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

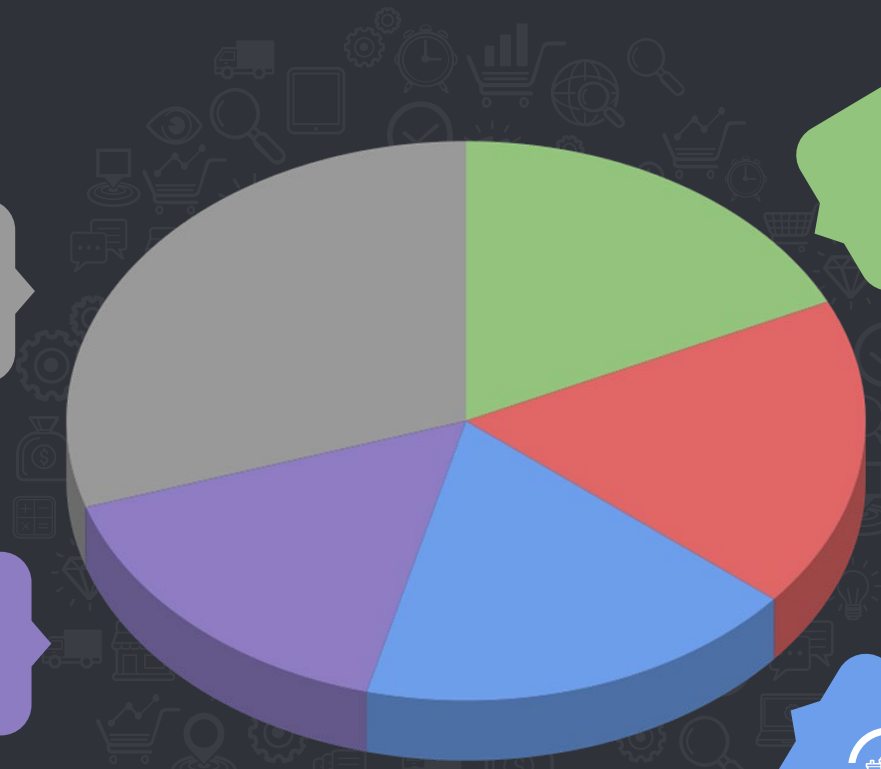
Triangulating the location of an imminent danger accurate to 20 feet when an emergency notification system is triggered within 15 seconds or less.

