



# LOCATING IMMINENT THREATS

By: Dominic Adams, Mehul Sen, Dan Lynch, Aslan Cronister



# The Challenge

On-site security personnel at U.S. Government overseas offices need a way to quickly identify the location of imminent danger when the emergency notification system is triggered in order to create an escape plan or diffuse the threat before it causes harm to human lives and property.

# The Problem Statement

Original

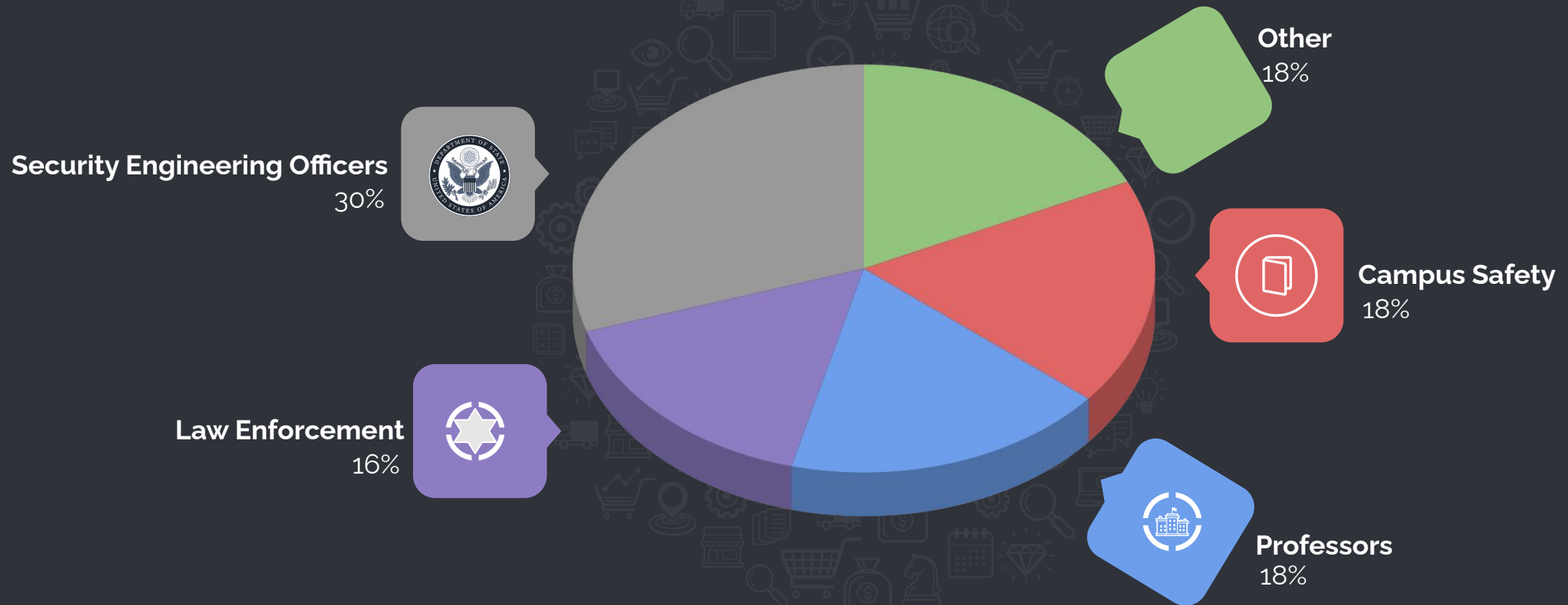
Triangulating the location of an imminent danger accurate to 20 feet when an emergency notification system is triggered within 15 seconds or less.

