Welcome
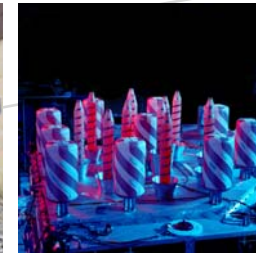
Dynamic Multi Sensor Management System

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Introduction

A Sensor Performance Data Management System is proposed to account for interaction of static and dynamic aspects of sensor performance.

This will support Battlespace Management of sensor networks by providing information of sensor performance at specific locations and times within an area of interest.

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Introduction

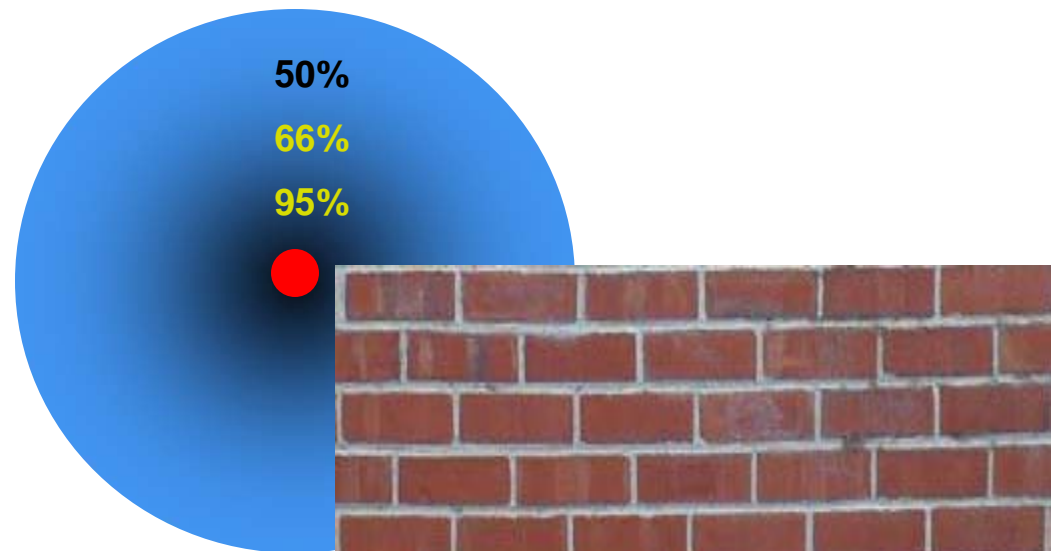**A Sensor Performance Data Management System is proposed to:**

account for interaction of static and dynamic aspects of sensor performance.

This will support Battlespace Management of sensor networks by providing information of sensor performance at specific locations and times within an area of interest.

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Multi Sensor Network To Protect Entry Gate

Each Sensor has a limited field of regard

Each Sensor has it's own unique performance contour

50%
66%
95%

🔴 Chemical Sensor

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Multi Sensor Network To Protect Entry Gate

Each Sensor has a limited field of regard
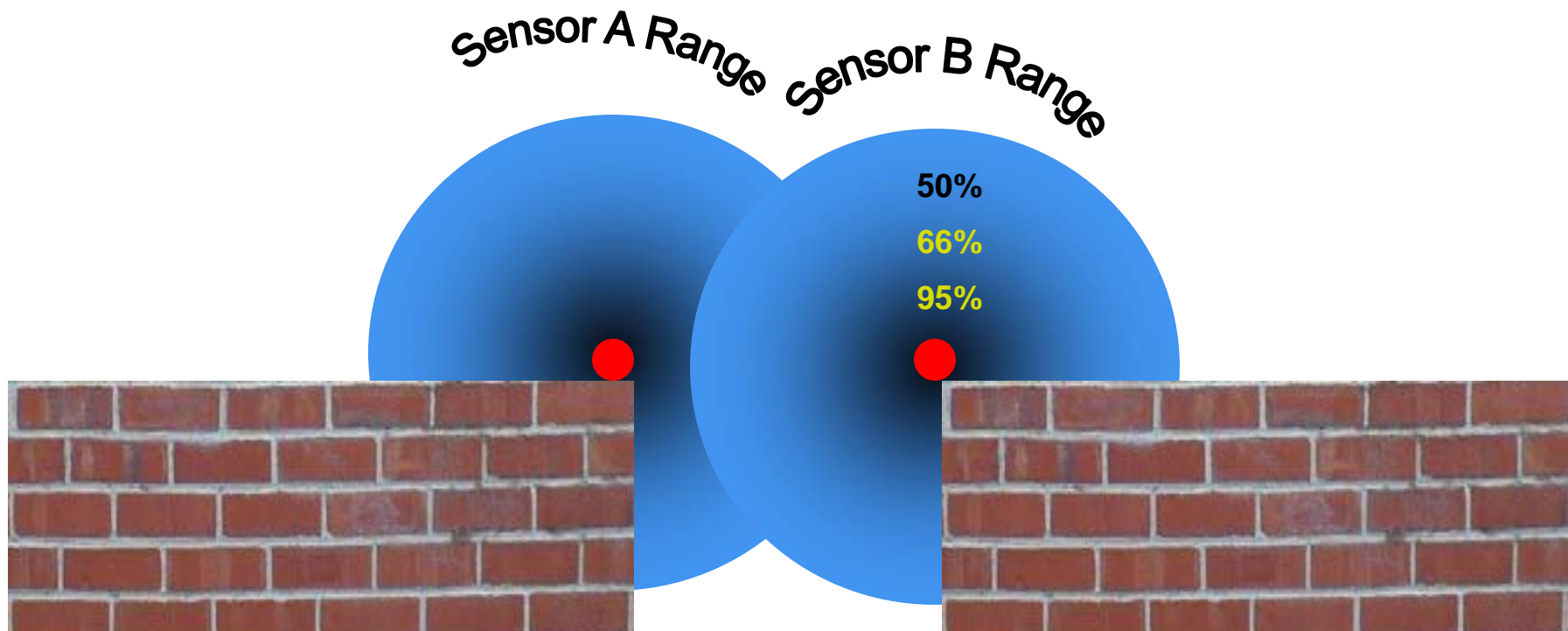
Each Sensor has it's own unique performance contour

