



# REAL-TIME IMAGING OF THE ULTRA-WIDEBAND (UWB) SYNCHRONOUS IMPULSE RECONSTRUCTION (SIRE) RADAR



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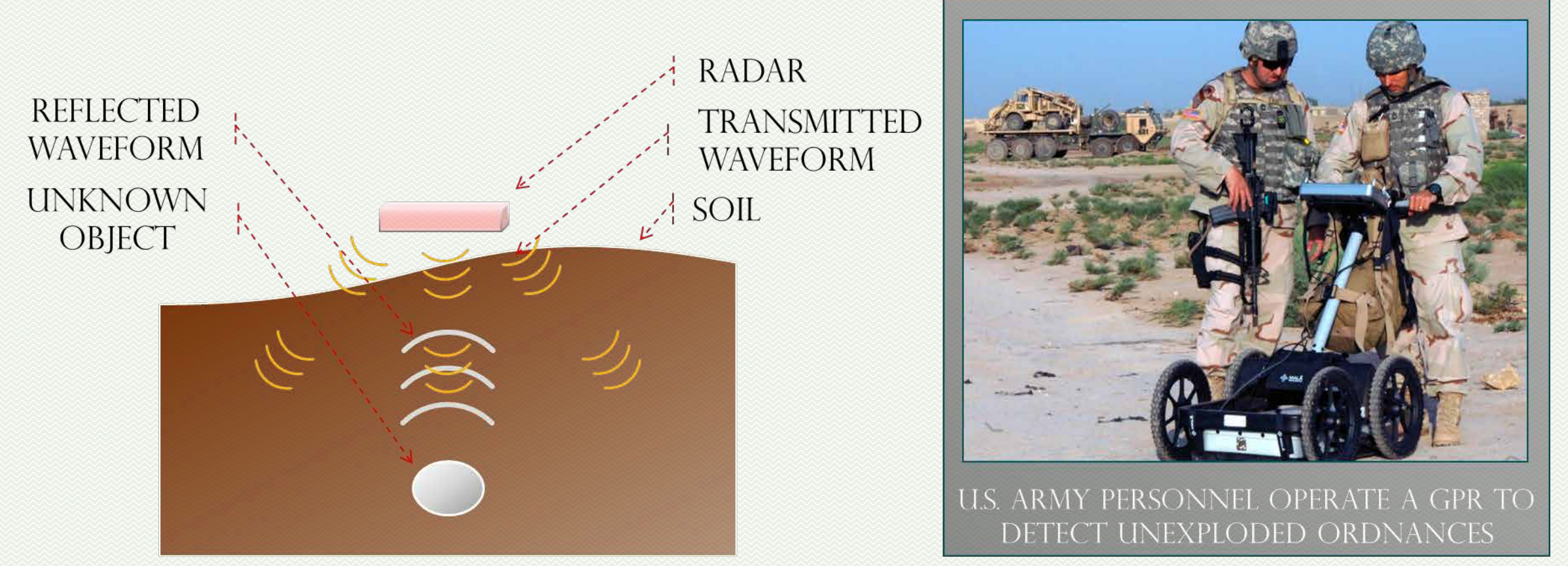
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UNDERGRADUATE RESEARCHER



