
OVATION

SPACE

AND DEFENCE

# Biometric Wireless Sensors Systems: Current Implementations and Future Needs

# MDA VISION SYSTEMS AND SENSORS

# MDA Overview

| 1928 | 1977 | 1999 | 2005 | 2017 & Beyond |
| --- | --- | --- | --- | --- |
| RCA Limited Government and Commercial Systems Division | SPAR Aerospace Limited | EMS Technologies Incorporated | MDA | MDA A MAXAR COMPANY |





| Space Radar and Defence Radar | Satellite Ground Systems | Robotics for Space and Terrestrial Applications | Satellite Components and Payloads | Defence Systems |
| --- | --- | --- | --- | --- |

**Vertically integrated**

Built on core capabilities in systems engineering, large-scale systems experience, and sound business practices

# MDA VSS (formerly Neptec) – Overview

- Neptec is now part of MDA's Vision Systems and Sensors (VSS) group, of which Neptec is the largest component
  - 25+ years in the space business
  - A full-service supplier to the space sector: we design, build, test and flight qualify hardware to operate in the harsh space environment
- Staff
  - ~80 people
  - Sites
    - Kanata, Ontario (Main)
    - Brampton, Ontario

# VSS Space Program Capabilities

## We are a full-service supplier to the space sector

- MDA VSS designs, builds, tests and flight qualifies hardware to operate in the harsh space environment
    - Long history of innovative development and commercialisation
- We have the expertise to produce Hardware and Software for demanding mission-critical manned space flight programs
    - Supported 49 Space Shuttle and ISS missions
- Staff provide full support of missions including requirements definition, simulations, operating procedure development, training, on-orbit support, analysis and anomaly investigation
- Our production and quality systems are ISO and NASA certified
- We satisfy the world’s most demanding space customers

# AUTONOMOUS MEDICINE AND BIOMETRIC WIRELESS SENSOR SYSTEM

# AMS Program at MDA

## Autonomous Medicine

As future human spaceflight missions extend beyond Low Earth Orbit, greater physical distances and mission durations mean reduced, if not zero, opportunity for the quick return of a sick or injured crewmember to definitive medical treatment. As well, the vast physical distances result in increased time delays in telemedicine interactions such that effective communications between the Crew Medical Officer and the ground based Flight Surgeon will be at times impossible.

This remoteness and isolation will require an evolution in medical support capabilities from the telemedicine paradigm of LEO missions to that of medical autonomy.

Increased medical autonomy will be accomplished through the development of an integrated system of advanced technologies to assist the CMO in maintaining the health of the crew and in the diagnosis and management of a sick or injured crewmember.

*Canadian Space Agency – Advanced Crew Medical System, 2012*

# AMS Program at MDA

## Advanced Crew Medical System (ACMS)

CSA concept study awarded (2013) to an MDA-led team of medical and engineering researchers from St Mary’s Research Centre and McGill University to address the imperative all Space exploration agencies have to provide an in-situ healthcare capability for beyond LEO missions.

# AMS Program at MDA

## Advanced Crew Medical System (ACMS)

Critical for the medical support of crew on long-duration exploration-class missions is the development of a suite of integrated medical technologies which will include:

1. Behaviour and performance measurement tools to assess the ability of the crew as well as each individual crewmember to perform critical and complex tasks in extreme, remote and isolated environments;
2. Remote patient monitoring capabilities including non-invasive, wireless, wearable sensors and data management technologies that provide the CMO as well as Flight Surgeons with vital signs data, situational awareness and the ability to remotely monitor and manage a sick or injured crew member;
3. In-situ laboratory capabilities that would allow for point-of-care, near real-time bio-assays of biological tissues and fluids analysis for diagnostic purposes.

# AMS Program at MDA

## Biometric Wireless Sensor System

The ACMS work led to MDA's development of a small wireless sensor to continuously monitor vital signs.  The biometric readings are derived from measuring the vibrations in the chest cavity.  This technique is known as seismocardiography and has been around since the early 1970s.