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



Other
18%

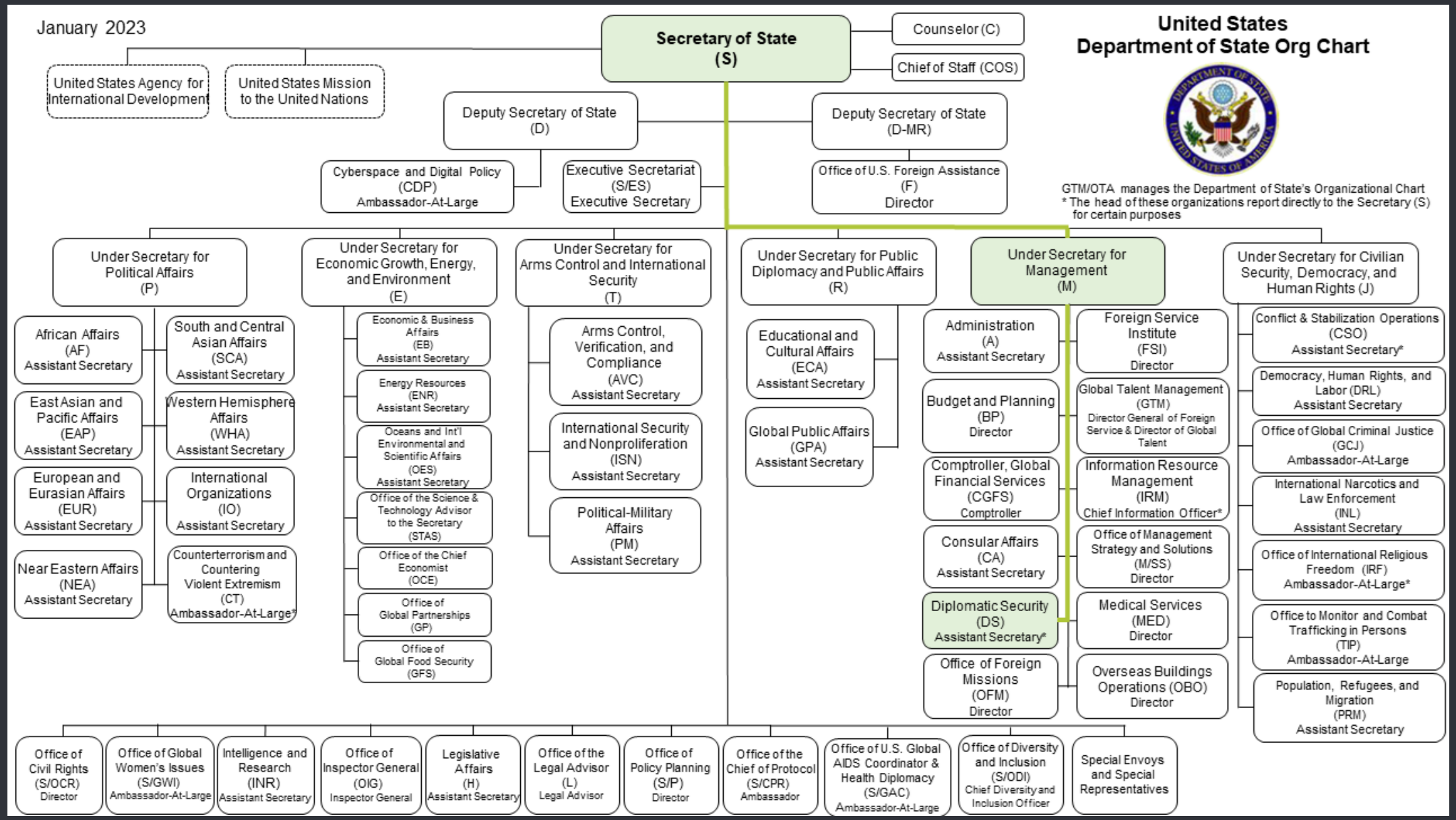
Campus Safety
18%

Professors
18%

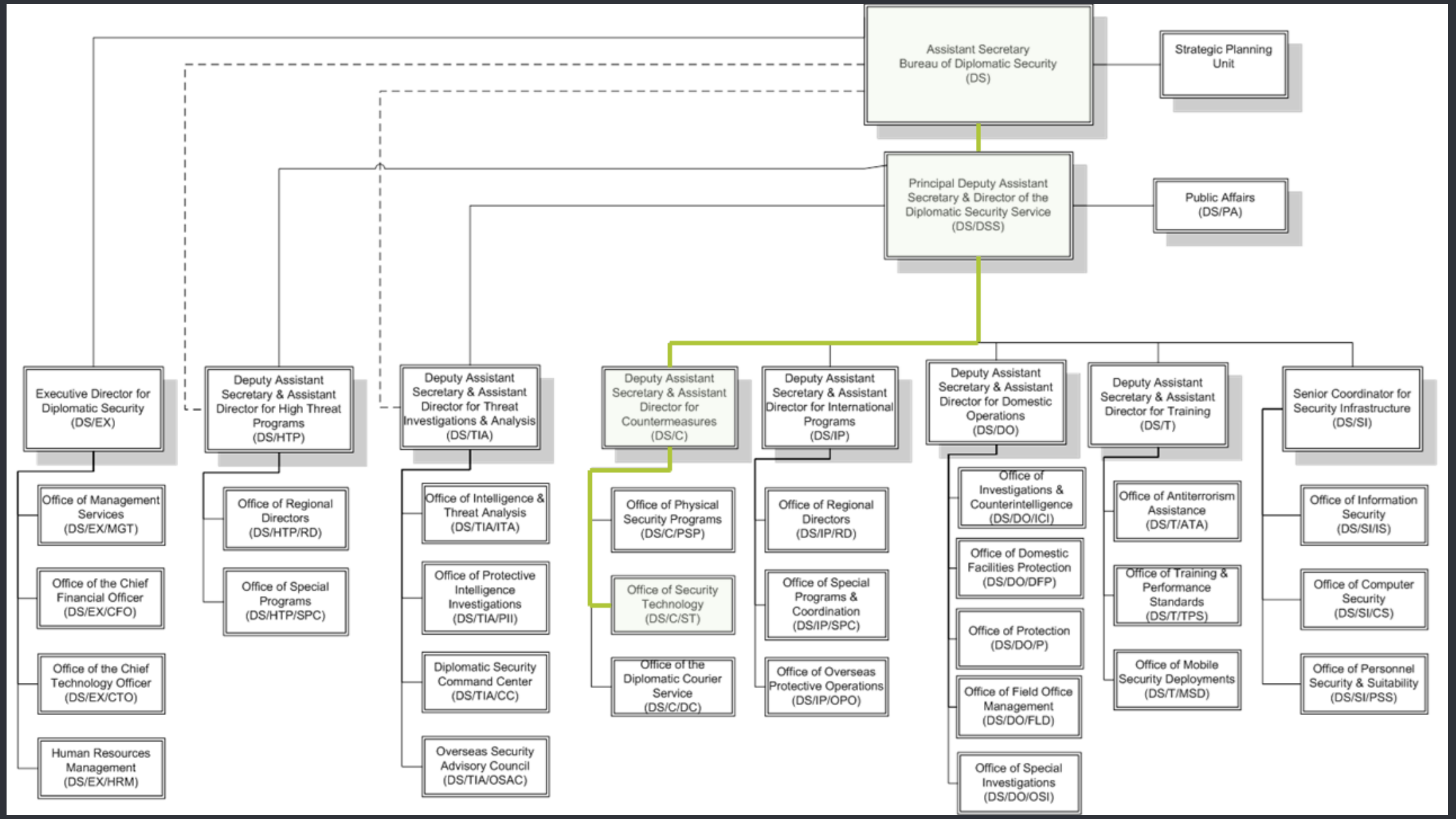
Law Enforcement
16%

Security Engineering Officers
30%

Where We Are in the DoS



Where We Are in the DoS

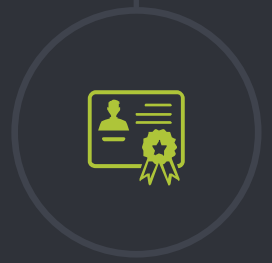


Our Journey

January

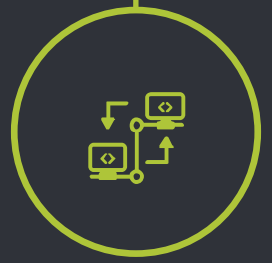
We investigate The Challenge and developed a list of knowns and unknowns. A draft of our Problem Statement was made.