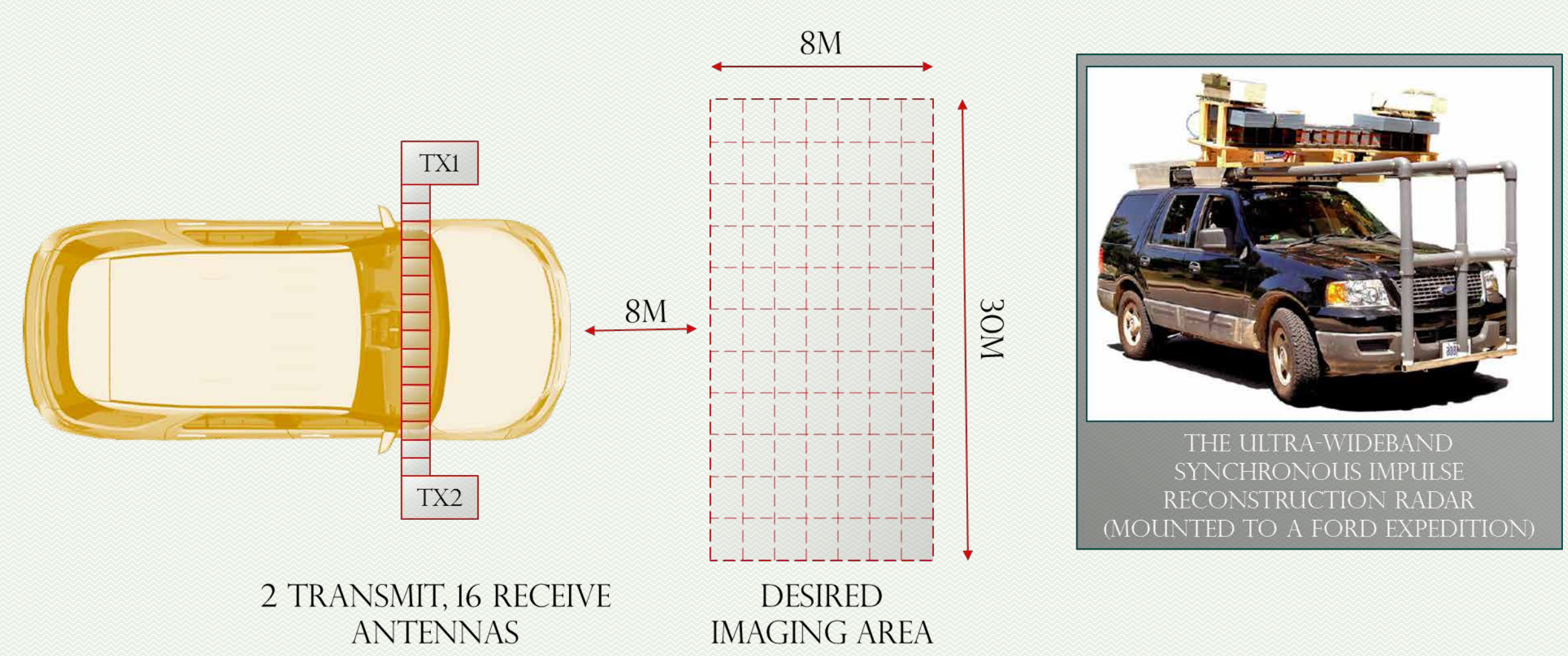
DR. JOHN M.M. ANDERSON  
PROFESSOR

## BACKGROUND

### GPR OPERATING PRINCIPLES



### UWB-SIRE PROJECT SETUP

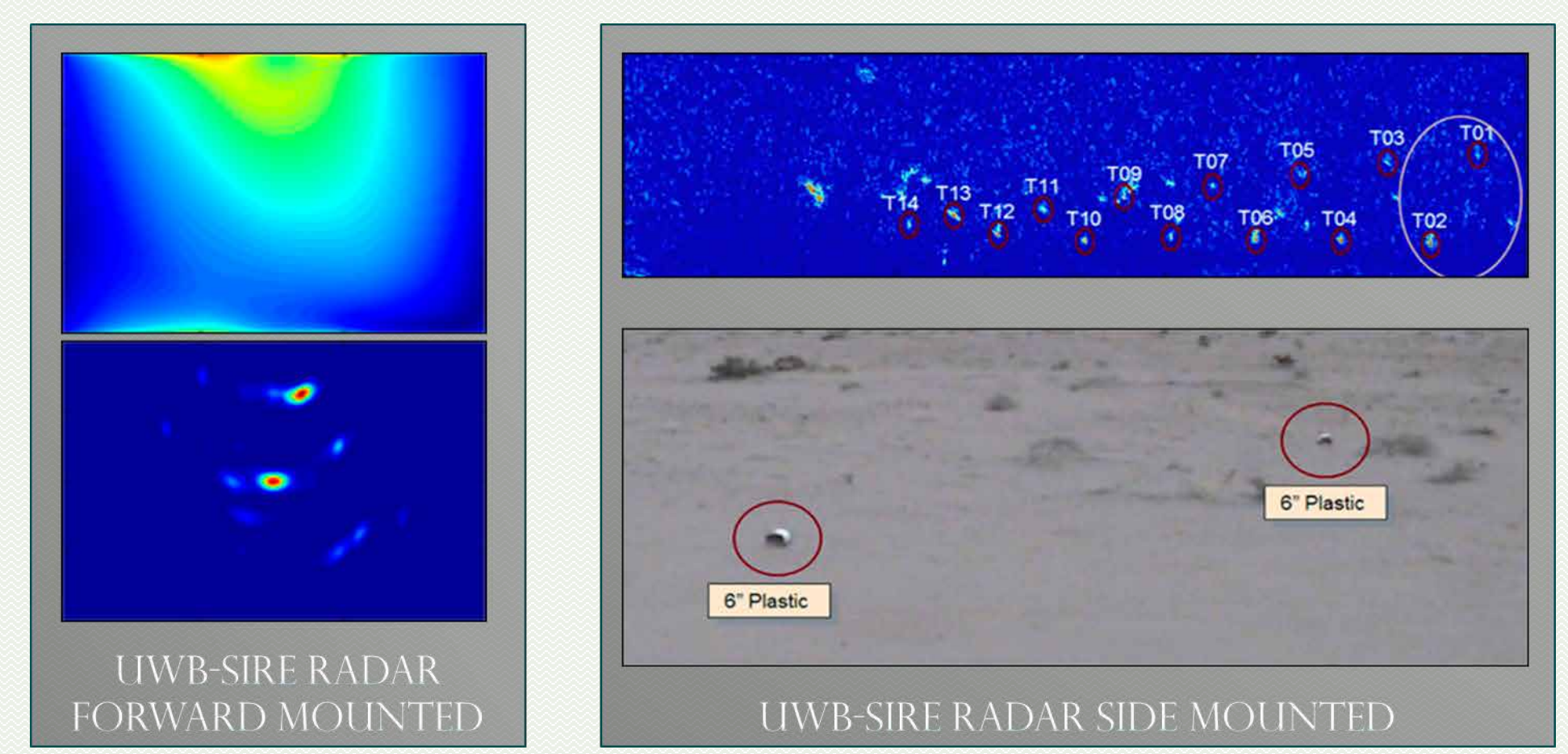


### DATA COLLECTION

LOCATION		RECEIVE CHANNEL SAMPLES																			
TX		RX																			