Sensor A Range   Sensor B Range

50%

66%

95%

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Performance Modeling Today

• Performance Modeling (PM) is often a single prediction as though sensor performance is uniform over an entire field of regard assuming

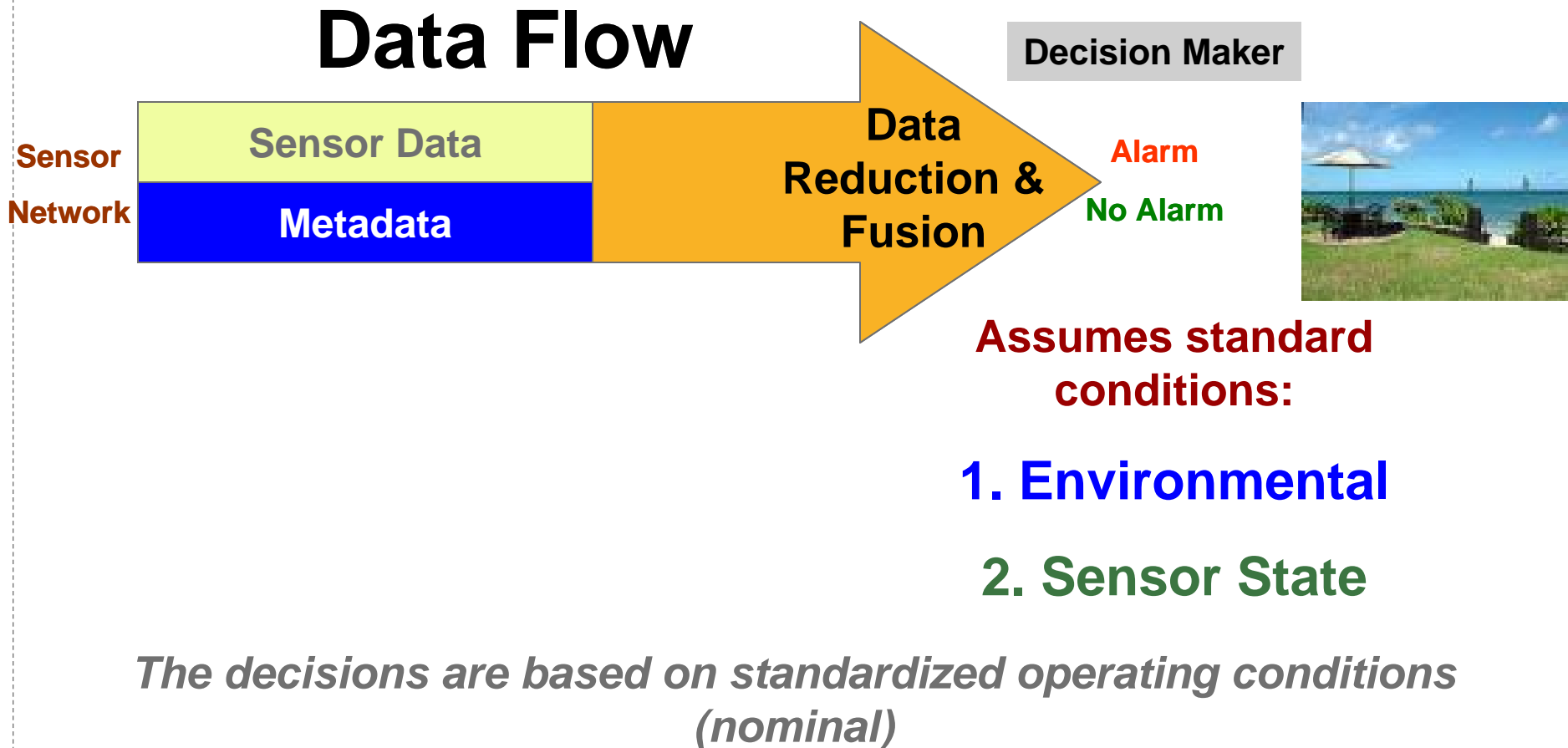– Worst Case

– Average Case

– Best Case

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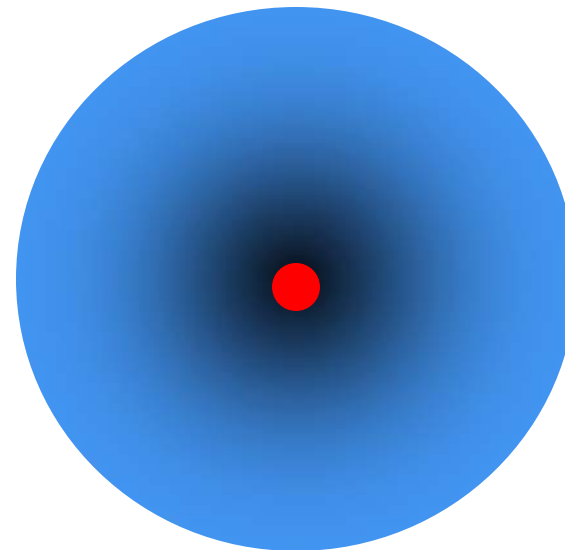
Issues