# BIOMETRIC WIRELESS SENSOR SYSTEM

# Continuous Vital Signs Monitoring

Vital Signs sensor

- small encapsulated sandwich of integrated circuits
- provides communications, power management and processing

Biometric readings

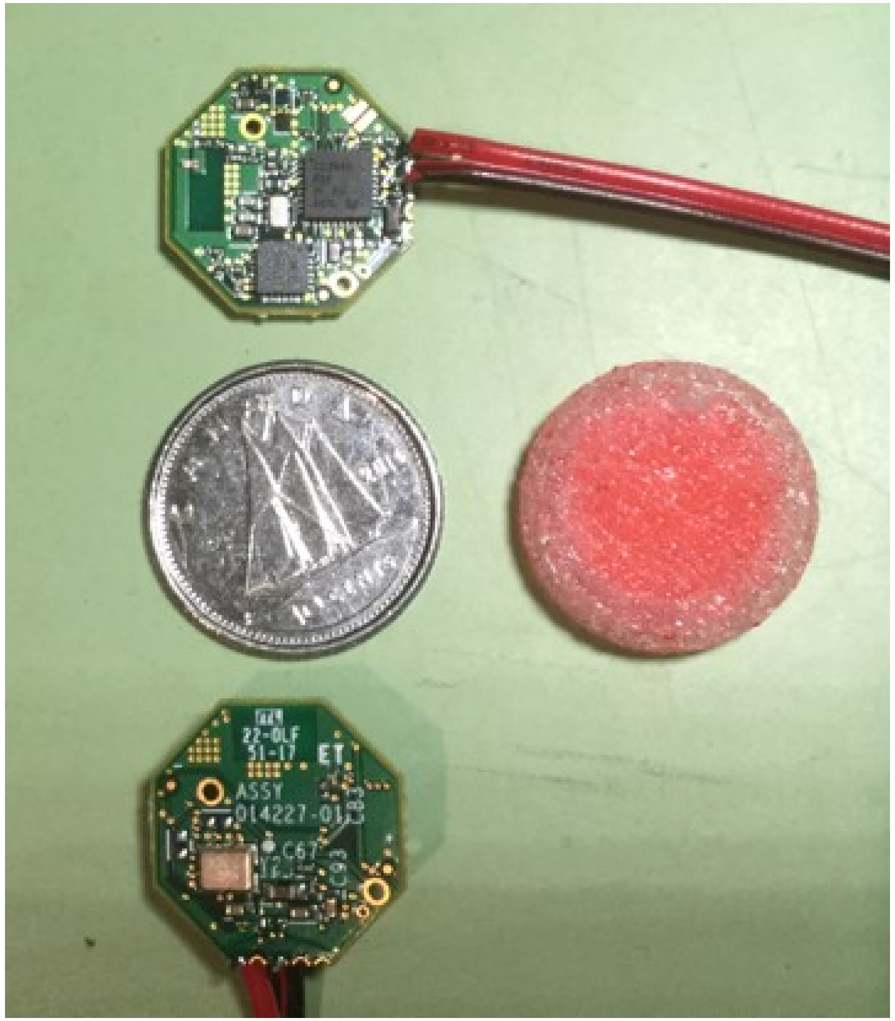
- Heart Rate
- Heart Rhythm
- Respiration Rate
- Respiration Phase / Volume
- Body temperature

Encapsulation

- 14 mm diameter by 5 mm high
- Less than 10g
- Medical grade silicone

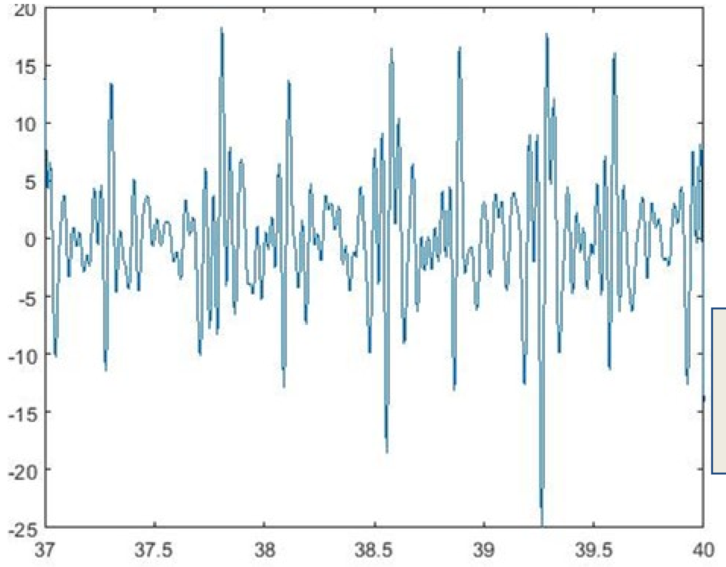
Wearability

- Confirmed through clinical trial - August 2016
- Comfort through small size, negligible weight and breathable attachment
- Will not interfere with clothing, daily activities, exercise or sleep