February



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

March



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

April

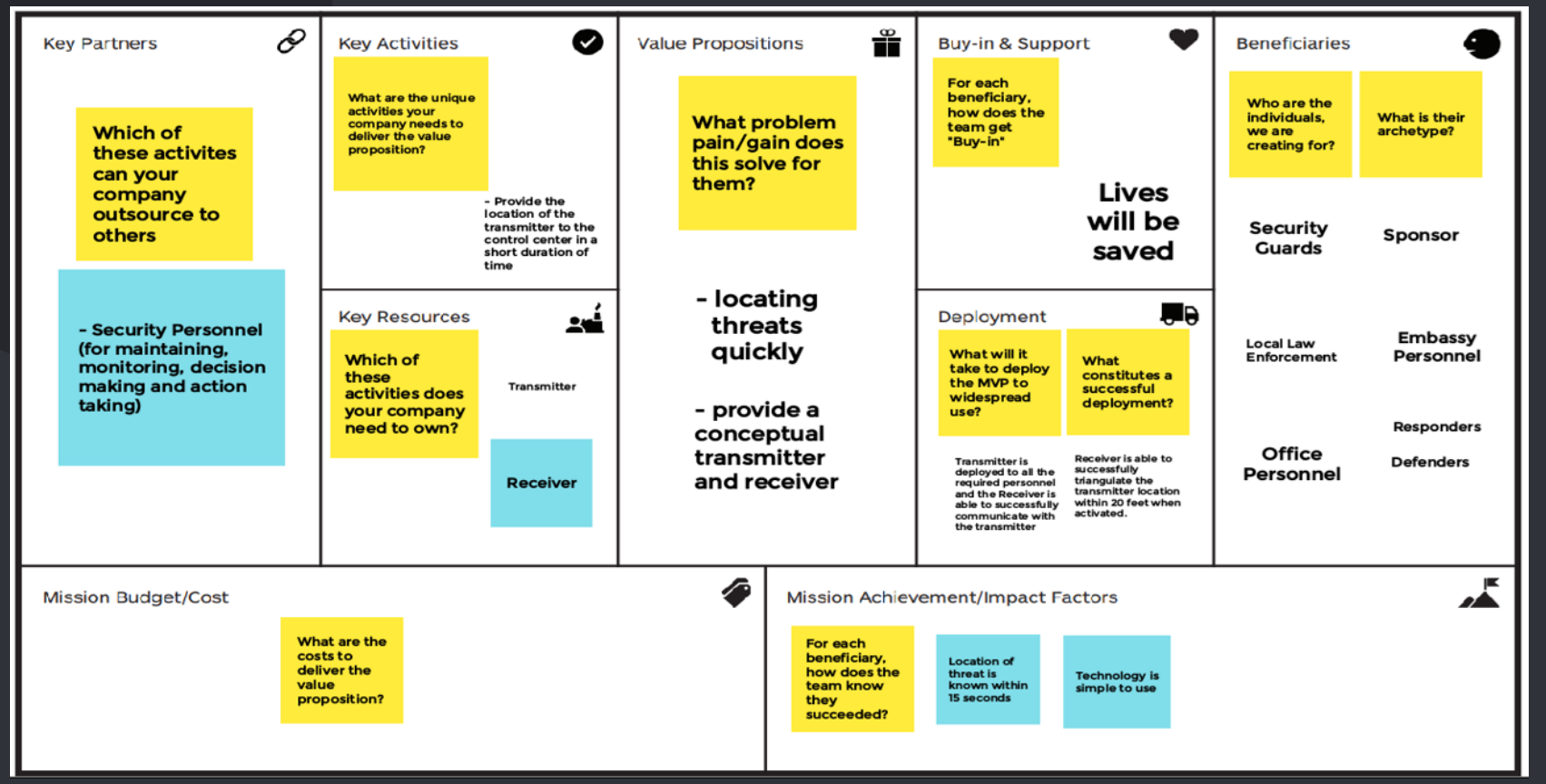
Beneficiary discovery continued, a single MVP was decided upon, and our group met with our Sponsor, Mario May, in DC.

May

Suggestions and future improvements on our MVP were recommended.