# The Problem Statement

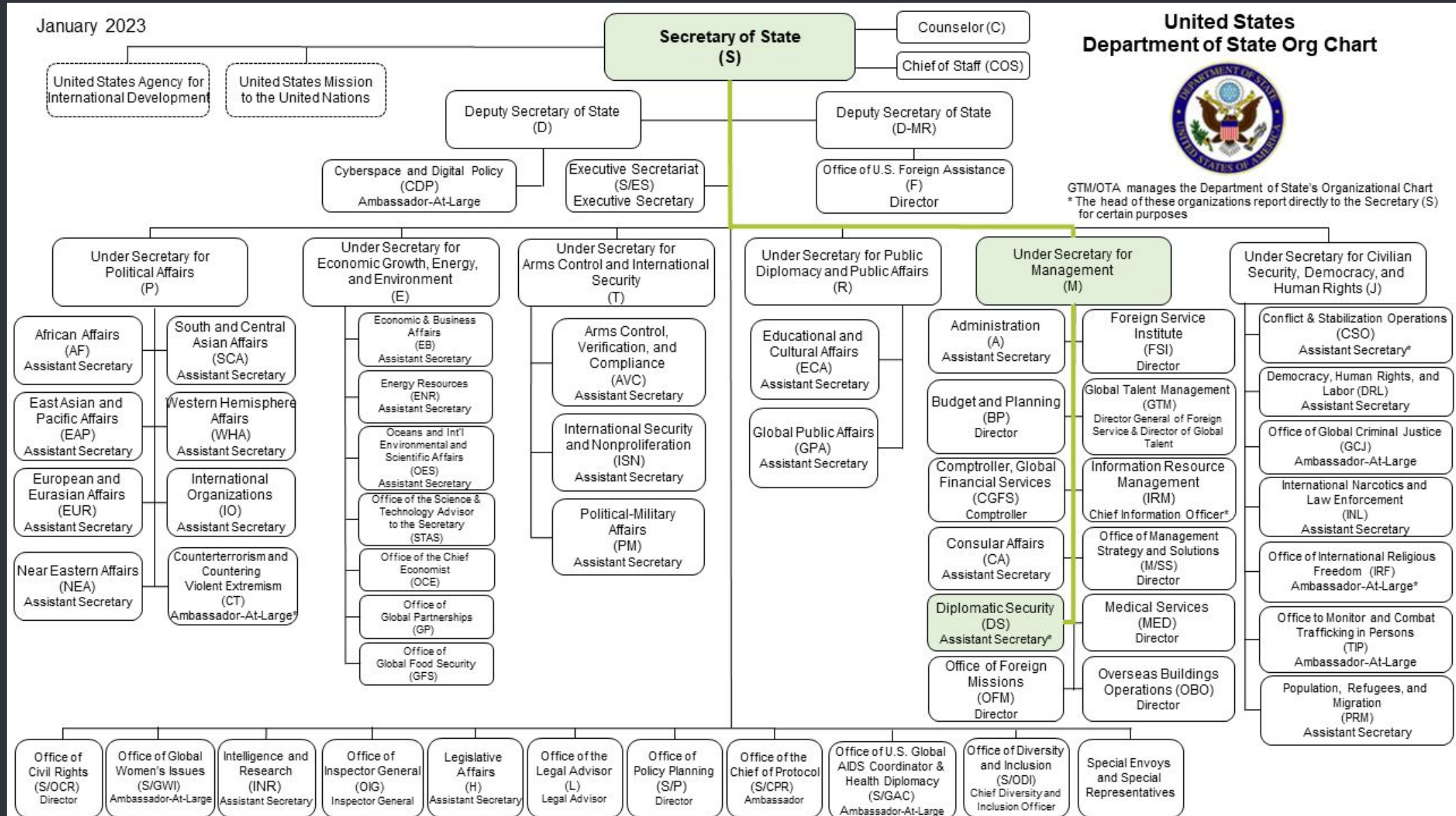
Pivot

Identify the best solution for triangulating the location of an imminent danger, accurate to 20 feet, when an emergency notification system is triggered within 15 seconds or less.

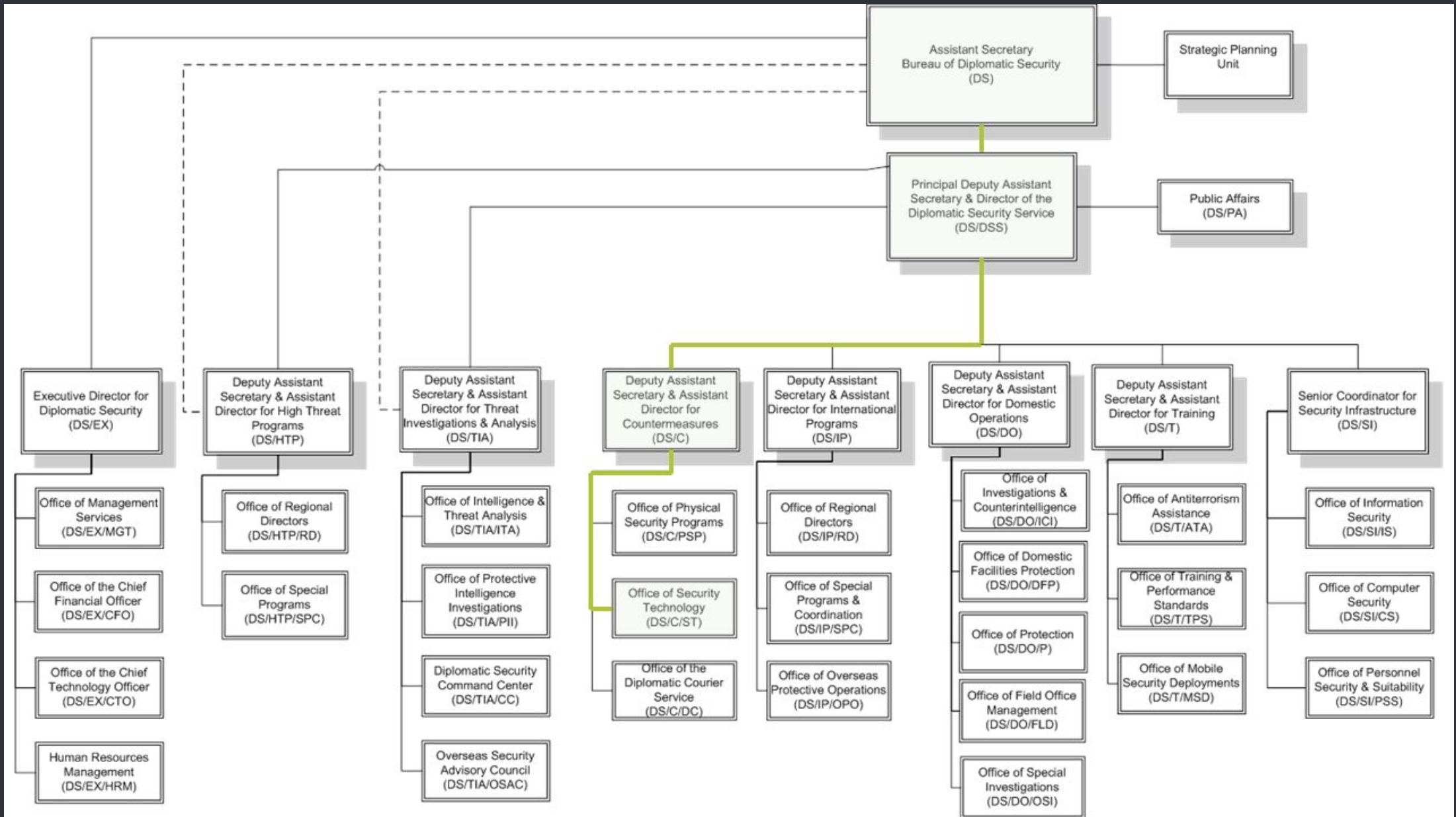
# Interviewee Breakdown



# Where We Are in the DoS



# Where We Are in the DoS



# Our Journey

January

February

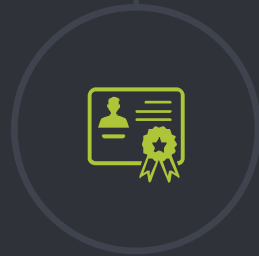
March

April

May



We investigate The Challenge and developed a list of knowns and unknowns. A draft of our Problem Statement was made.



Beneficiary discovery was started, our MVP was drafted, and our problem statement was refined.