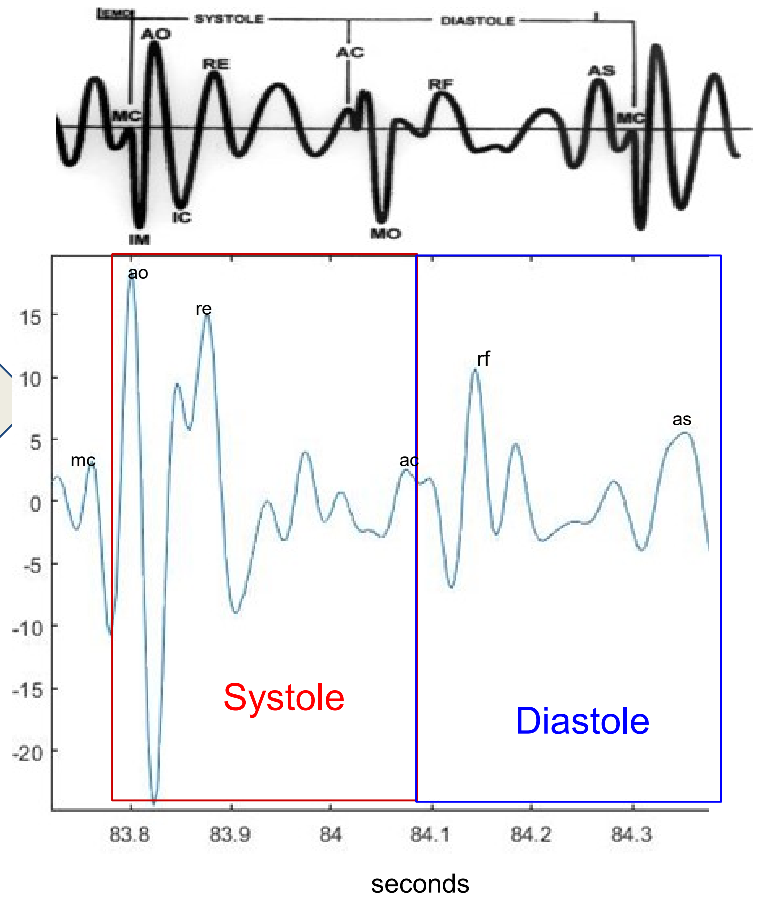
# Continuous Vital Signs Monitoring

Seismocardiography waveform




With corrections to sensor signal; calculations off loaded to SIU / DMS

Improvement of 3 axis cal. and functions




Example: conducted under stress test. Under non ideal conditions signal is clear and displays standard waveform.