Mission Model Canvas

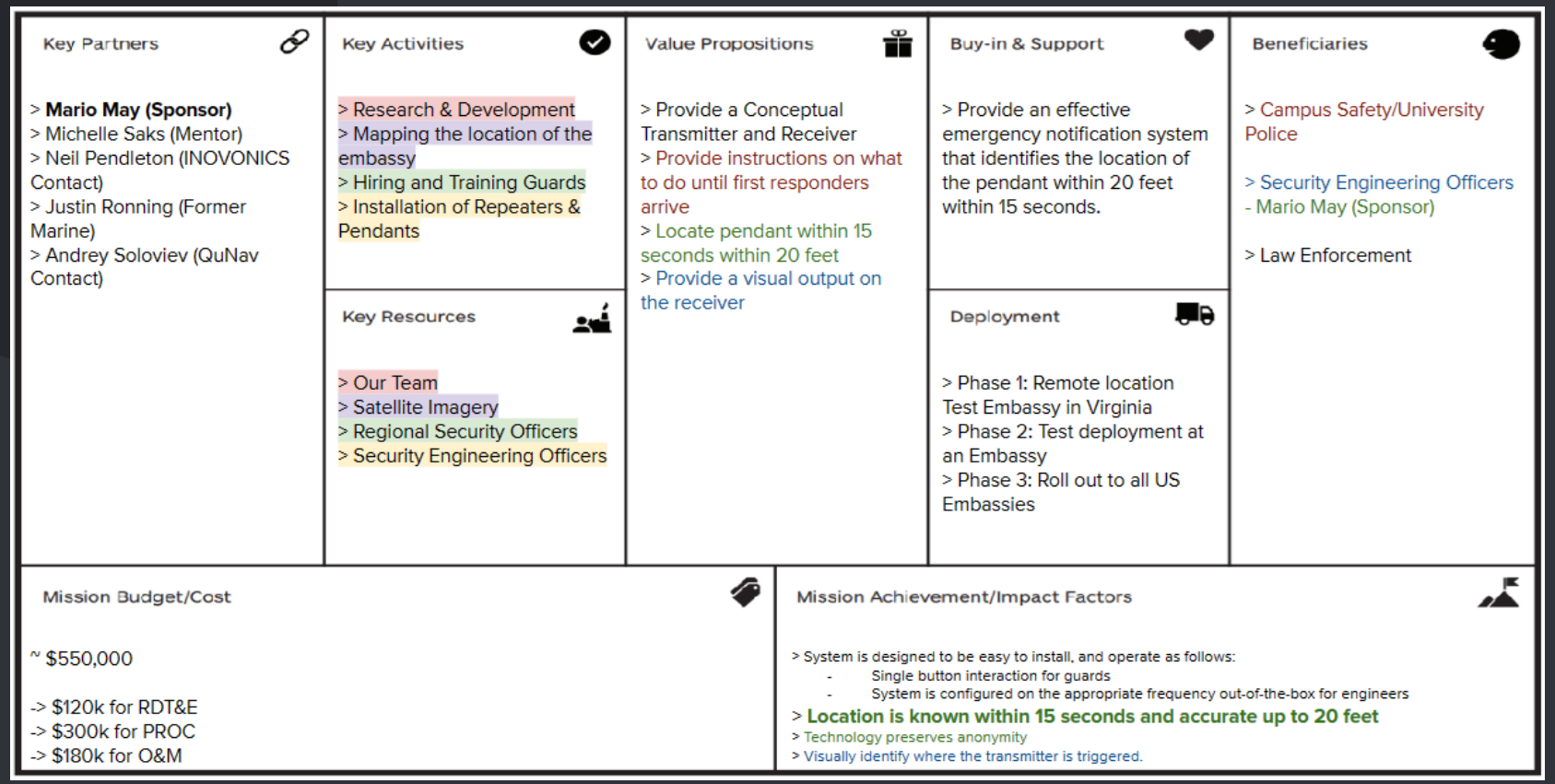
Original MMC



Week 1 (01/31/2023)

Mission Model Canvas

Final MMC



Week 13 (04/18/2023)

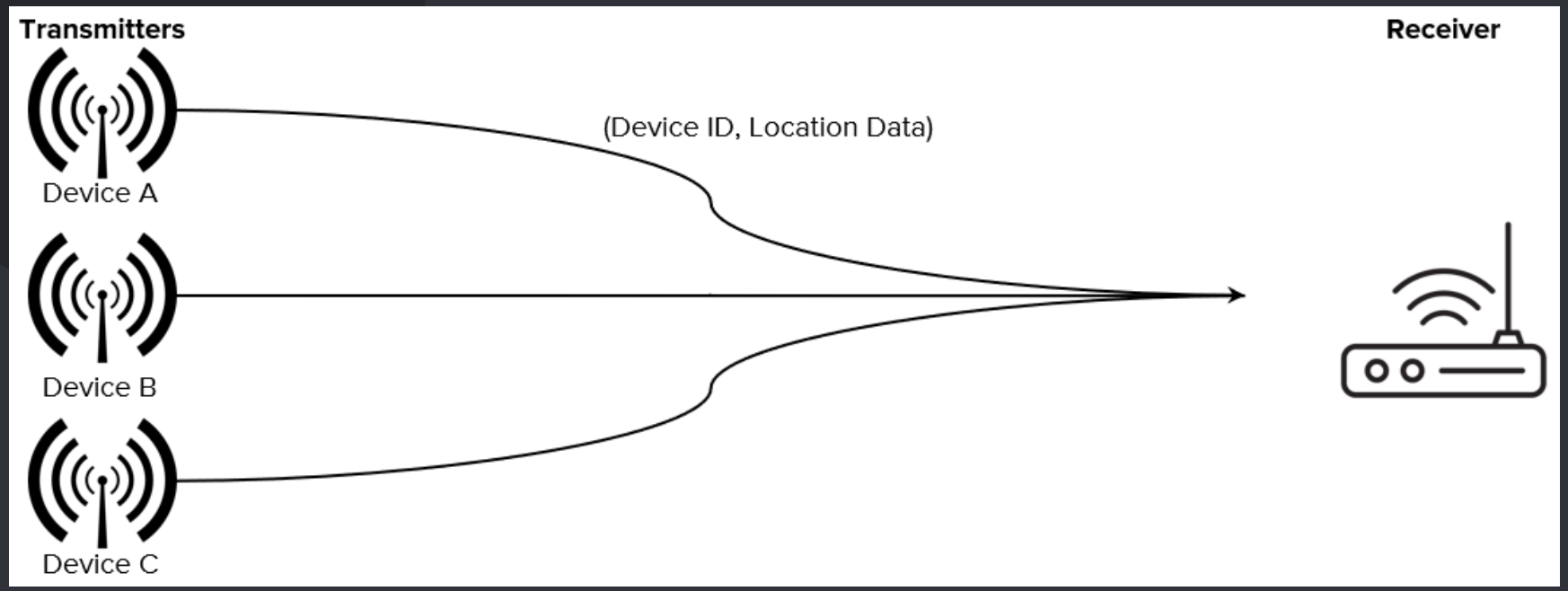
“The more you complicate it, the riskier is the solution”

Daniel Krebs

Deputy Director of Cybersecurity/Information Systems, Monroe County

Minimum Viable Product

Initial MVP



Week 2
(02/07/2023)

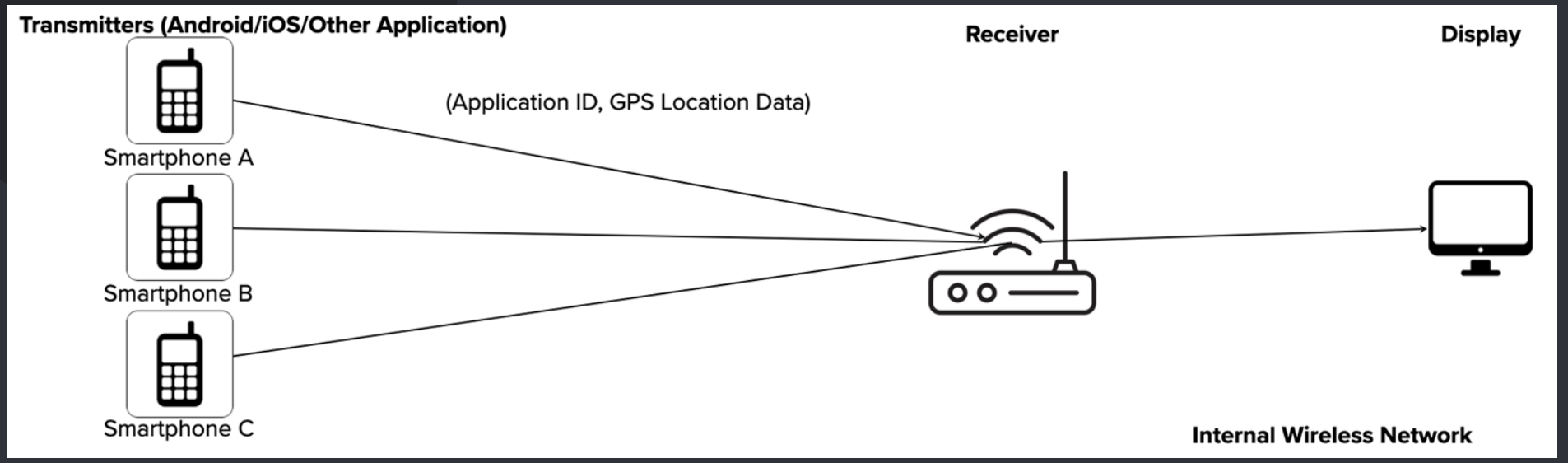
“Redundancy is key”

