C2 and Comms—New C4ISR and Operational Implications

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C4ISR Convergence

• Velocity of Tech Change
• Cyber and EW
• Explosion of Sensors
  – Open Source ISR—GIS, UASs, 24x7 News Cycle, Social Media
  – IoT Sensors as ISR contributors
• OODA Loop & Decision Cycles
• People and Organizational Changes
• Processes and Technology Changes
• Emerging Research Areas

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Velocity of Tech Change

If a factor, e.g. computing power/unit cost, doubles every 18 mo, 5 yr increase is 900%, 10 yr 10,000%

Biotech even faster, robotics ubiquitous, nano poised for breakout, energy impacts global

Interactions complicate things

Linear projections CAN’T work
Cyber and EW

• Maneuver in Electromagnetic Spectrum (EMS) Space
  – Navy Electromagnetic Maneuver Warfare (EMW)
  – Army Cyber Electromagnetic Activities (CEMA)
    • EW Planning & Management Tool (EWPMT)
  – Marine Corps Cyber EW Coordination Cell (CEWCC)
  – USAF
• C4ISR Implications
Explosion of Sensors (1)
Open Source ISR-GIS

Near-Real-Time Coverage:
- Terra Bella (formerly SkyBox),
- Planet Labs data

HiRes:
- GeoEye (.41m pan, 1.65m multi-spectral);
- DigitalGlobe (.31m pan on Worldview 3)
- Licensing issues

Image courtesy Dr. Walter Dorn
Explosion of Sensors (2)

UASs

Israeli
American
Japanese

Canadian

Australian

Hand launched

Slide Courtesy Dr. Walter Dorn

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Explosion of Sensors (3)
IV4 (Info Volume, Velocity, Veracity, Value)

From Patrick Meier iRevolution

Ushahidi

24x7 News Cycle

Public-Private, Whole-of-Govt, Transnational
Explosion of Sensors (4)

Mobile, Wearable

- Cameras, radios, GPS receivers, accelerometers
- Health monitors
- Personal Geiger counters in Japan
Explosion of Sensors (5)
Internet of Things (IoT)

- IoT (Cloud of Everything is better name)
  - Gartner est. 21 billion connected devices by 2020
  - Cheap chips and sensors (insecure and networked)
  - Software-defined everything (SDR, SDN) etc.

- People at the center

- Huge attack surface

- Biggest market of all
Data Visualization/Virtual Reality


Graphics by SynglyphX

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Info Sharing and Security

• Info Sharing Rules
  – Create immediate value
  – Give back better
  – Share derivative works

• Alternative approaches to cybersecurity
  – Big data
  – NRT anomaly detection
  – Supply chain

• Major policy, legal, moral, ethical issues

• Privacy
Command and Control/Sensemaking/Decision Support

How to achieve “Unity of Action” when there’s no “Unity of Control?”
OODA Loop & Decision Cycles

- “Observe” and “Orient” phases increasingly electromagnetic
- “Decide” and “Act” supported by information processing
- Cyber can dominate OODA loop in any domain
- Tech changes
  - Processing power
  - Machine learning
  - Sensor proliferation
  - Army 2050 battlefield—can you move?
- Speed of decisions
  - “Man-on-the-loop,” vice “Man-in-the-loop”
People and Organizational Changes (1)

• Need institutions to act quickly enough
  – And people to run them
  – Life-long learning supported by point of need content delivery
    • Leverage explosion of innovation in private sector adult education
    • No lesson is learned until behavior changes

• Realistic ranges, M&S, wargames
  – Cross-cutting
  – Cyber and EMW

• Feedback loops
People and Organizational Changes (2)

• Address massive, continuous data feeds
• Reach beyond the .mil domain
  – Engage with non-traditional mission partners
  – Support to PKO/HADR
  – Humanitarian cyber
  – Build for resilience
• Info sharing rules critical
  – Give info back better
Process & Technology Changes (1)

• Much info will be outside of/faster than TPED
• Open architectures
• Civ-Mil, public-private, trans-national convergence
  – Changing conditions for RMA
• *Economist* article on future of computing
• BRINE (bio-robo-info-nano-energy)
Process & Technology Changes (2)

• Frequency-agile equipment
  – Navy will buy EMW systems
  – IT & OT
  – Digital-analog issues
  – Army cognitive radios and IEW&S

• 3rd Offset Strategy
  – Deep Learning Systems
  – Human-Machine Collaboration
  – Human-Machine Combat Teaming
  – Assisted Human Operations
  – Network-Enabled, Cyber-Hardened Weapons
Emerging Research Areas

- C4I & Cyber implications of ubiquitous sensor world
- C2 of large-scale swarms, MUM-T
- Trusted internet and resilient/reliable network ops
- Networked (technological & sociological) approaches to civil-military operations
- Expanded inter-organizational/international collaboration
  - Information sharing and analysis in a less trusting environment
  - Better public-private partnerships
- Training for staff development
- Experimentation & prototyping
- Add cyber into C2 simulations
Questions?