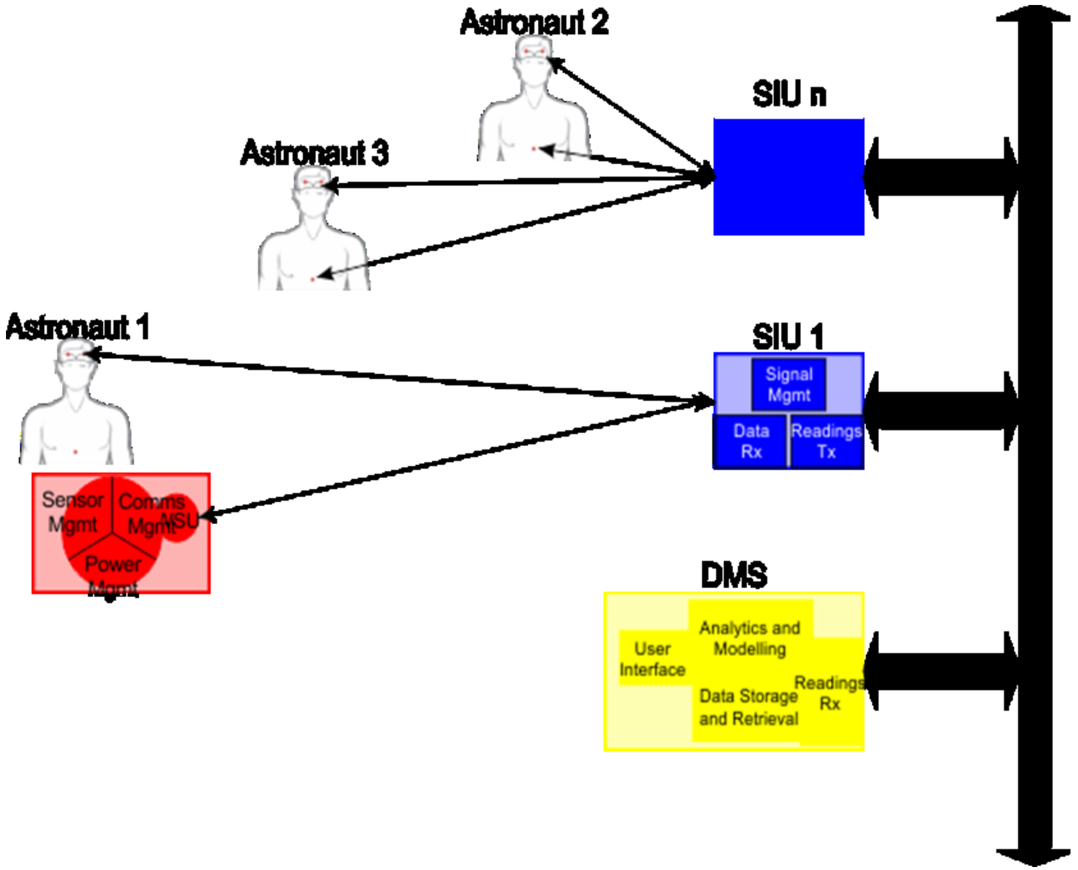
# Continuous Vital Signs Monitoring

## Institutional implementation

- Fixed geography
- Multiple subjects per gateway
- Provides subject location within geography

## Implementation examples

- Space station (ISS, Lunar Gateway)
- Surface and sub-surface combatants
- Battlefield casualty monitoring
- Home care / Telemedicine
- Playing field / Athletic installations



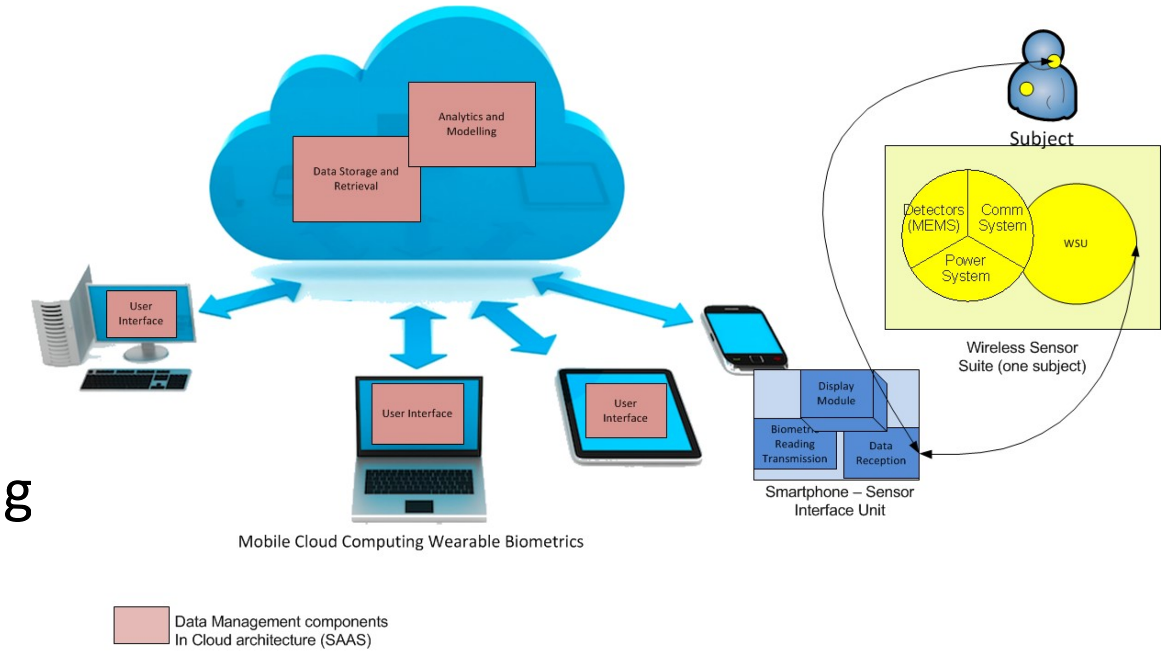
# Continuous Vital Signs Monitoring

## Consumer implementation

- Untethered  geography
- Single subject per gateway

## Implementation examples

- Individual athletes / runners
- Ambulatory patients needing monitoring
- Quantified self