Beneficiary discovery continued, multiple MVPs were developed, and a timeline was devolved.



Beneficiary discovery continued, a single MVP was decided upon, and our group met with our Sponsor, Mario May, in DC.

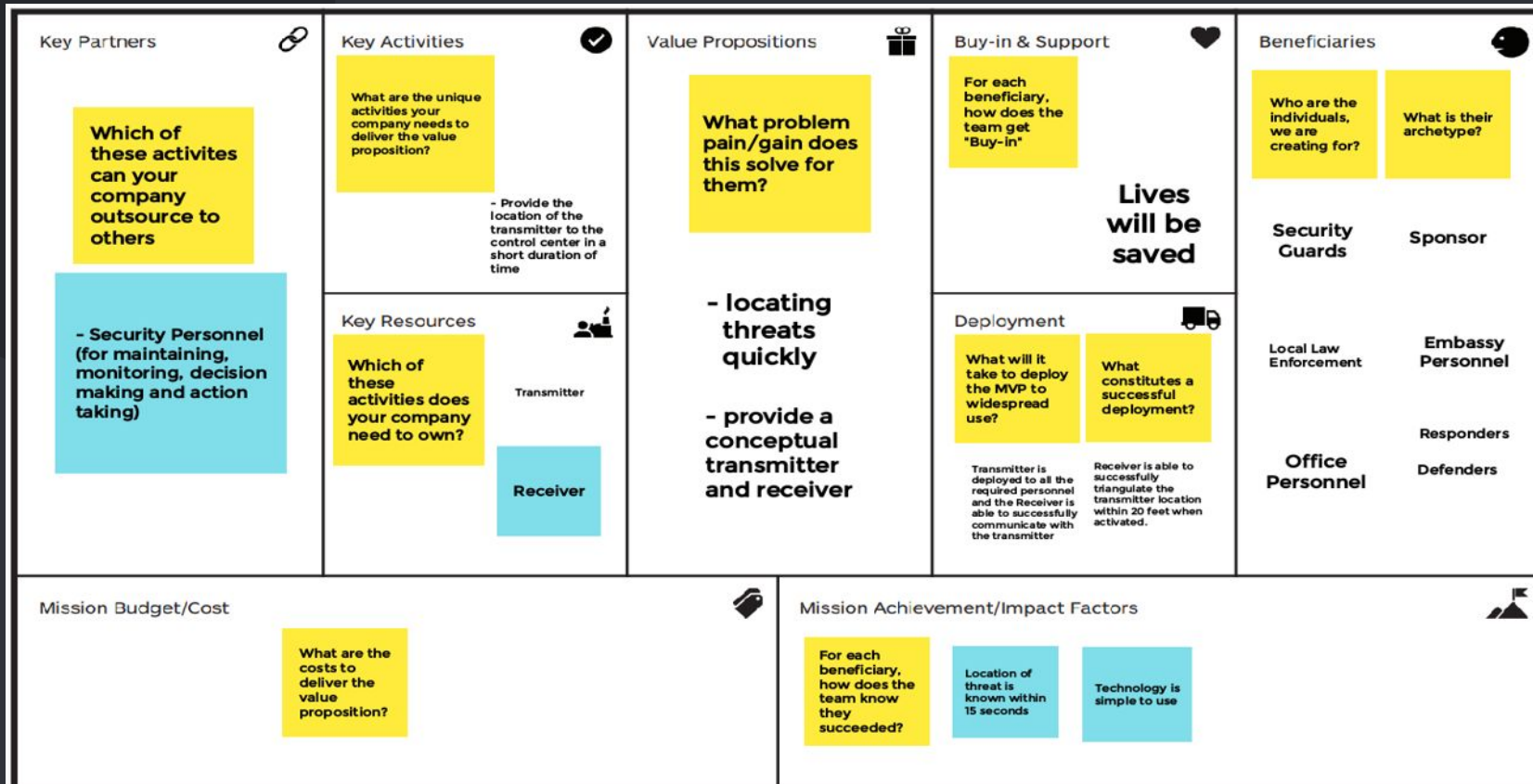


Suggestions and future improvements on our MVP were recommended.



# Mission Model Canvas








Original MMC



Week 1  
(01/31/2023)

# Mission Model Canvas

## Final MMC

<p><b>Key Partners</b> </p> <ul style="list-style-type: none"> <li>&gt; <b>Mario May (Sponsor)</b></li> <li>&gt; Michelle Saks (Mentor)</li> <li>&gt; Neil Pendleton (INOVONICS Contact)</li> <li>&gt; Justin Ronning (Former Marine)</li> <li>&gt; Andrey Soloviev (QuNav Contact)</li> </ul>	<p><b>Key Activities</b> </p> <ul style="list-style-type: none"> <li>&gt; Research &amp; Development</li> <li>&gt; Mapping the location of the embassy</li> <li>&gt; Hiring and Training Guards</li> <li>&gt; Installation of Repeaters &amp; Pendants</li> </ul>	<p><b>Value Propositions</b> </p> <ul style="list-style-type: none"> <li>&gt; Provide a Conceptual Transmitter and Receiver</li> <li>&gt; Provide instructions on what to do until first responders arrive</li> <li>&gt; Locate pendant within 15 seconds within 20 feet</li> <li>&gt; Provide a visual output on the receiver</li> </ul>	<p><b>Buy-in &amp; Support</b> </p> <ul style="list-style-type: none"> <li>&gt; Provide an effective emergency notification system that identifies the location of the pendant within 20 feet within 15 seconds.</li> </ul>	<p><b>Beneficiaries</b> </p> <ul style="list-style-type: none"> <li>&gt; Campus Safety/University Police</li> <li>&gt; Security Engineering Officers - Mario May (Sponsor)</li> <li>&gt; Law Enforcement</li> </ul>
<p><b>Mission Budget/Cost</b> </p> <p>~ \$550,000</p> <ul style="list-style-type: none"> <li>-&gt; \$120k for RDT&amp;E</li> <li>-&gt; \$300k for PROC</li> <li>-&gt; \$180k for O&amp;M</li> </ul>	<p><b>Mission Achievement/Impact Factors</b> </p> <ul style="list-style-type: none"> <li>&gt; System is designed to be easy to install, and operate as follows:             <ul style="list-style-type: none"> <li>- Single button interaction for guards</li> <li>- System is configured on the appropriate frequency out-of-the-box for engineers</li> </ul> </li> <li>&gt; <b>Location is known within 15 seconds and accurate up to 20 feet</b></li> <li>&gt; Technology preserves anonymity</li> <li>&gt; Visually identify where the transmitter is triggered.</li> </ul>			