X	Y	Z	X	Y	Z	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

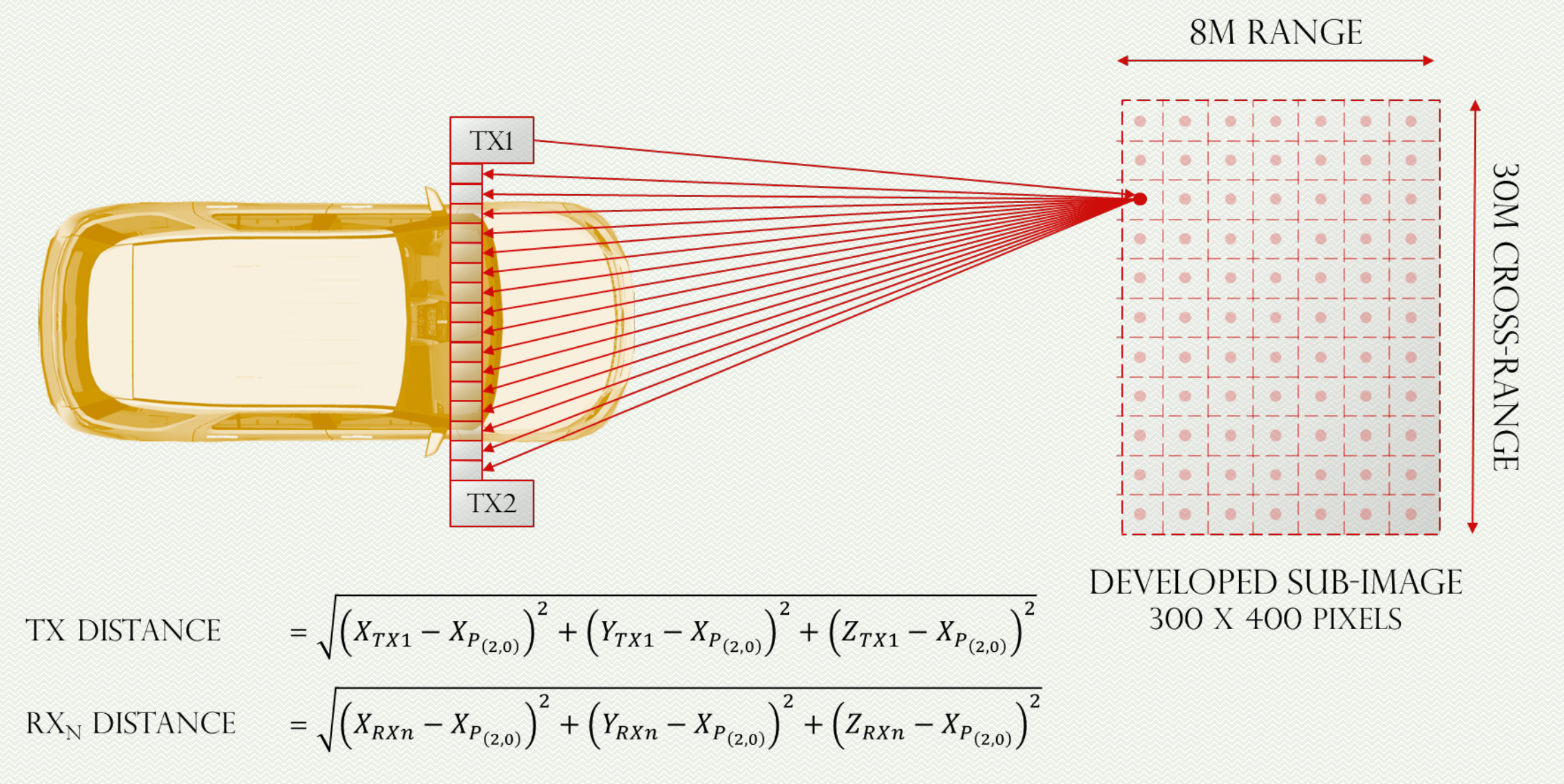
**SINGLE COLLECTION POINT**  
TX { X, Y, Z } = 3 DOUBLES  
RX { X<sub>1N</sub>, Y<sub>1N</sub>, Z<sub>1N</sub> } = 48 DOUBLES  
SAMPLES { CH<sub>1-16</sub> } = 43,200 DOUBLES  
= 0.329 MBYTES