- Sensor performance is inherently a spatially AND temporally variant quantity

  – A single performance prediction may be good 'on average', but poor at any particular location or time

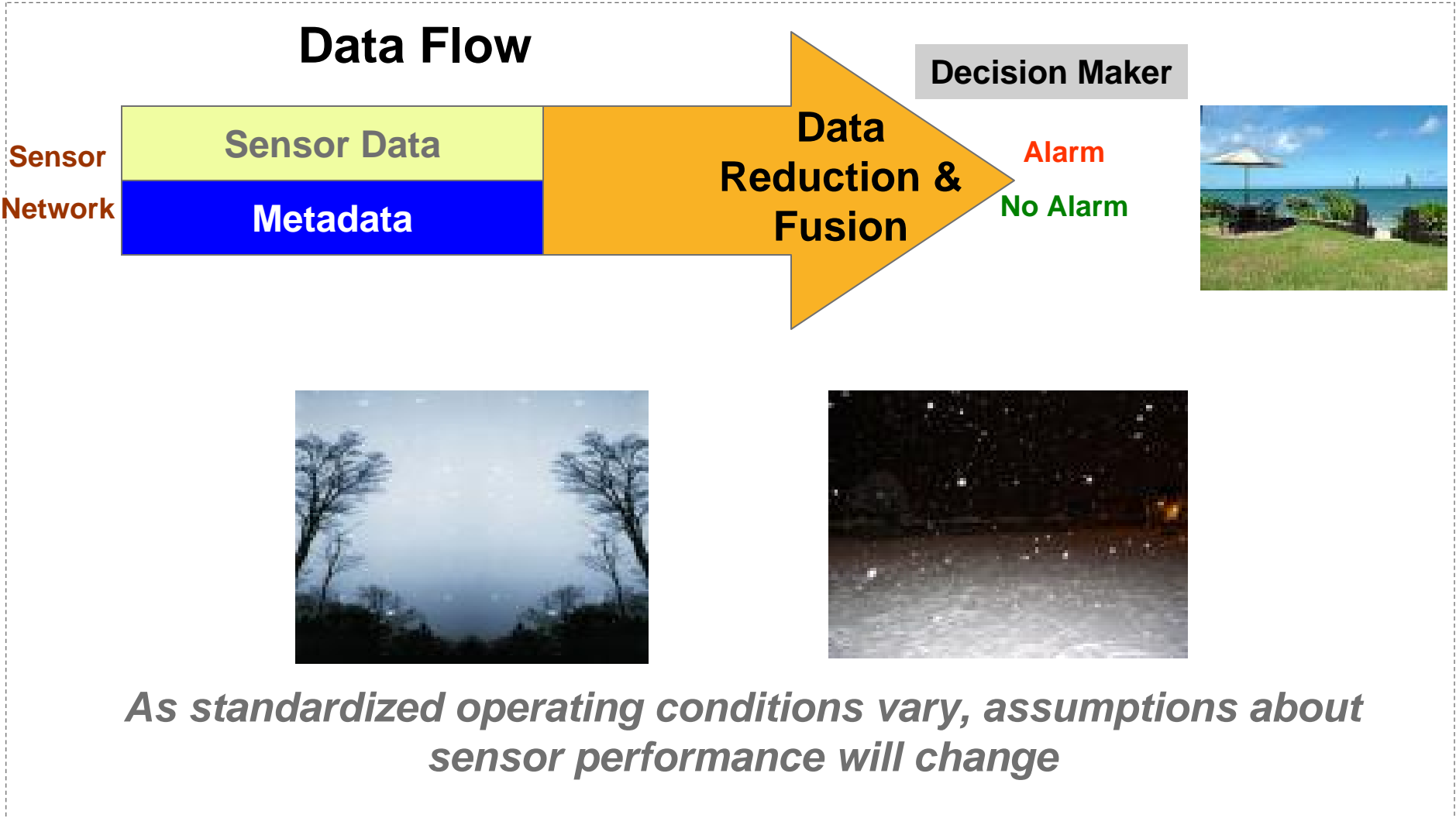 – What happens when a sensor is not operating within design limits?