Week 13  
(04/18/2023)

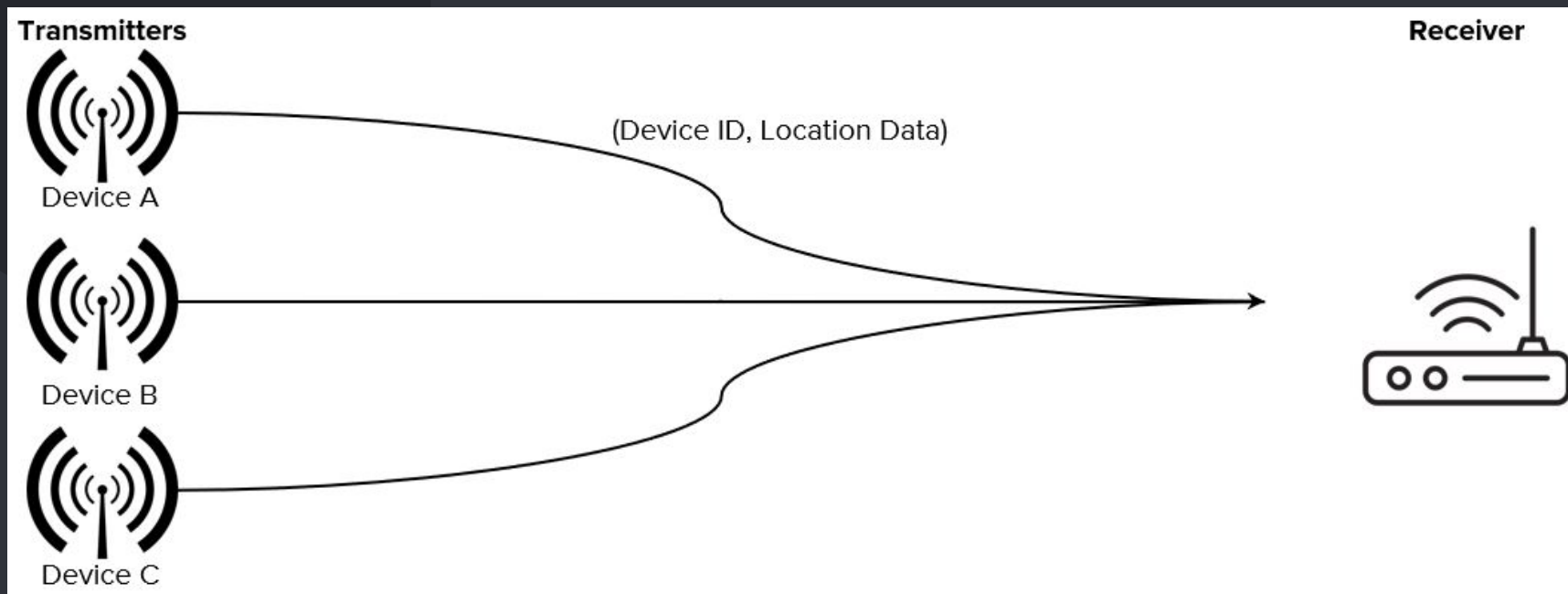
“The more you complicate it,  
the riskier is the solution”

**Daniel Krebs**

Deputy Director of  
Cybersecurity/Information  
Systems, Monroe County

# Minimum Viable Product

Initial MVP



Week 2  
(02/07/2023)

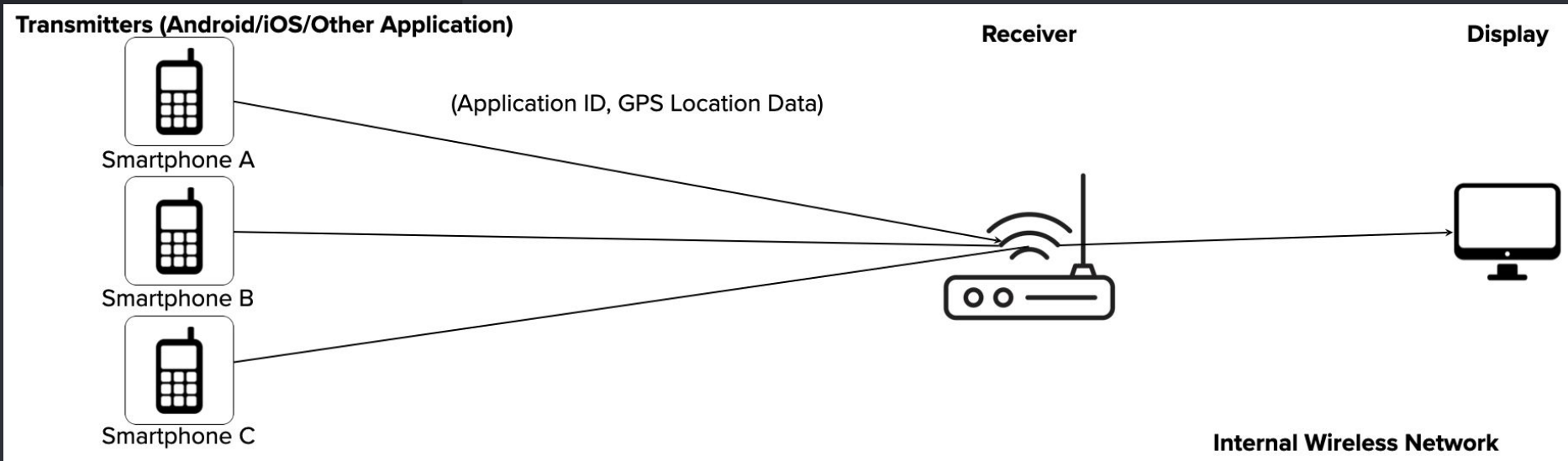
“Redundancy is key”