Frederick J. Rion

Emergency Manager, SUNY Brockport

Minimum Viable Product

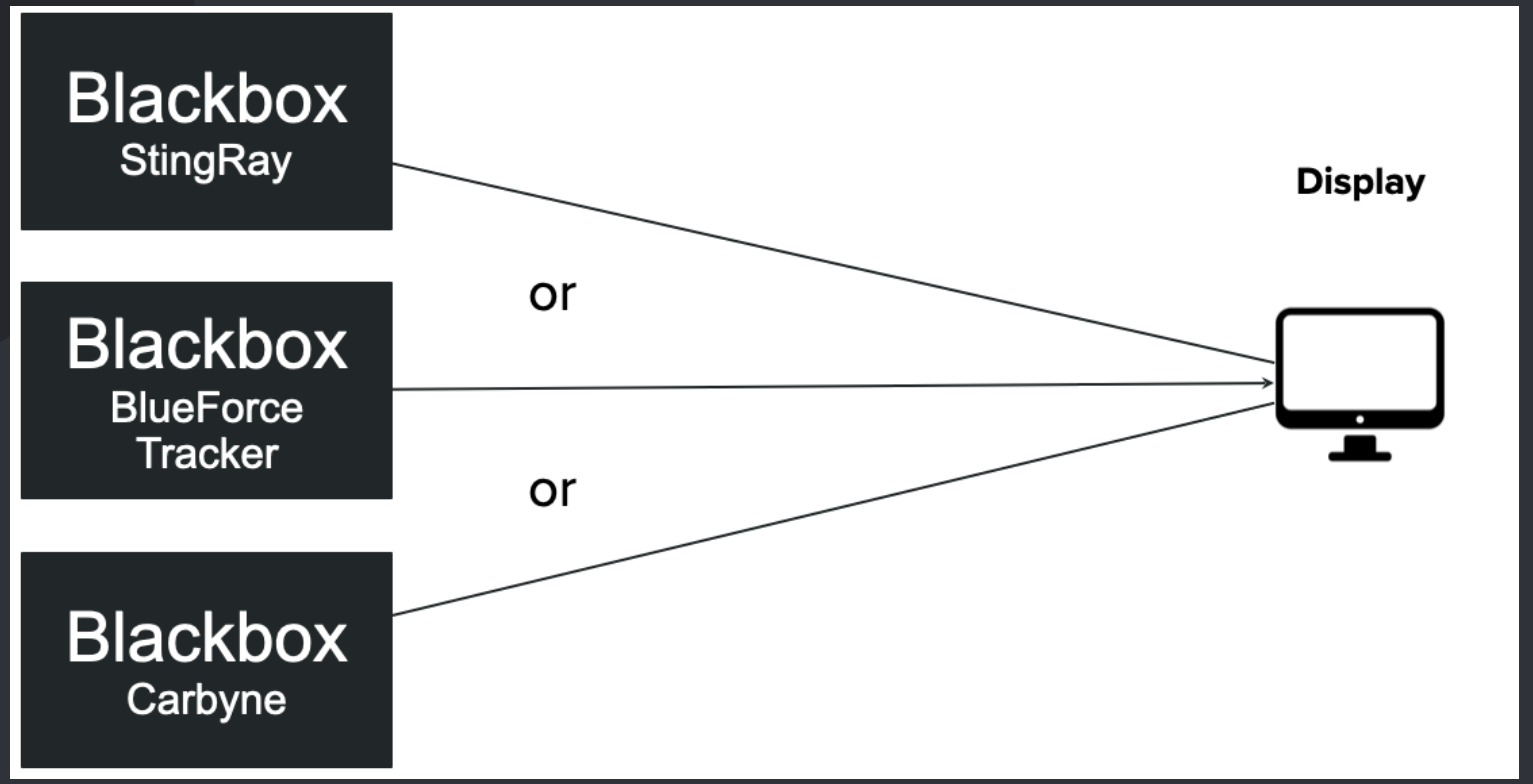
Intermediate MVPs



Week 7
(02/28/2023)