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Variables Effecting Sensor Performance

- **Environmental Issues**

  – Wind

  – Humidity

  – Lighting

  – Temperature

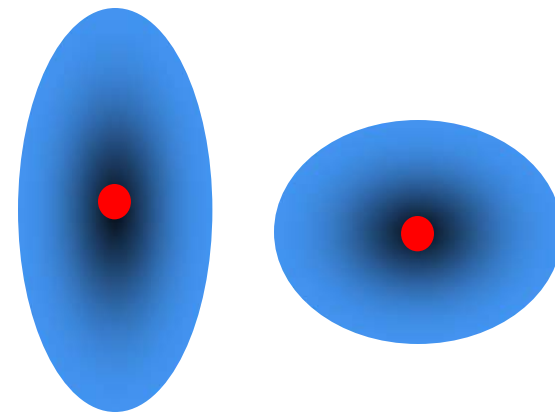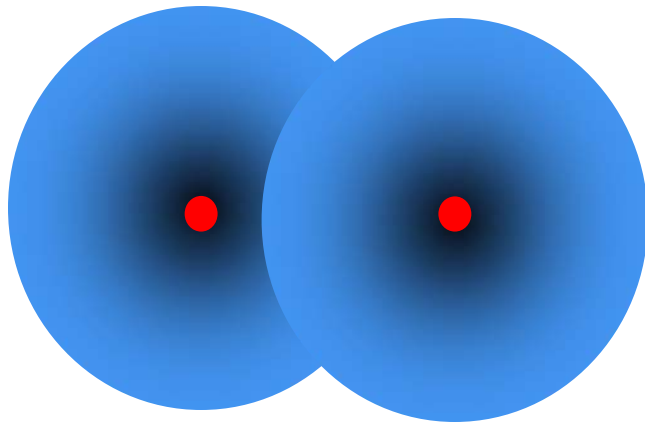- **Sensor Issues**

  – Calibration state

  – Sensor health

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Decision Maker Assumes Standard Operating **Environmental** Conditions

Data Flow

Sensor Network

| Sensor Data |
| Metadata |

Data Reduction & Fusion

Decision Maker

Alarm
No Alarm

Assumes standard conditions:

1. Environmental

2. Sensor State

The decisions are based on standardized operating conditions (nominal)

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Actual **Environmental** Conditions

Data Flow

Decision Maker

Sensor
Network

Sensor Data

Metadata

Data Reduction & Fusion

Alarm

No Alarm

As standardized operating conditions vary, assumptions about sensor performance will change
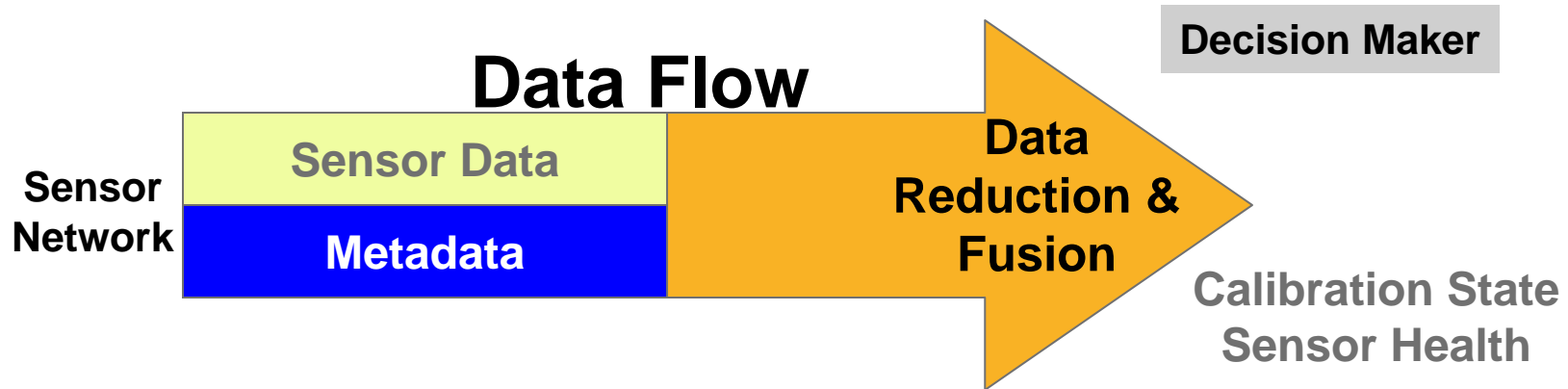
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Sensor Coverage: Environmental Differences

Sensor Operating Performance & Area Coverage

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Sensor State Conditions

Data Flow

Decision Maker

Sensor Network

Sensor Data

Metadata

Data Reduction & Fusion

Calibration State
Sensor Health

The decisions are based on standardized operating conditions (nominal)