**Frederick J. Rion**

Emergency Manager, SUNY  
Brockport

# Minimum Viable Product

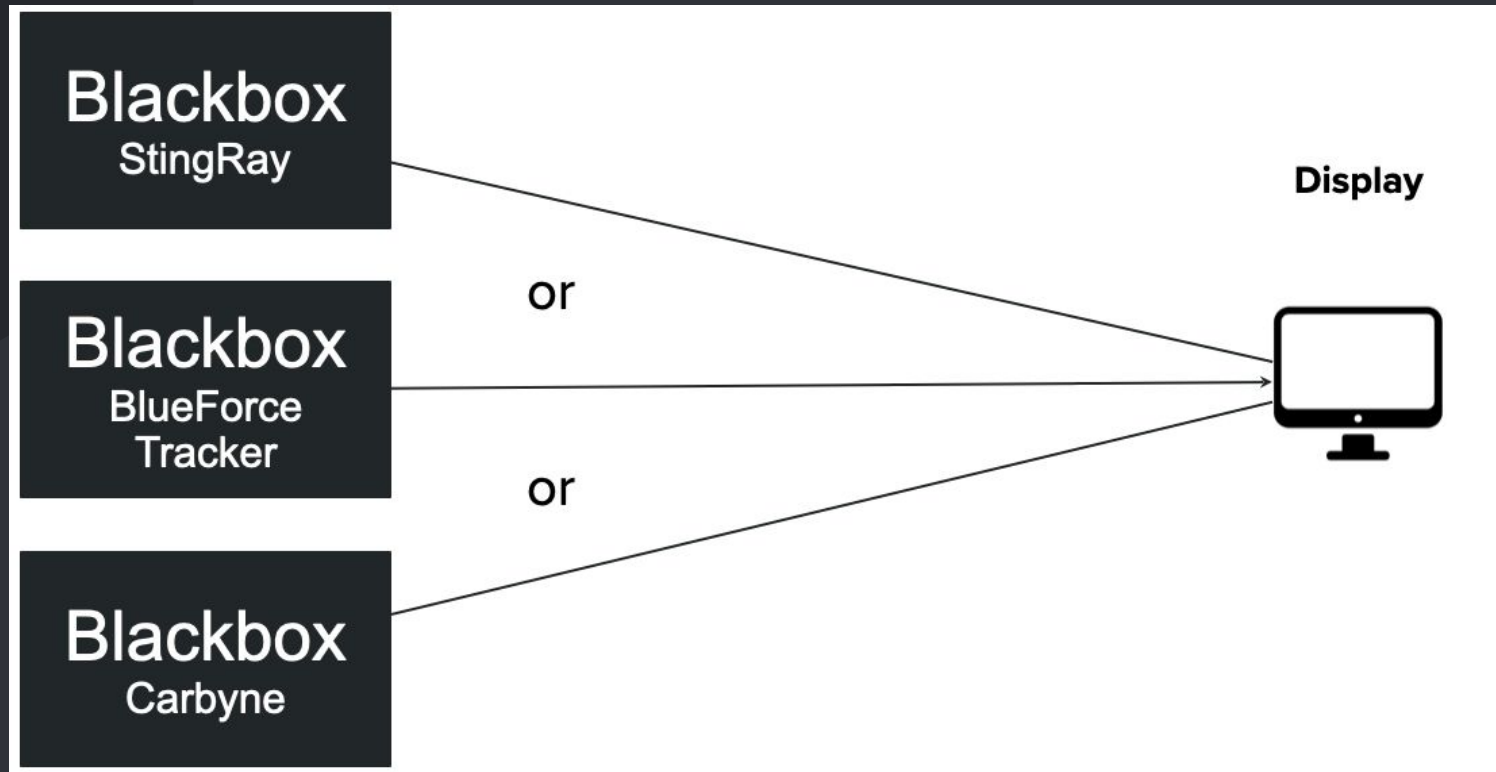
## Intermediate MVPs



Week 7  
(02/28/2023)

# Minimum Viable Product

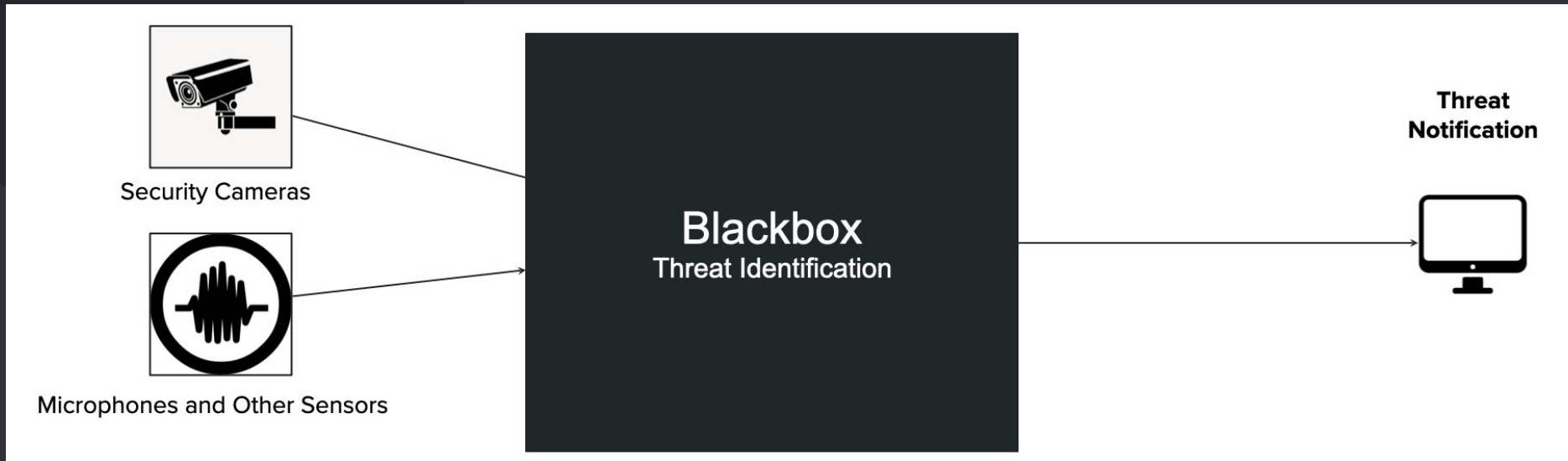
Intermediate MVPs



Week 7  
(02/28/2023)