**8X30 METER IMAGE**  
121 COLLECTIONS = 5,233,371 DOUBLES  
= 39.93 MBYTES



## DELAY AND SUM ALGORITHM

### DELAY AND SUM (DAS)



### CALCULATION STEPS:

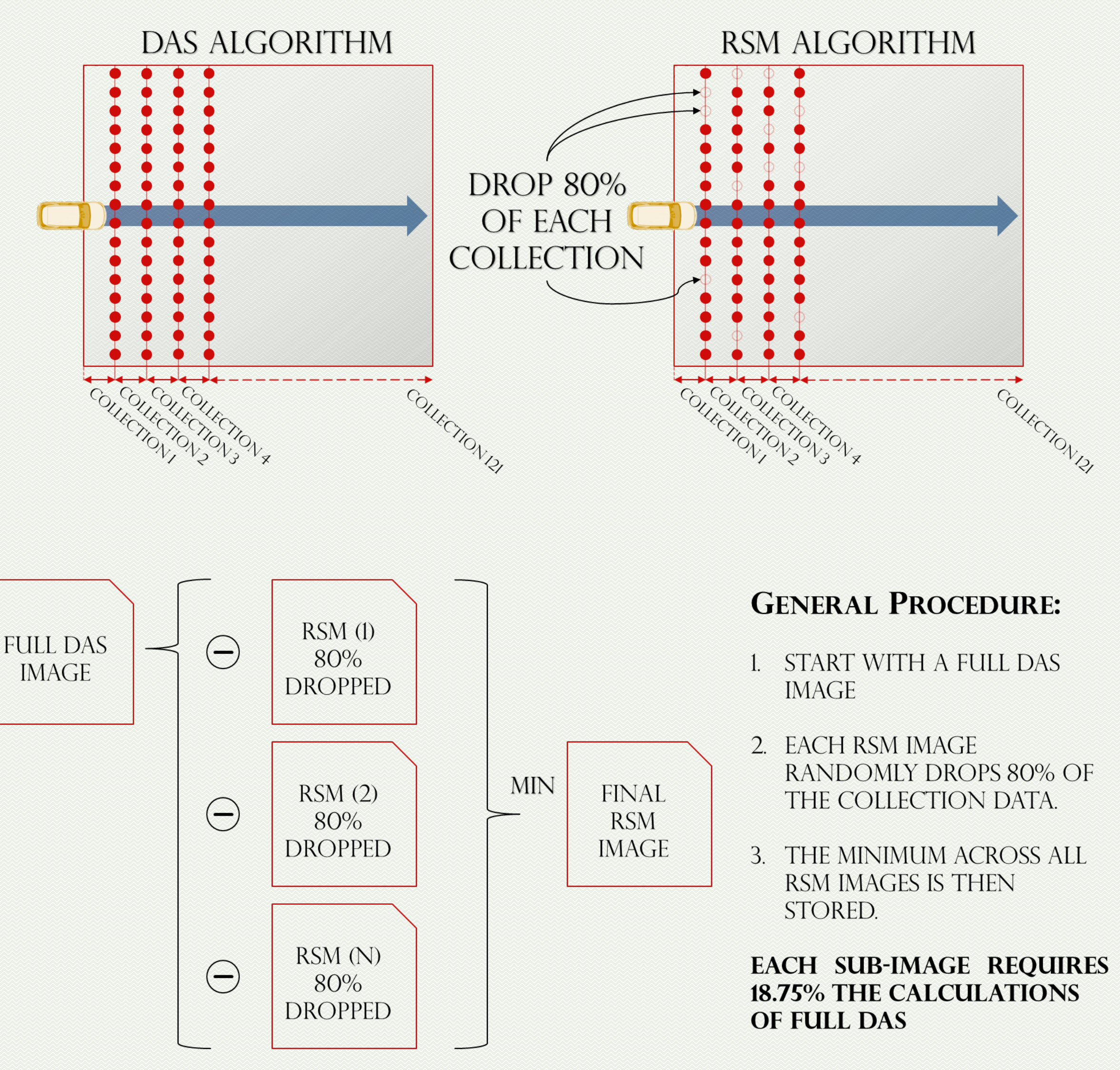
FOR EACH PIXEL *N*  
FOR EACH COLLECTION *I*  
FOR EACH RECEIVER *J*  
1) CALCULATE PIXEL *N* DISTANCE TO TX OF (*I, J*)  
2) CALCULATE PIXEL *N* DISTANCE TO RX OF (*I, J*)  
3) SUM AND DETERMINE TOTAL IN-FLIGHT TIME  
4) PIXEL *N* += SAMPLE RESULT 3 ] \* WEIGHT