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Sensor State Coverage
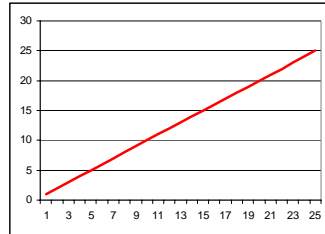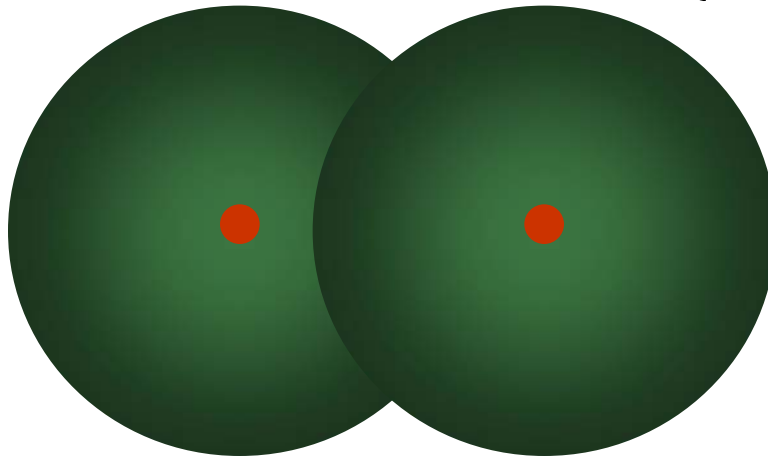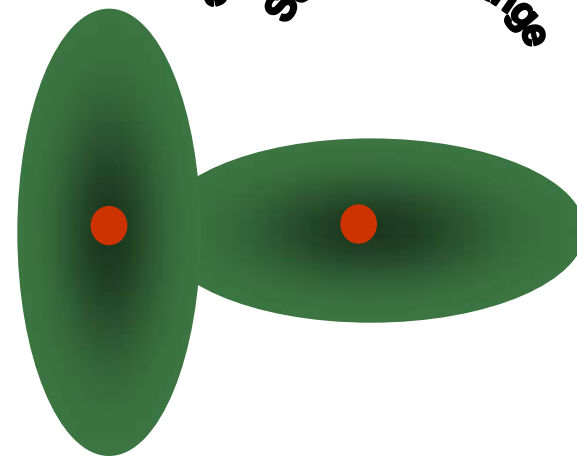

Lens cracks
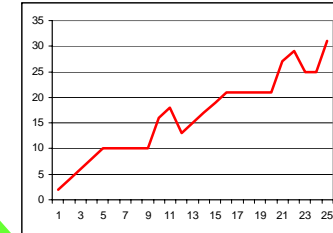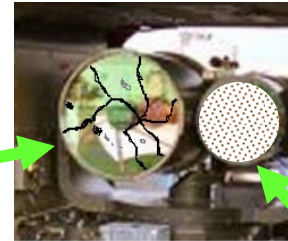
Dirty Window

Sensor A Range   Sensor B Range
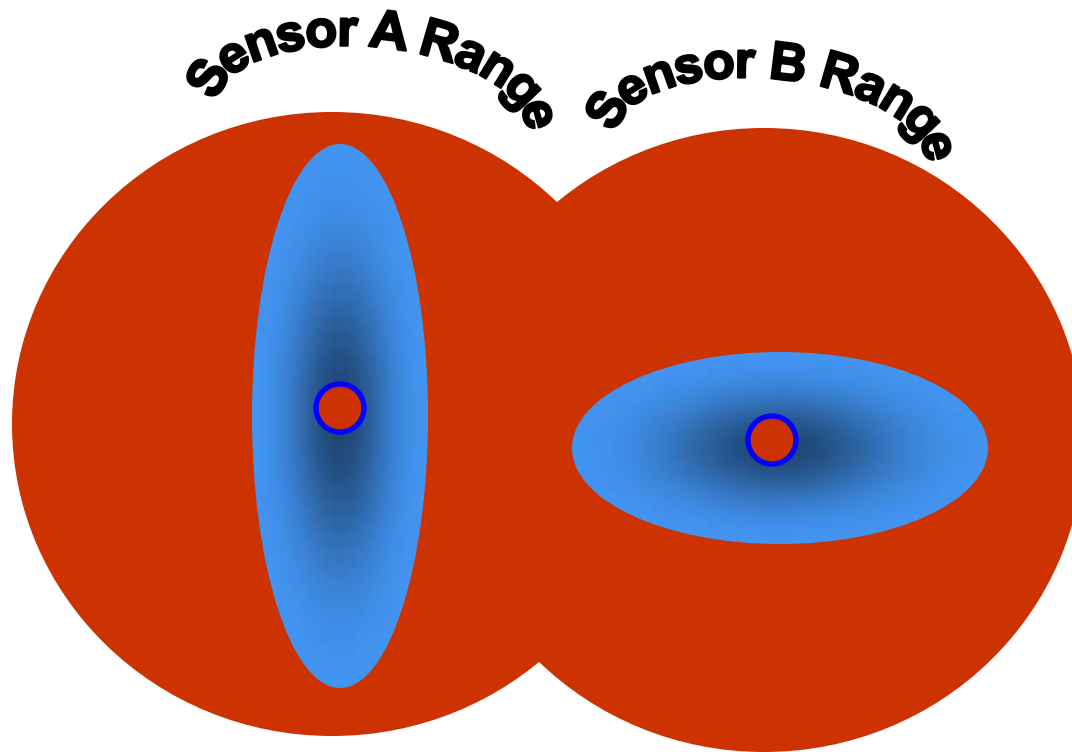
Sensor A Range   Sensor B Range

Sensor State Operating Performance & Area Coverage

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Combination of Environmental and Sensor State Contours