Minimum Viable Product

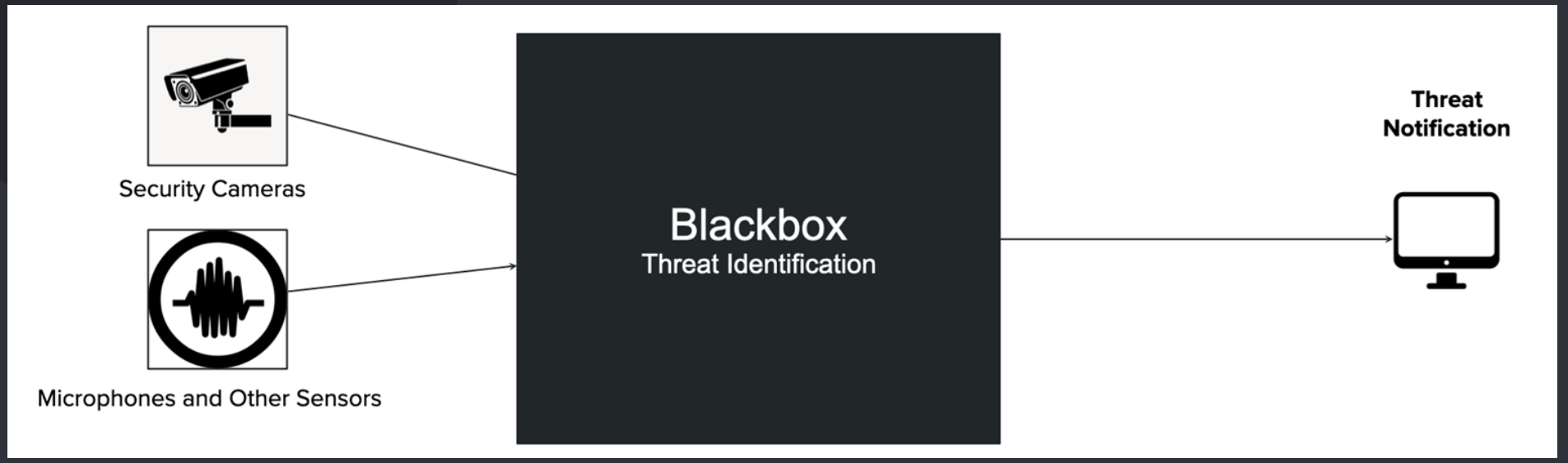
Intermediate MVPs



Week 7
(02/28/2023)

Minimum Viable Product

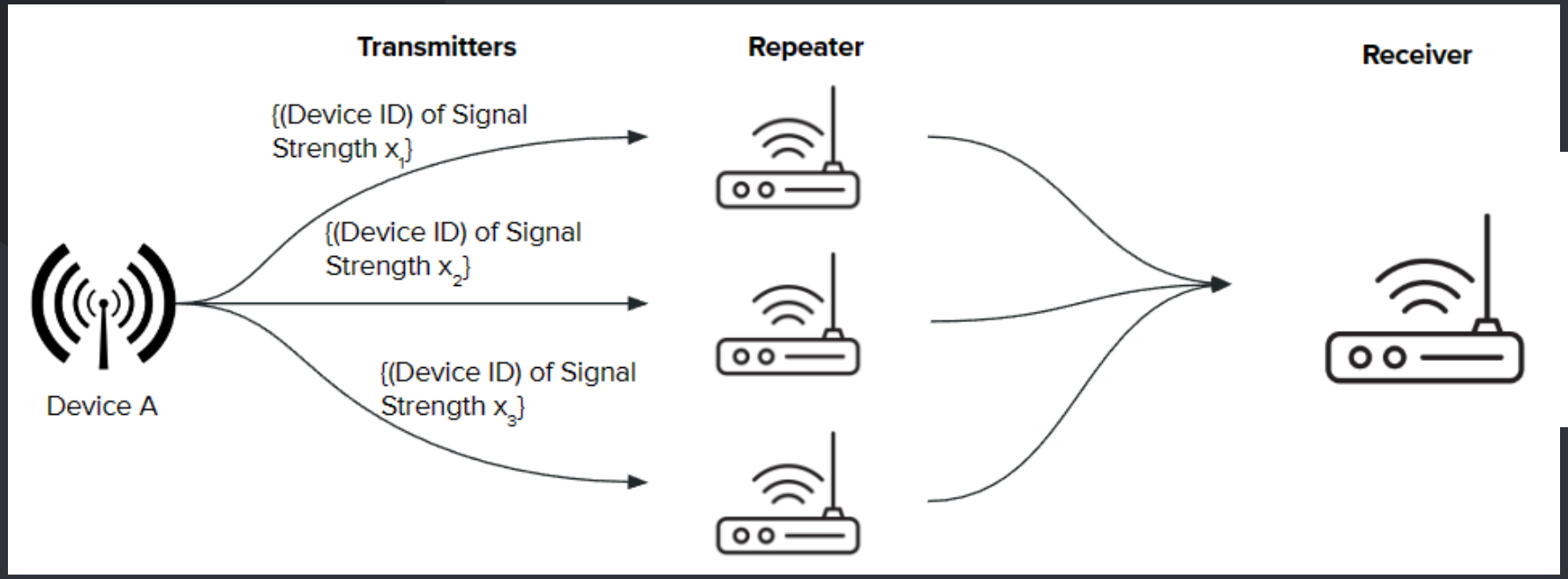
Intermediate MVPs



Week 7
(02/28/2023)

Minimum Viable Product

Final MVP



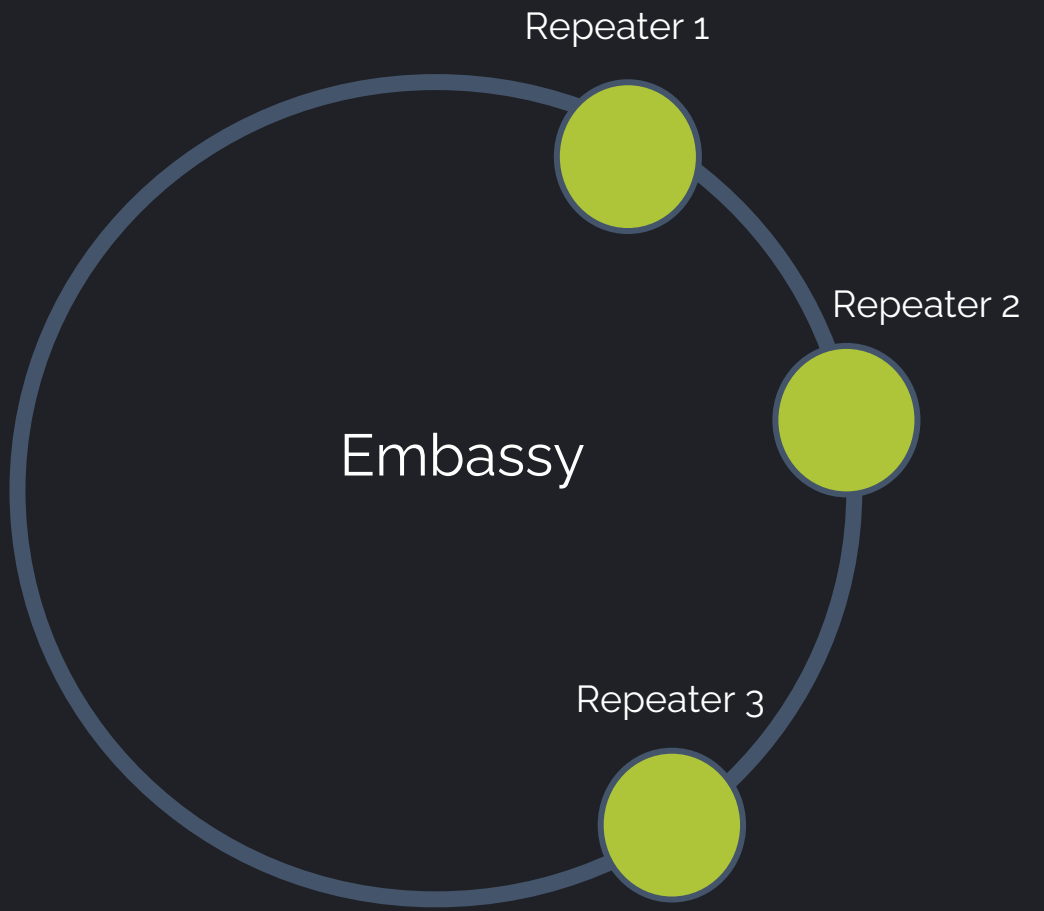
Week 13 (04/18/2023)