# Minimum Viable Product

Intermediate MVPs

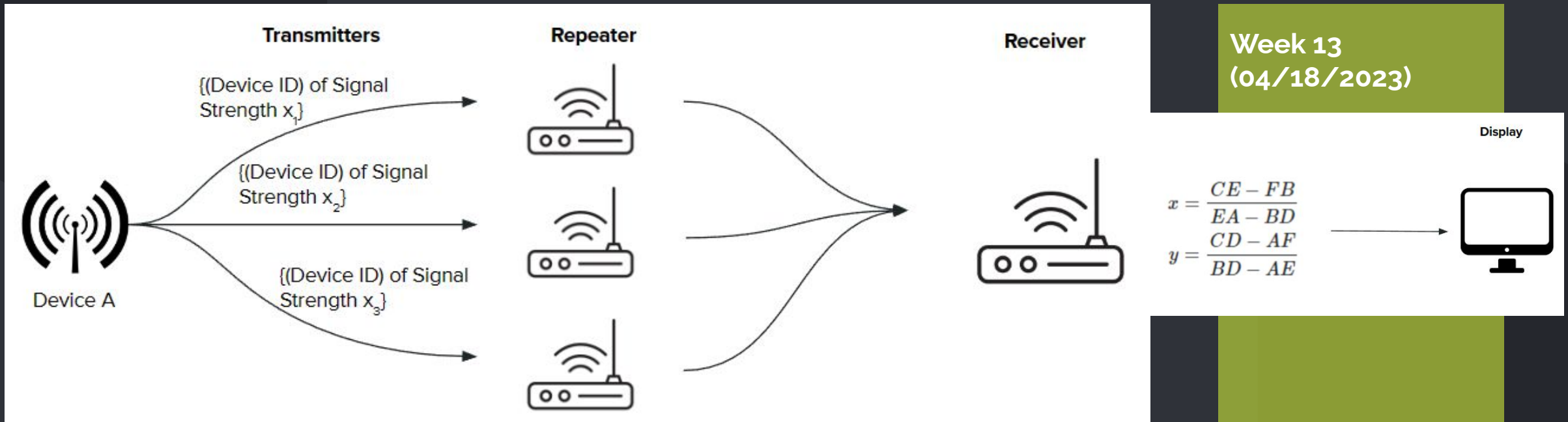


Week 7  
(02/28/2023)