ASSUMING INTEL IA-32,  
ADD: 1 CYCLE  
MUL: 3 CYCLES  
DIV: 5 CYCLES  
TOTAL OF 18.8 BILLION CYCLES

STEP	ADDITIONS	MULTIPLICATIONS	DIVISIONS	
1	8	8	7	0
2	8	8	7	0
3	2	2	0	2
4	2	3	0	2
OPERATIONS	20	17	7	2
16 RECEIVERS	320	272	112	32
121 COLLECTIONS	38720	32912	13672	4032
120,000 PIXELS	4,646,400,000	3,949,440,000	1,640,640,000	483,840,000

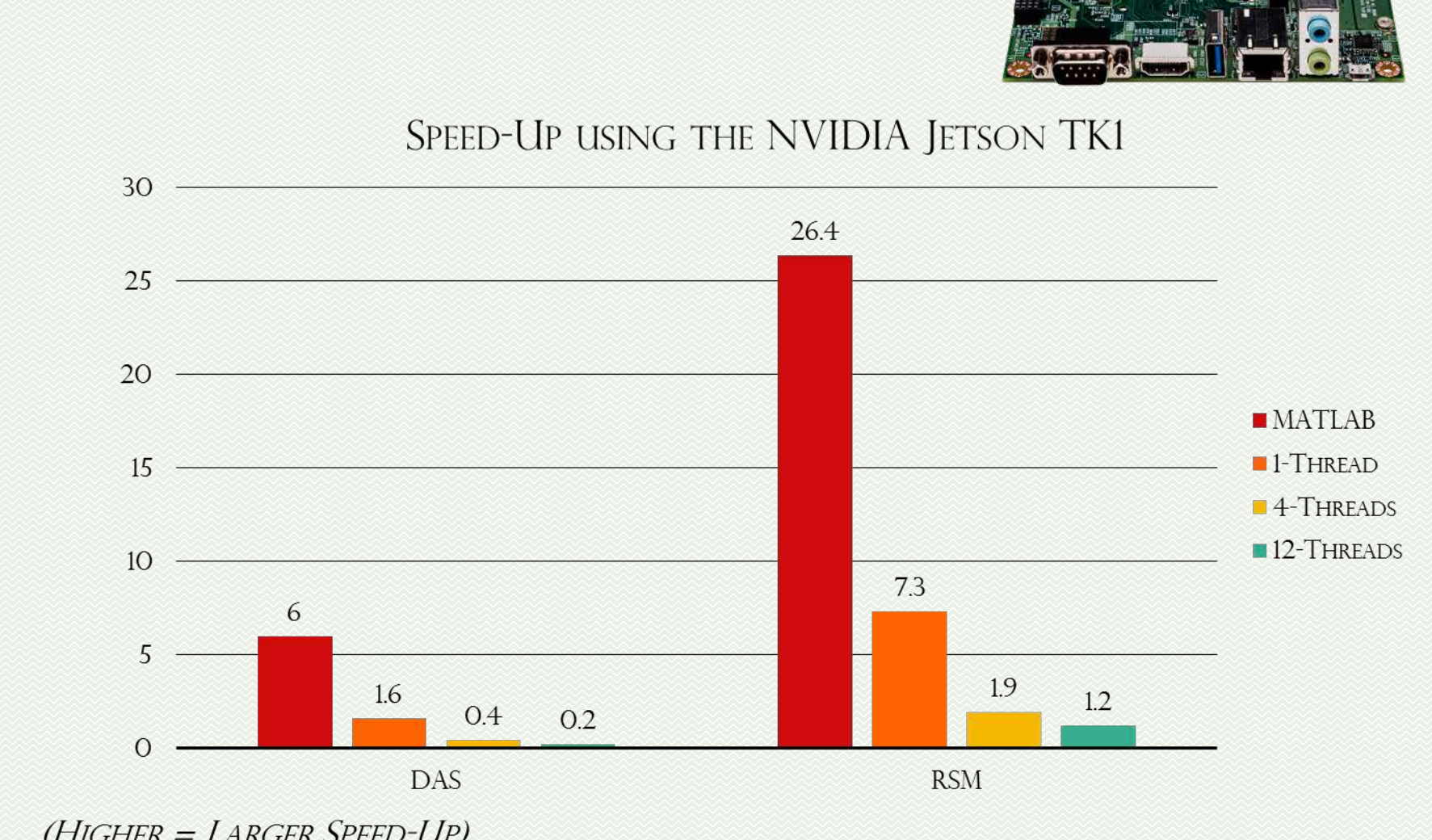
## RECURSIVE SIDELobe MINIMIZATION

### RECURSIVE SIDELobe MINIMIZATION (RSM)

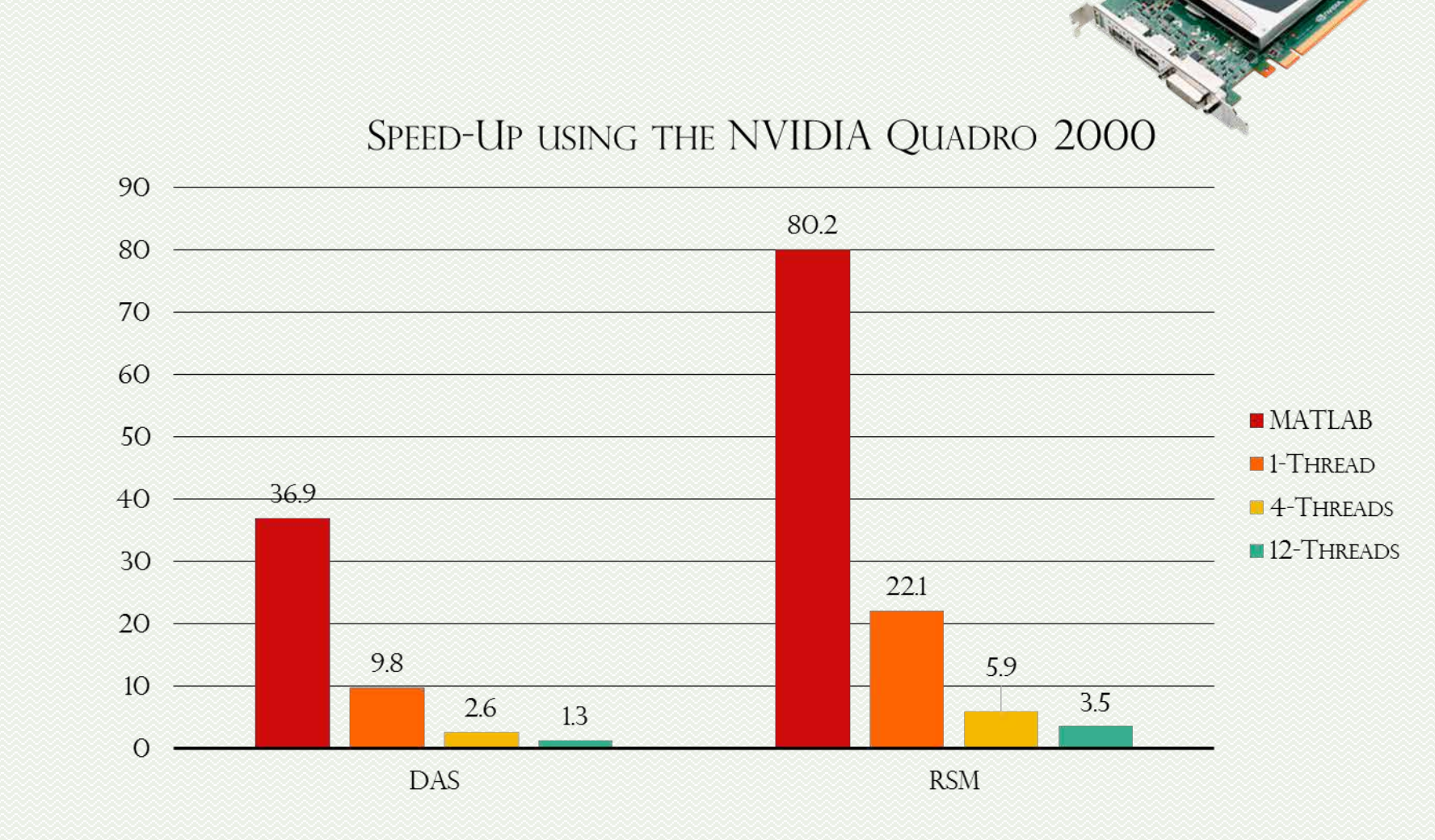


## PERFORMANCE RESULTS

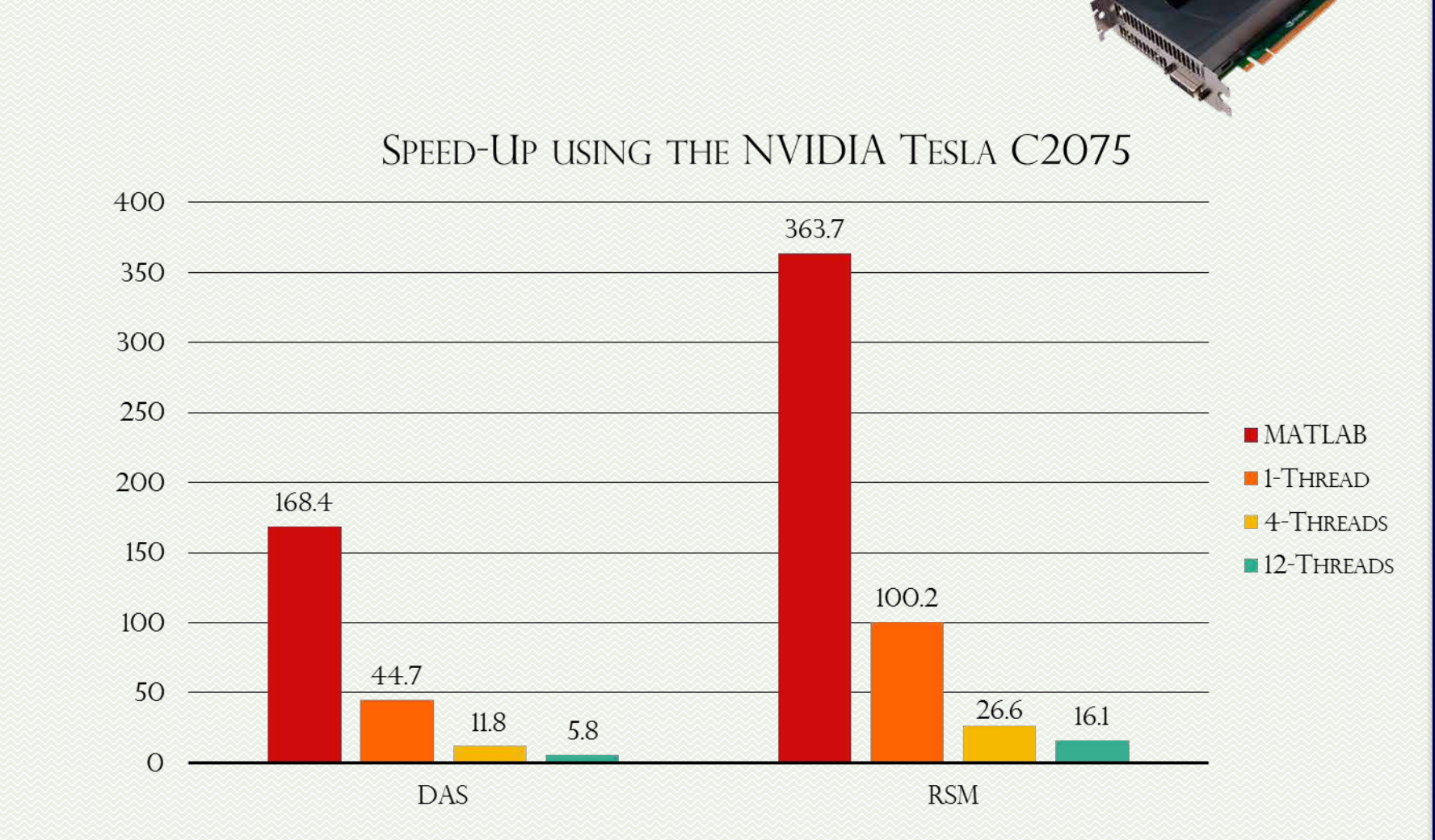
### JETSON TK1 SPEED-UP



### QUADRO 2000 SPEED-UP



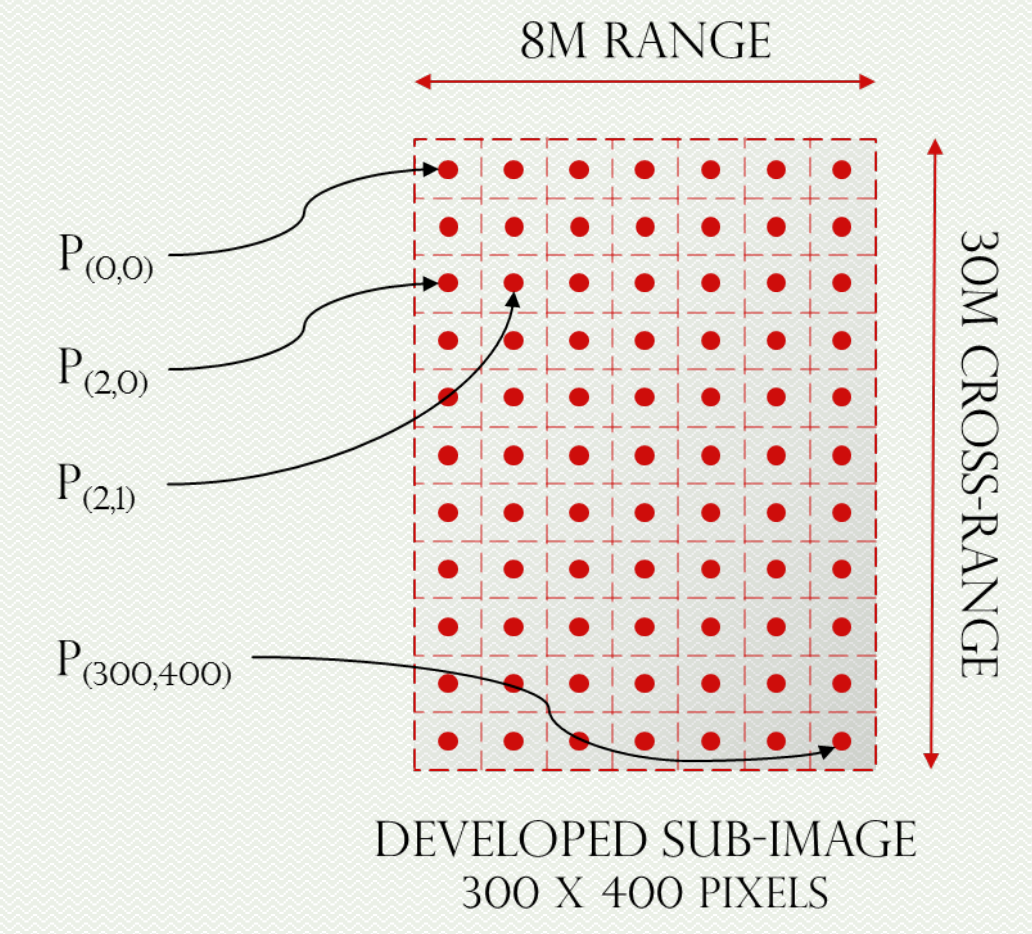