Display

$$x = \frac{CE - FB}{EA - BD}$$

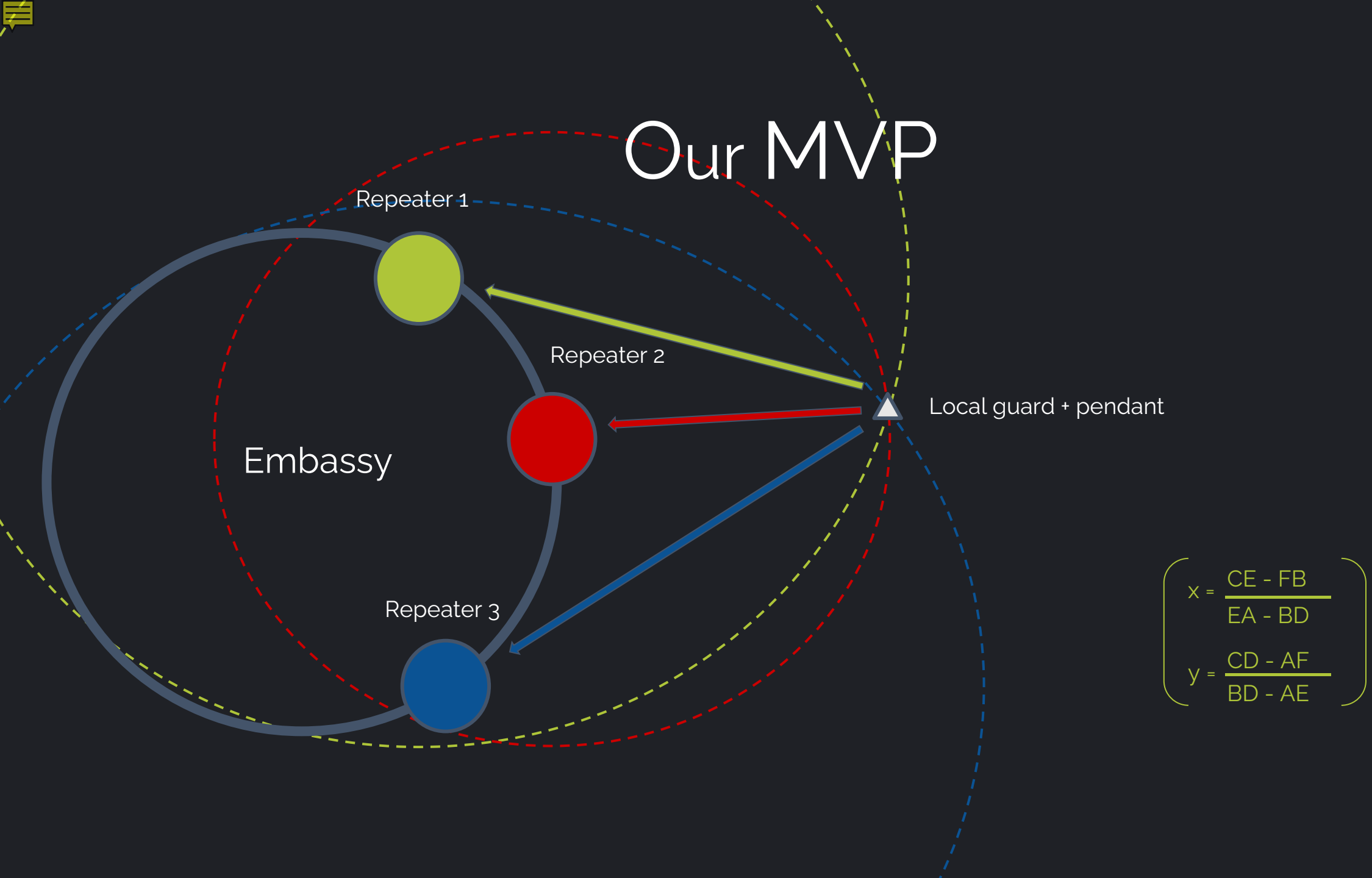
$$y = \frac{CD - AF}{BD - AE}$$

Our MVP



Local guard + pendant

Our MVP

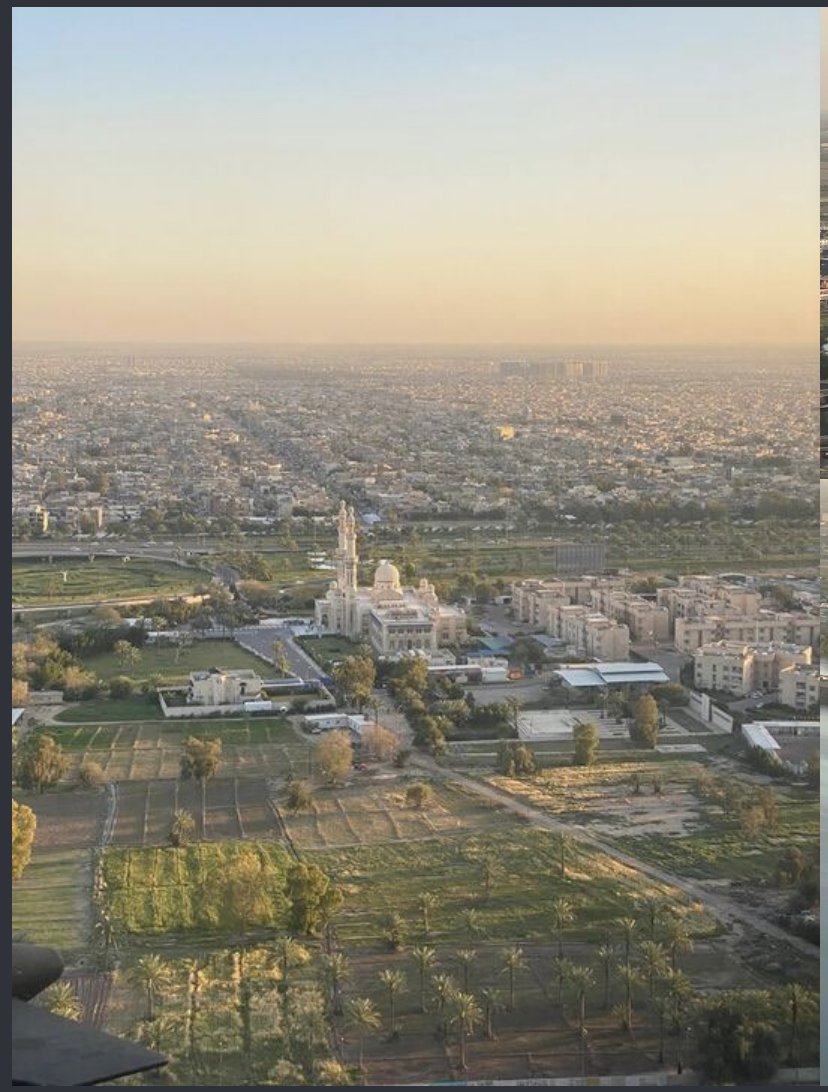


$$\begin{pmatrix} x = \frac{CE - FB}{EA - BD} \\ y = \frac{CD - AF}{BD - AE} \end{pmatrix}$$