Sensor A Range

Sensor B Range

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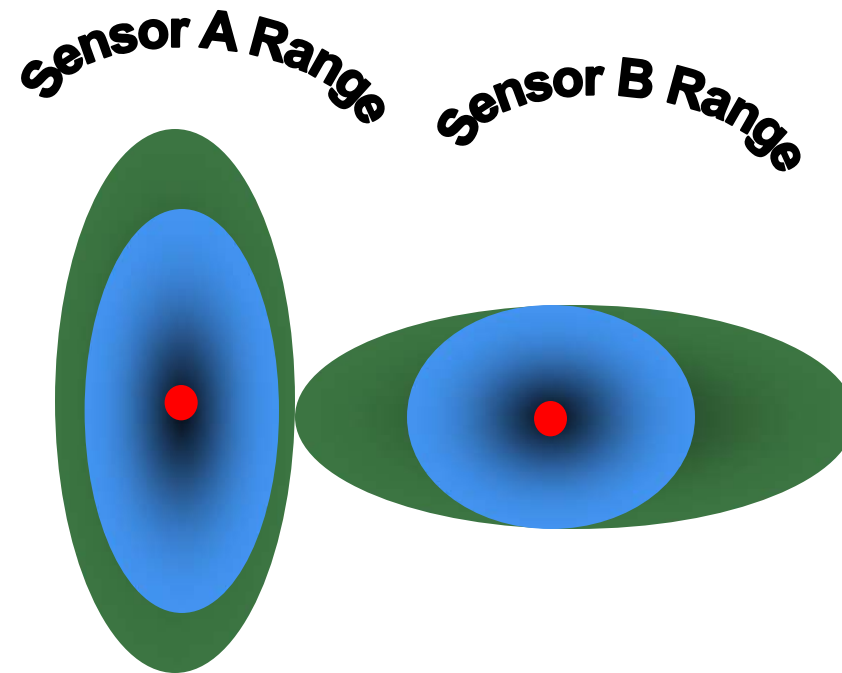
Sensor Area Coverage Lost from Nominal Conditions

Sensor A Range   **Sensor B Range**

■ = **Sensor area coverage lost due to Environmental & Sensor State Restraints**

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Solution: A Picture of Sensor Performance

Manage Sensor performance actively during operations of each sensor

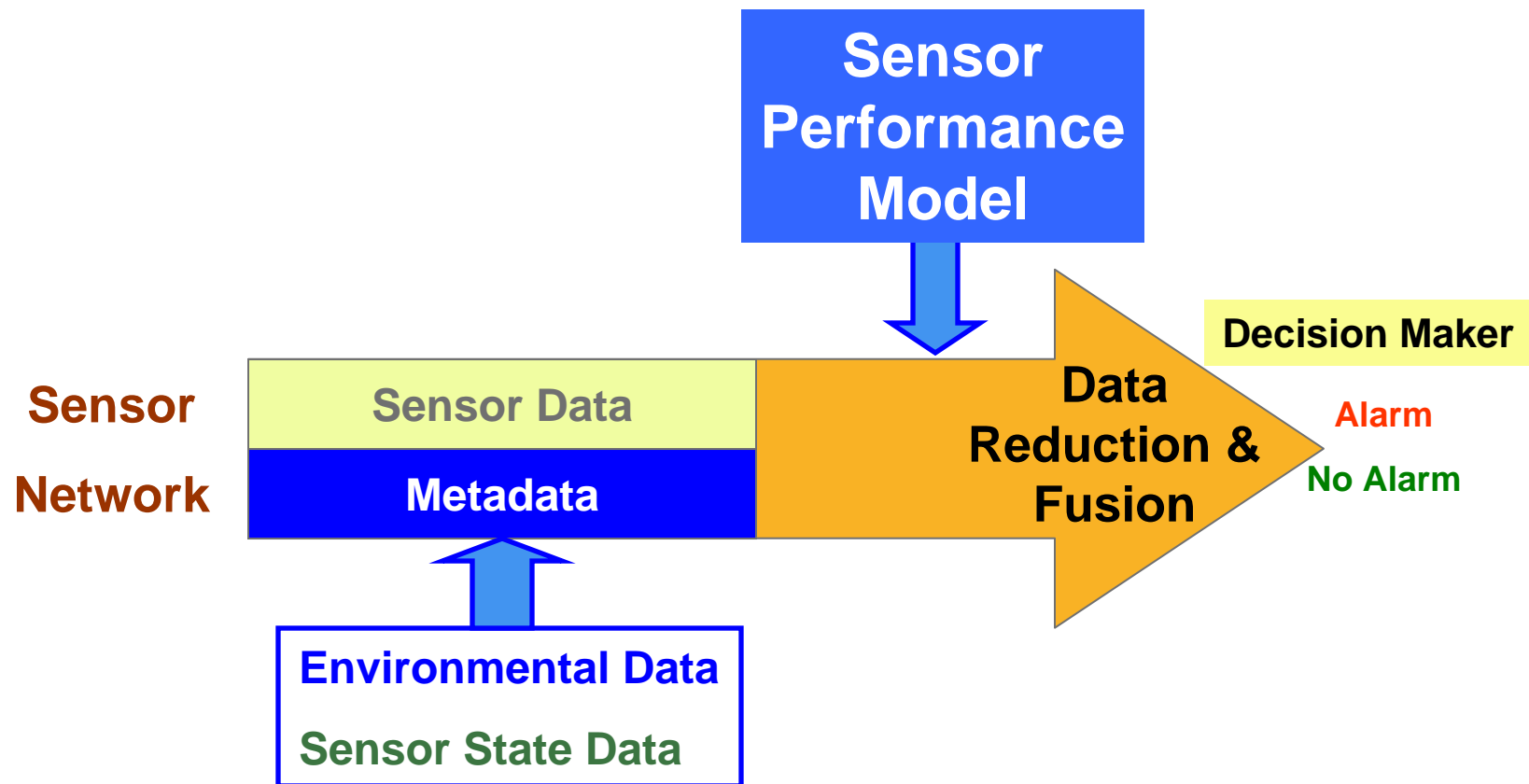Update as a function of location and time within the sensor field of regard