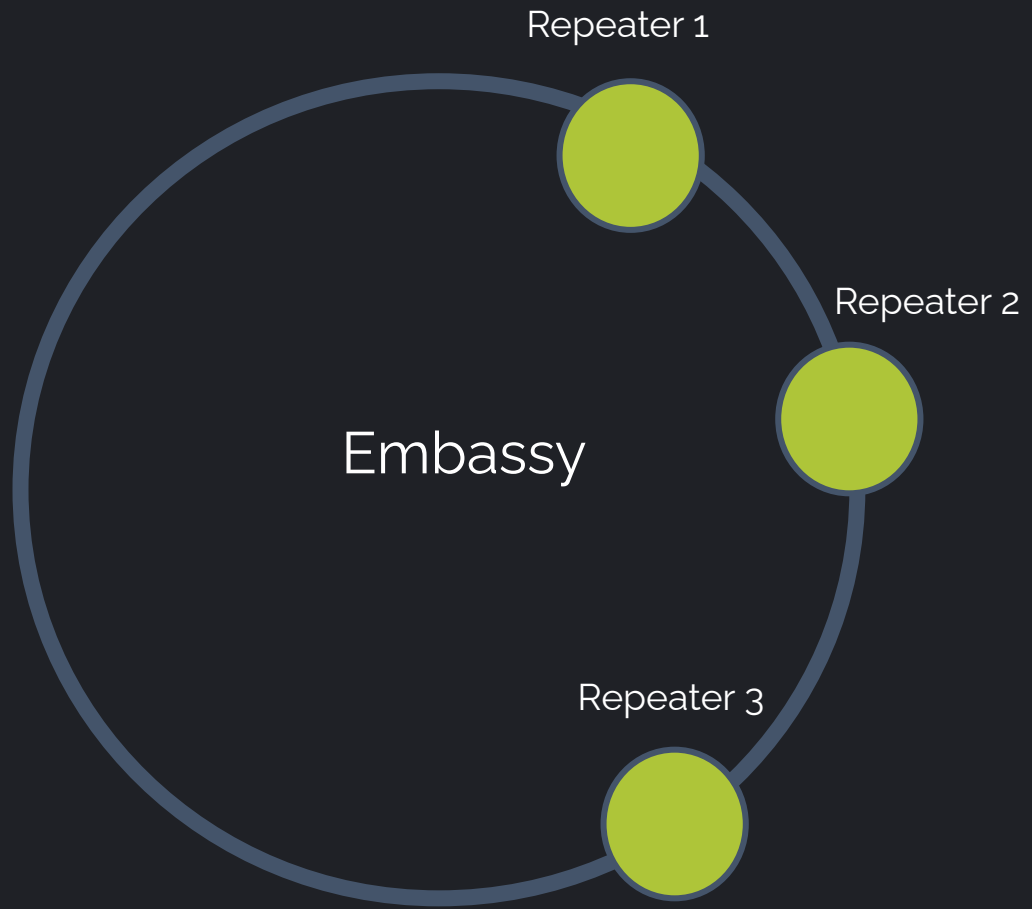


# Minimum Viable Product

Final MVP

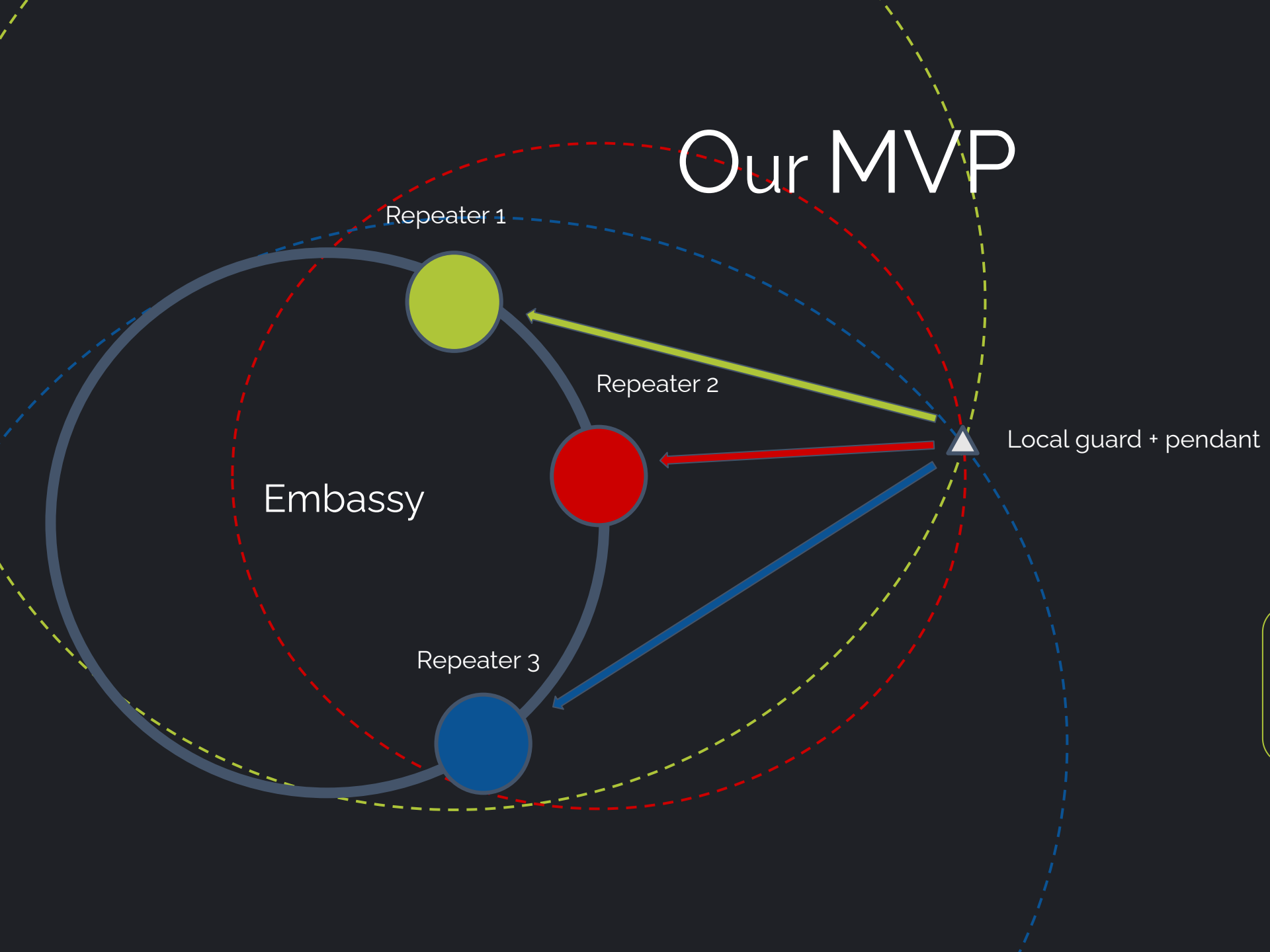


# Our MVP



Local guard + pendant

# Our MVP



$$\begin{cases} x = \frac{CE - FB}{EA - BD} \\ y = \frac{CD - AF}{BD - AE} \end{cases}$$

# What Informed Our MVP?

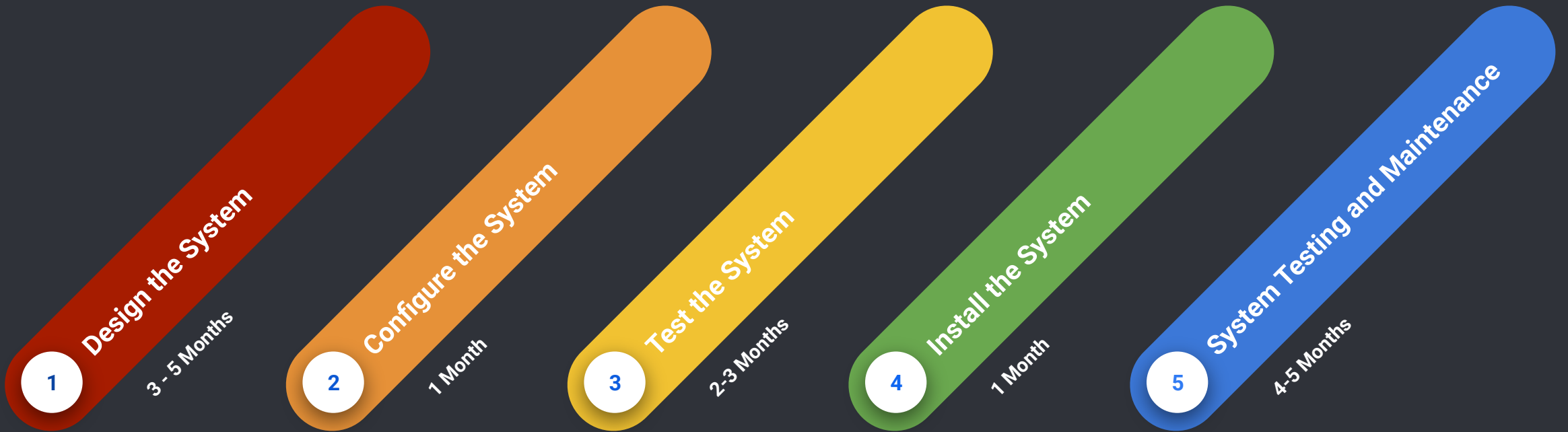
- ❖ 67 interviews
  - 50 unique touchpoints
- ❖ Rigorous academic research
- ❖ Beneficiary & product discovery
- ❖ On-site lab visit
- ❖ Validated by Inovonics