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

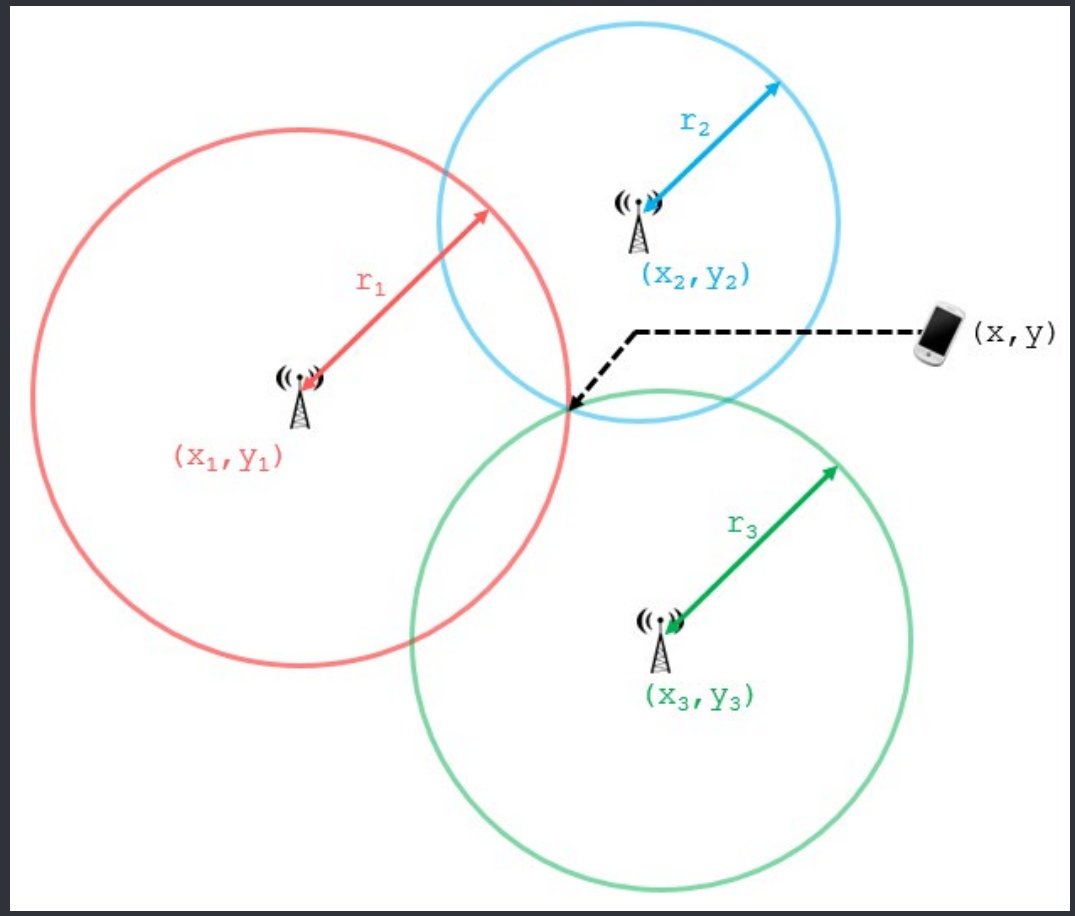
Dr. James Santa

Adjunct professor at RIT

Our professor

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

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