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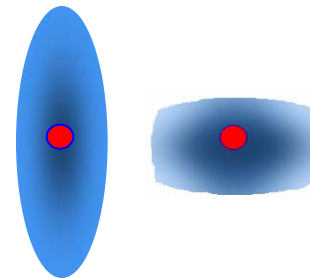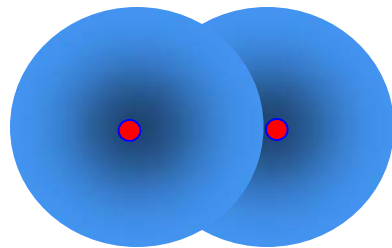
Sensor Performance Models

Sensor Performance Models are commonly used in sensor development and testing.

Examples:

- Chemical and Gas Sensing models include plume migration and wind effects as well as other important factors

- Imaging Sensor Models account for exposure, focus and atmospherics as well as other important factors

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Solution: Insert Sensor Performance Model

Sensor Performance Model

Sensor Network

Sensor Data

Metadata

Data Reduction & Fusion

Decision Maker

Alarm

No Alarm

Environmental Data

Sensor State Data

Insert Sensor Performance Model into operational architecture

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Solution: Insert Sensor Performance Model

Is it this Or this?

Sensor Performance Model → Evaluate Predictions Against Requirements → Confirm coverage **Or** Identify gaps
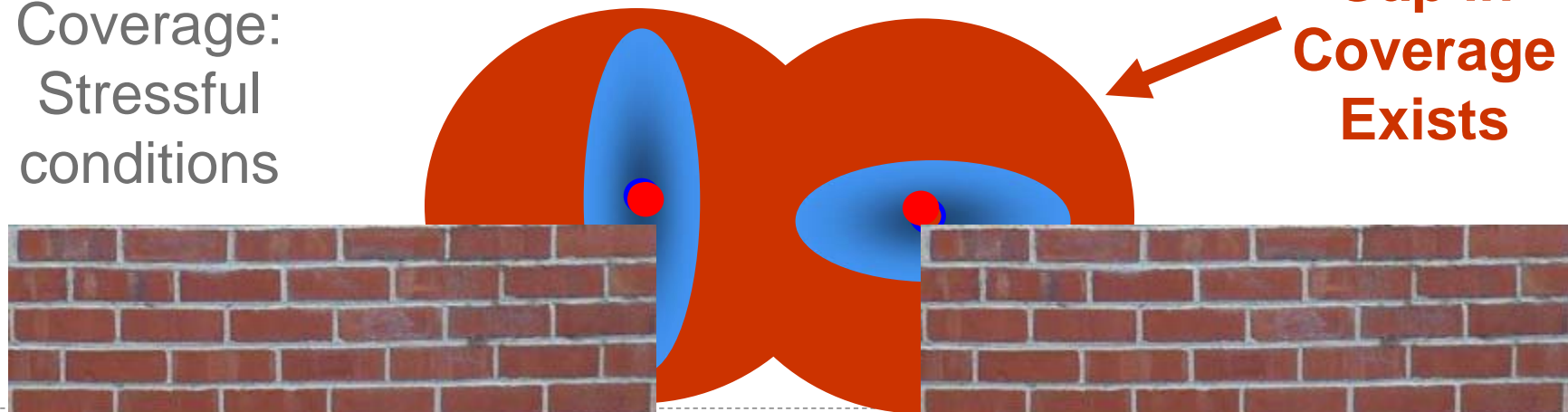
↓

