- Project not dependent on details of robot – could be substituted for more "battlefield-appropriate" robot in the future

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Robot Operating System (ROS)

- Communication framework
- Uses publish/subscribe architecture
- Provides abstraction and permits focus on details of project
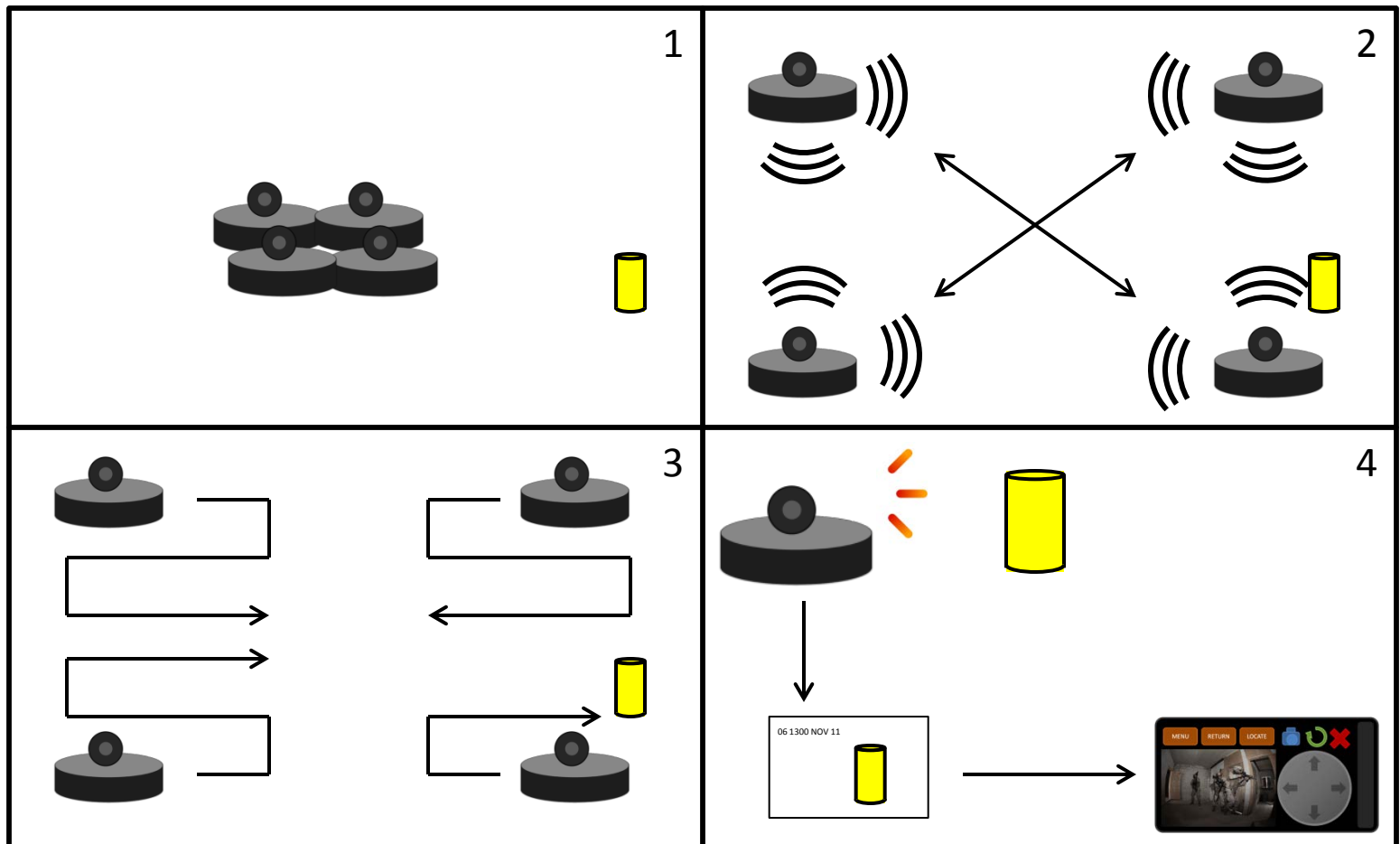- New ROSJava can be used in Android apps

Smartphone

- Google currently working with Willow Garage on ROSJava

- Not all Android versions work

  - Need to root phone to install ROSJava application

  - Android 9 on a Motorola Droid2 did not work

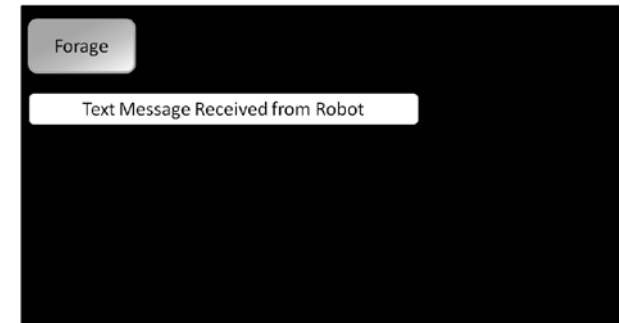 - Android 10 on a Nexus worked

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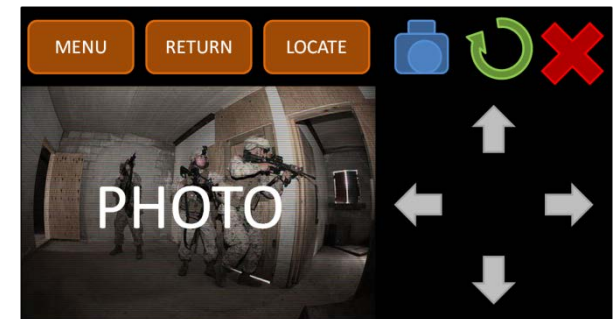# Next Steps: Foraging Algorithm

Next Steps: User Interface

Step 1: Basic Interaction
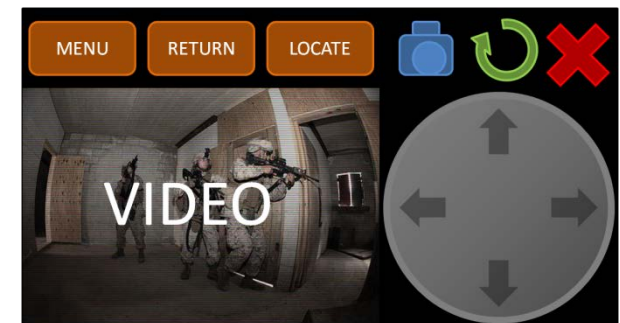- Single command
- Text

Step 2: Intermediate Interaction
- Discrete directional controls
- Photograph receipt

Step 3: Intermediate Interaction
- Dynamic directional controls
- Video streaming

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Future Work

- Infrared communication between robots
- Mapping of an area
- Tilt of Android Device controls camera view

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www.facebook.com/AndroidSwarm

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