# Potential Testing Site



US Baghdad Embassy

# Deployment Timeline



11 - 15 Months



5 - 6 Months

“We will investigate it”

**Mario May**

Security Engineering Officer  
Office of Security Technology,  
Technology Development  
Branch, DoS



With A Special Thanks To



# Mario May

Security Engineering Officer

Our project sponsor



# Michelle Saks

Our project mentor



# Dr. James Santa

Adjunct professor at RIT

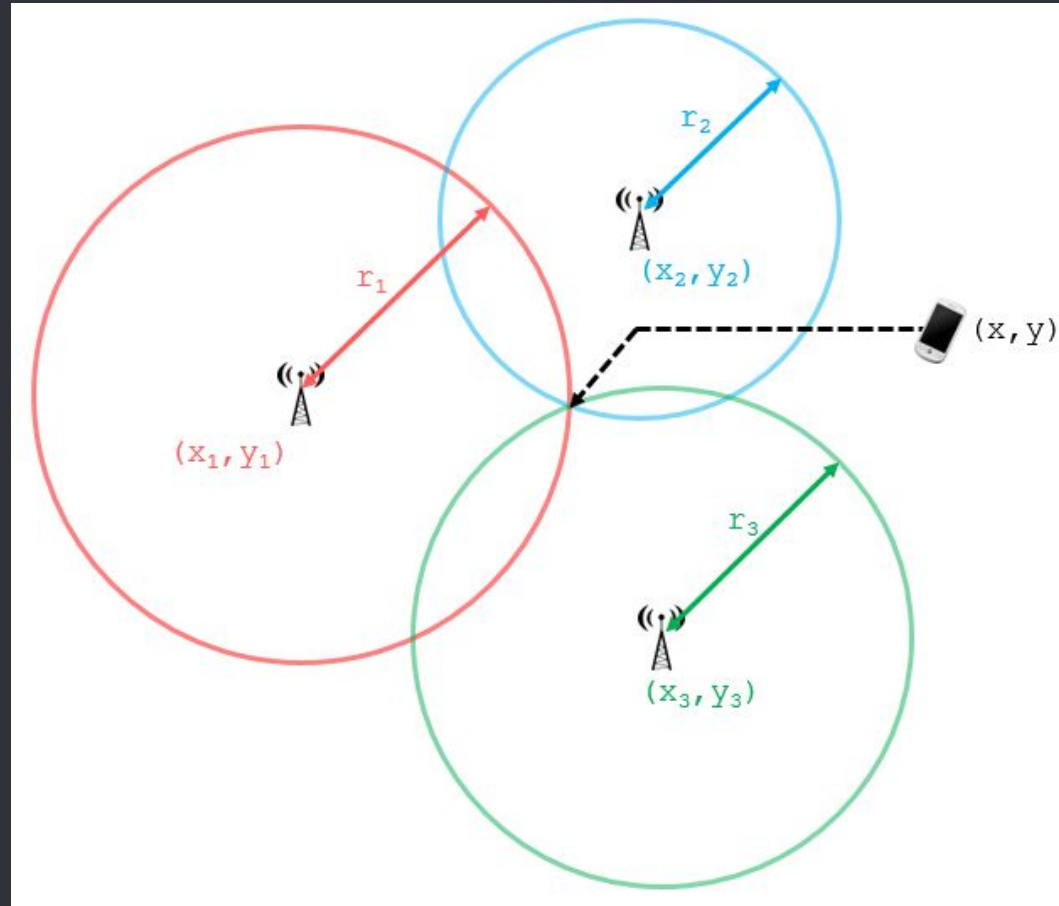
Our professor



The image features a solid green background. In the top-left and bottom-right corners, there are white, stylized geometric line art elements. These elements consist of overlapping lines that form a series of interconnected shapes, resembling a stylized 'G' or a similar letterform. The central text 'THANK YOU' is rendered in a white, clean, sans-serif font. The word 'YOU' is unique, as the letter 'O' is replaced by a white geometric shape that matches the corner art, consisting of multiple overlapping lines that create a faceted, crystalline appearance.

THANK YOU

# Trilateration Calculations



# Trilateration Calculations

$$\begin{aligned}(x - x_1)^2 + (y - y_1)^2 &= r_1^2 \\ (x - x_2)^2 + (y - y_2)^2 &= r_2^2 \\ (x - x_3)^2 + (y - y_3)^2 &= r_3^2\end{aligned}$$

$$\begin{aligned}x^2 - 2x_1x + x_1^2 + y^2 - 2y_1y + y_1^2 &= r_1^2 \\ x^2 - 2x_2x + x_2^2 + y^2 - 2y_2y + y_2^2 &= r_2^2 \\ x^2 - 2x_3x + x_3^2 + y^2 - 2y_3y + y_3^2 &= r_3^2\end{aligned}$$

Euclidean Distance for all points

$$\begin{aligned}(-2x_1 + 2x_2)x + (-2y_1 + 2y_2)y &= r_1^2 - r_2^2 - x_1^2 + x_2^2 - y_1^2 + y_2^2 \\ (-2x_2 + 2x_3)x + (-2y_2 + 2y_3)y &= r_2^2 - r_3^2 - x_2^2 + x_3^2 - y_2^2 + y_3^2\end{aligned}$$

Subtract 2nd eq. from 1st

Subtract 3rd eq from 2nd

$$\begin{aligned}Ax + By &= C \\ Dx + Ey &= F\end{aligned}$$

Rewritten two equations

$$\begin{aligned}x &= \frac{CE - FB}{EA - BD} \\ y &= \frac{CD - AF}{BD - AE}\end{aligned}$$