Decision Maker

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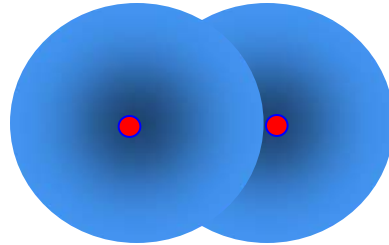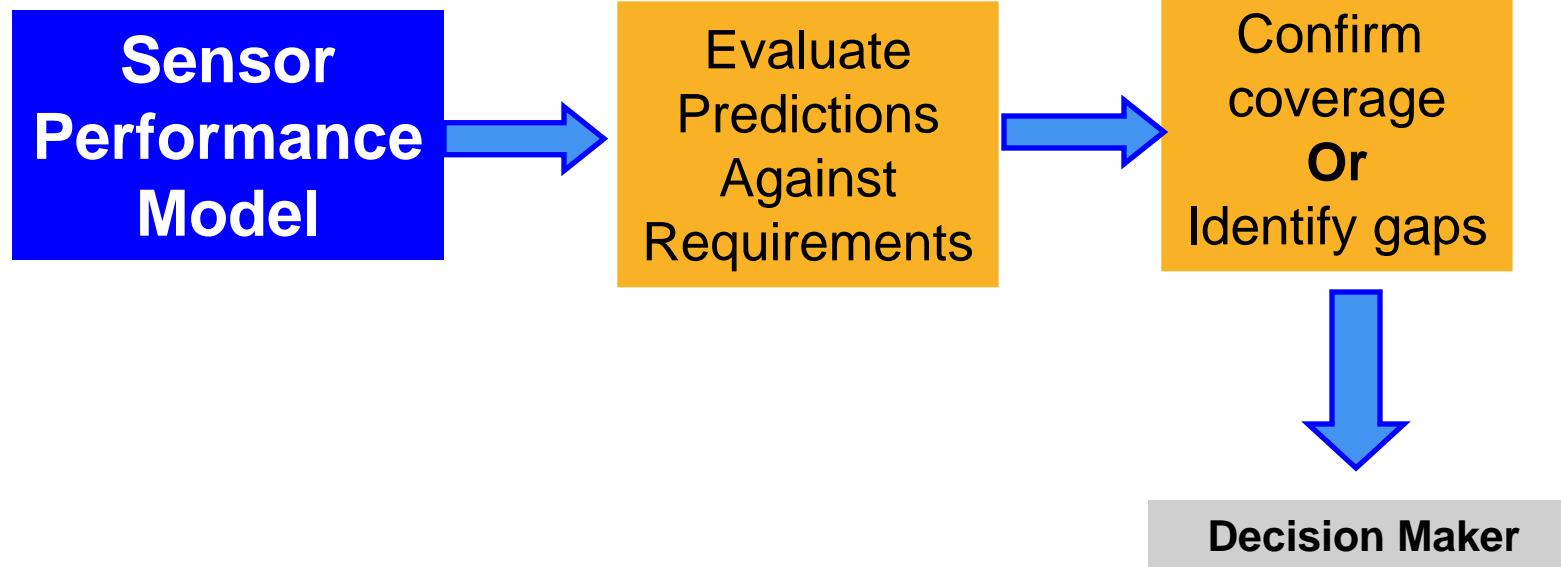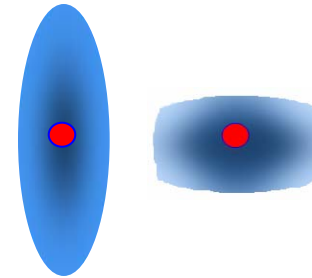
Predictions Evaluated Against Requirement

Coverage:
Nominal
conditions
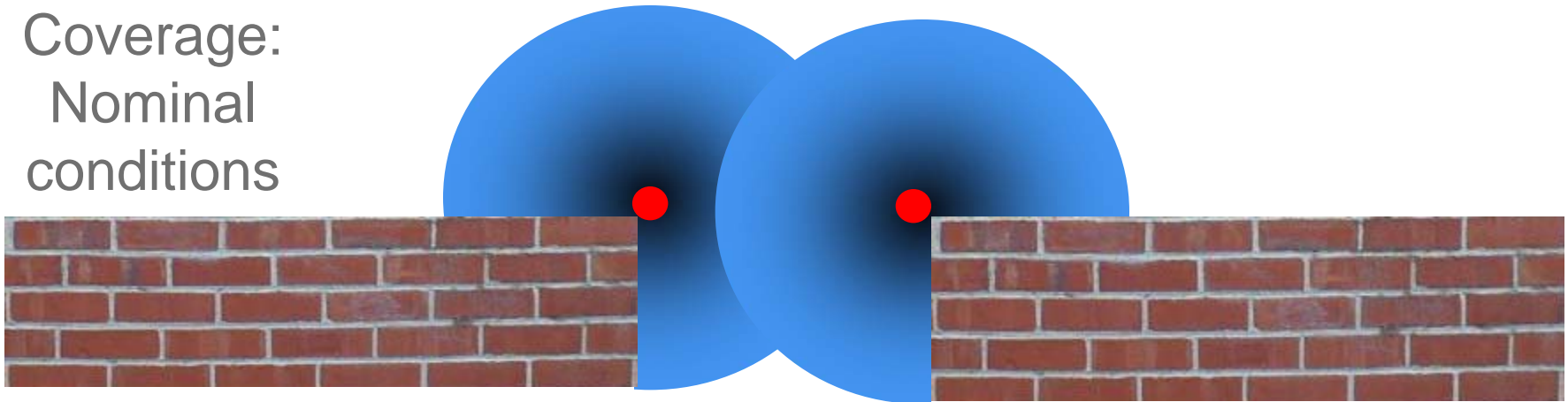
Coverage:
Stressful
conditions

Gap in Coverage Exists

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Near Real Time Threat Mitigation

Identify coverage gaps due to

- Changes in Environmental conditions
- Failed/degraded sensors

Answer the following questions

- Where coverage gaps?
- How big are they?
- Can I redeploy existing sensors to remove/reduce the gap?
- Where do I deploy additional sensors to fill gaps?

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Threat Management Applications

Supports re-assessment of network capability during operations

Provides capability to assess performance against stressful operational scenarios

Allows Redesign of operational sensor networks

– **New mission requirements**

– **Variable threat levels**

– **New/improved sensor technologies**

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Conclusion

Integration of the Sensor Performance Model into your operational sensor network will provide dynamic knowledge of the system performance at particular locations and times within an area of interest.

This benefits battlespace management by supporting:

Near Real Time Threat Mitigation

Threat Management Applications

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ITT Sensor Performance Modeling Experience

Sensor Type	Application
Thermal	Night time and low light Target Detection and identification
Video	Target detection, identification and tracking
Multi-Spectral	Materials Detection and Identification, full color and false color imaging
Hyper-Spectral	Material and Chemical Agent Detection and identification.
IMS	Chemical Gas Detection
LIDAR	Solid and Gas Biological and Chemical Agent Detection

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