### TESLA C2075 SPEED-UP



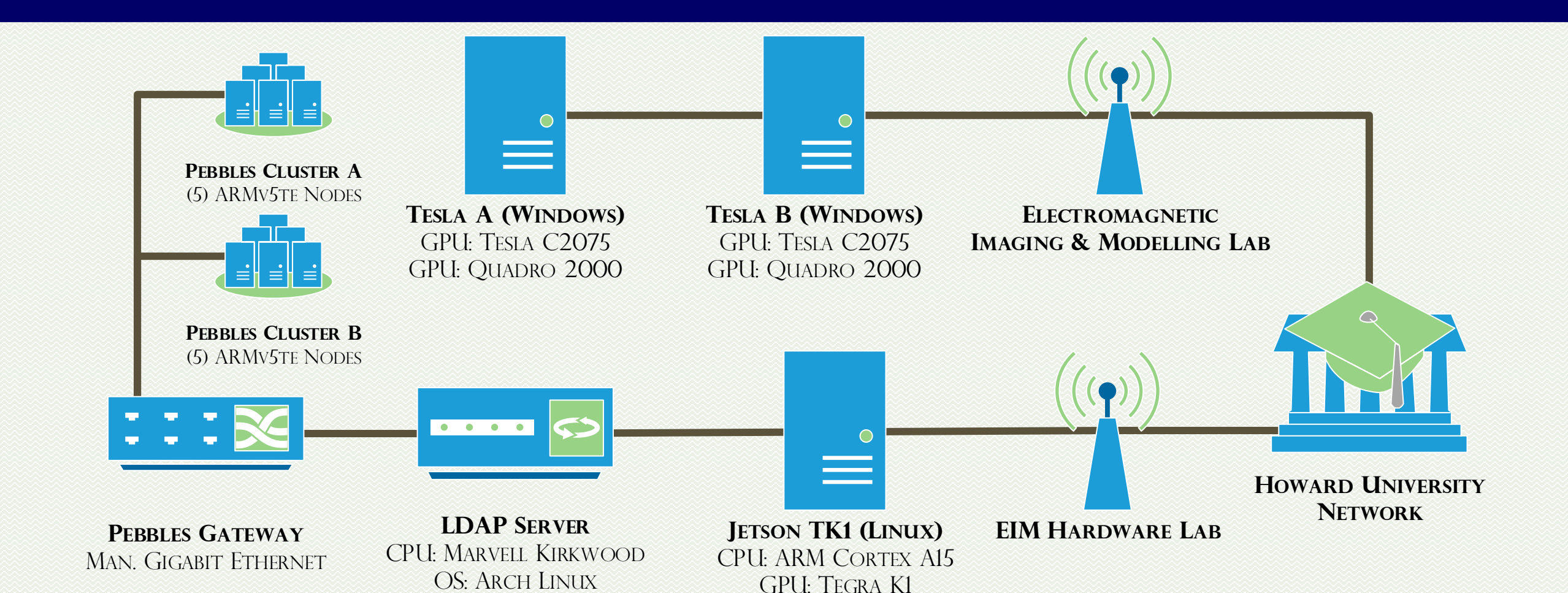
(HIGHER = LARGER SPEED-UP)  
Multithreaded CPU performance trials were performed on an Intel Core i7-4930K at 3.40GHz, 32GB DDR3 1600MHz, Windows 7 Professional 64-bit

## GENERAL PROCEDURE AND GOALS

- ESTABLISH USER-DESIRED IMAGING PARAMETERS:
  - RANGE
  - CROSS-RANGE
  - $\Delta$ RANGE
  - $\Delta$ CROSS-RANGE
- SETUP THE IMAGING GRID
- ESTIMATE THE MAGNITUDE OF EACH DESIRED PIXEL
- FORM AN IMAGE USING NEAREST NEIGHBOR OR BILINEAR INTERPOLATION



## PLATFORM SPECIFICATIONS



## IN CONTRIBUTION WITH