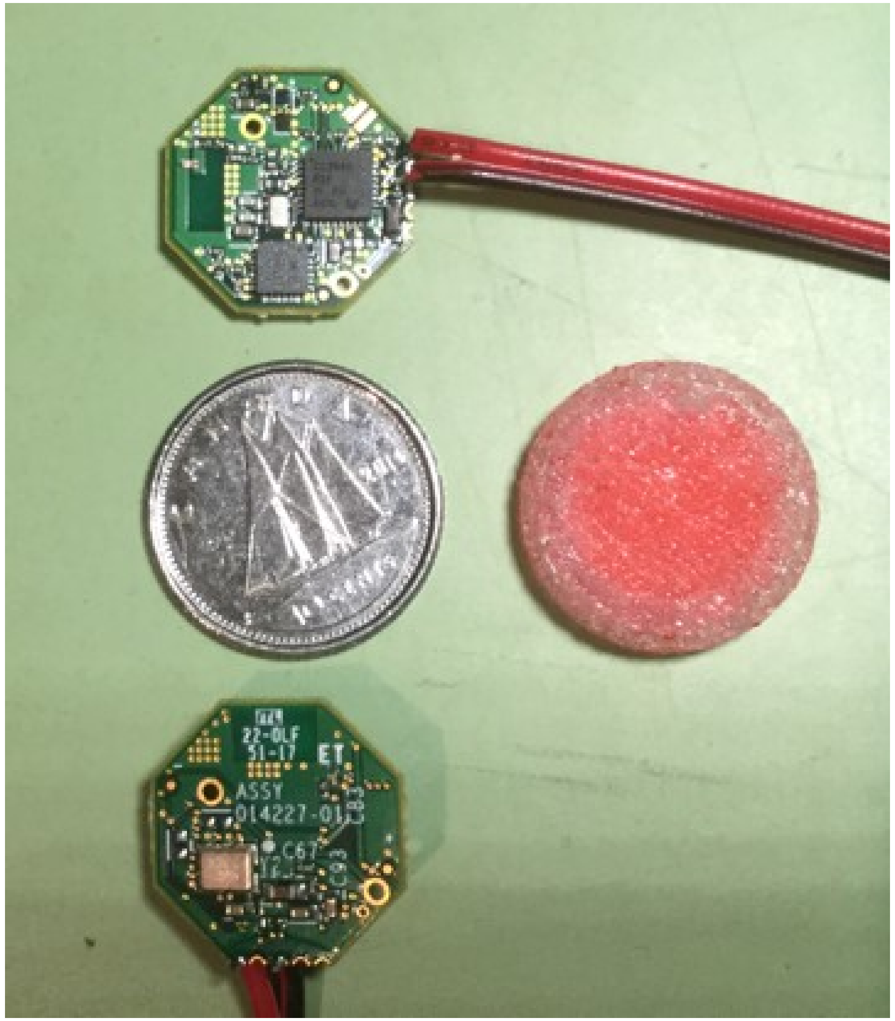
# FUTURE NEEDS

# Continuous monitoring – power requirements

MDA’s vital signs sensor is at the leading edge of commercial wearable technology both from a size and functionality perspective.

The trade-off between battery endurance, size and sealed encapsulation has led to an expensive ‘disposable’ device model.

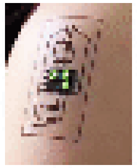
This trade-off is not an unusual one for wearable devices and represents a significant challenge for vendors.



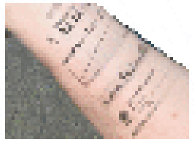
# Continuous monitoring – Better form factors

From recently released band-aid-like devices such as the BioStampRC from mc10 through to almost invisible graphene-based sensors such as developed at the University of Texas, the future of wearable, unobtrusive biometric sensing belongs to the tattoo.

Better skin contact, reduced sensitivity to motion artifacts and greatly reduced power demand are all current challenges for wearables that can be readily met by this better form factor.



Chaotic Moon



emerge interactive

mc10

University of Texas

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