CVW-14 INITIAL TRAINING

Week 7: A2A-1 BVR

OVERVIEW

- Welcome to Week 7! Time to kill some planes!
- This week, we will discuss:
  - **RADAR** – Fuckin' RADAR, how does that work?
  - **AIR-TO-AIR WEAPONS** – Alas DCS does not model the glorious WWI tactic of throwing bricks from your cockpit at the other guy, but we've got some other fun toys.
  - **BVR BASICS** – Because sometimes it's nice to be able to paint kill marks on the jet without having to take the other asshole to the merge.
- Any pressing questions?
  - We've got a lot to cover tonight, and it's going to get dense. Bear with me.

TOPIC 7.1 – RADAR

"At its most basic level, how does a RADAR function?"

"What are the various capabilities and modes of the Hornet's radar?"

"What does the symbology of the Hornet's radar look like?"

HORNET RADAR 101

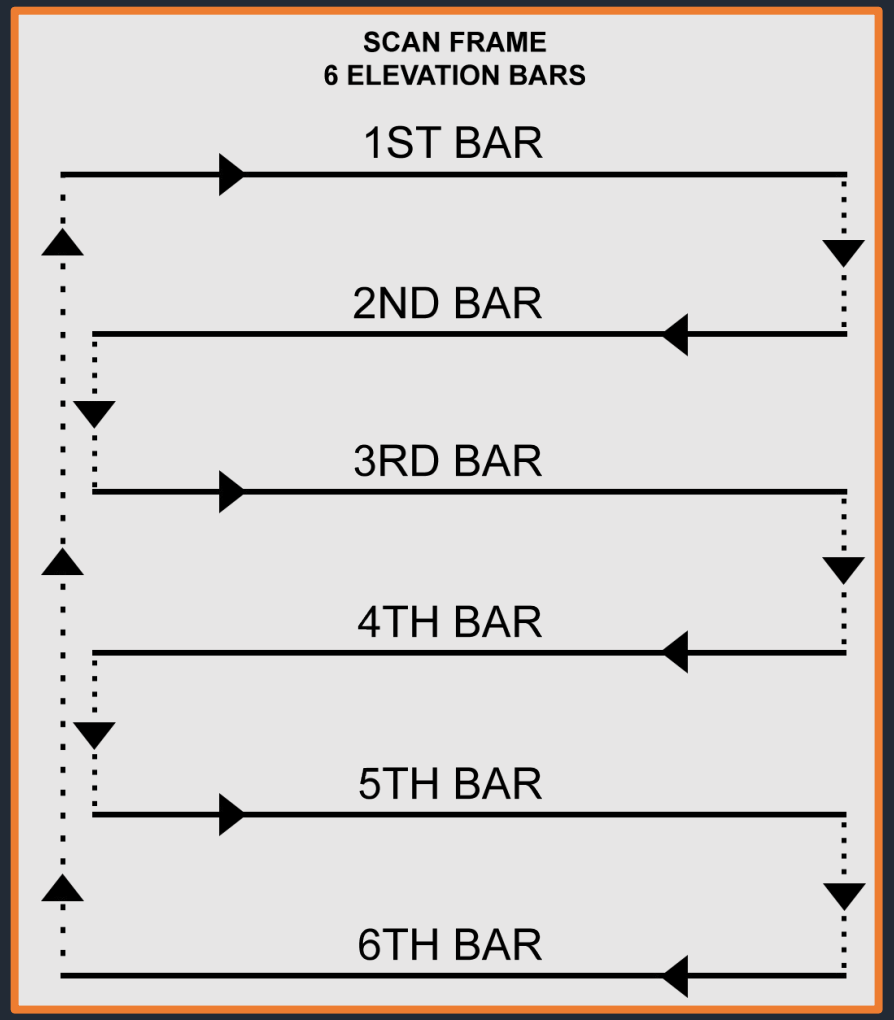
- AN/APG-73 All-Weather Multimode Pulse-Doppler RADAR
  - Allows aircraft to locate and track other aircraft
    - Adjustable in ***range, angle, sweep width, PRF*** – more on this shortly!
  - Guides some types of air-to-air Missiles
    - ***AIM-120, AIM-7***
  - Provides initial targeting to all weapons system
    - Gun Cueing, Slaving Sidewinder, Provides radar cueing and guidance to AIM-120 and AIM-7
  - Various Air To Ground functionalities – outside the scope of this lesson
  - RADAR synchronized with Datalink – displays DL contacts on scope, but *just because they show up there doesn't mean you're tracking them!*

HOW DOES IT WORK?

- The RADAR system uses a dish to produce a beam of energy
  - Beam hits something? Reflected back to the jet;
  - Can tell course, speed, altitude, etc.
  - Beam width is 3°, beam is “swept” in ***azimuth*** and ***elevation***
- ***Think of RADAR like a flashlight in a dark room***
  - You can see what the beam illuminates, but other people *outside the arc of the beam* can also tell that it's radiating!
  - If the flashlight hits you and tracks on you, you know the guy holding the flashlight knows you're there!

HOW DOES IT WORK?

- The RADAR sweep can be manipulated in various ways
  - Azimuth settings between 10° to 140° total scan volume
  - Elevation setting between 1 to 6 “bars”
- Tradeoff between wide area coverage and fast repetition of a specific area
  - There is no single right setting!



PULSE DOPPLER 101

- A ***Pulse-Doppler*** RADAR uses pulses of RADAR energy rather than a continuous wave
  - Pulses are emitted at various "pulse repetition frequencies," High/Medium/Interleaved (more on this later)
- PD RADAR calculates:
  - ***ATA*** based on where the dish is pointed when a pulse is returned
  - ***Range*** based on the time it takes to get a return
  - ***Target's altitude*** based on dish elevation
  - ***Closure rate*** of the contact based on Doppler Shift
  - ***Bandit Heading*** (BH) based on the target's change in position over time (Δ_P)

PULSE DOPPLER 101

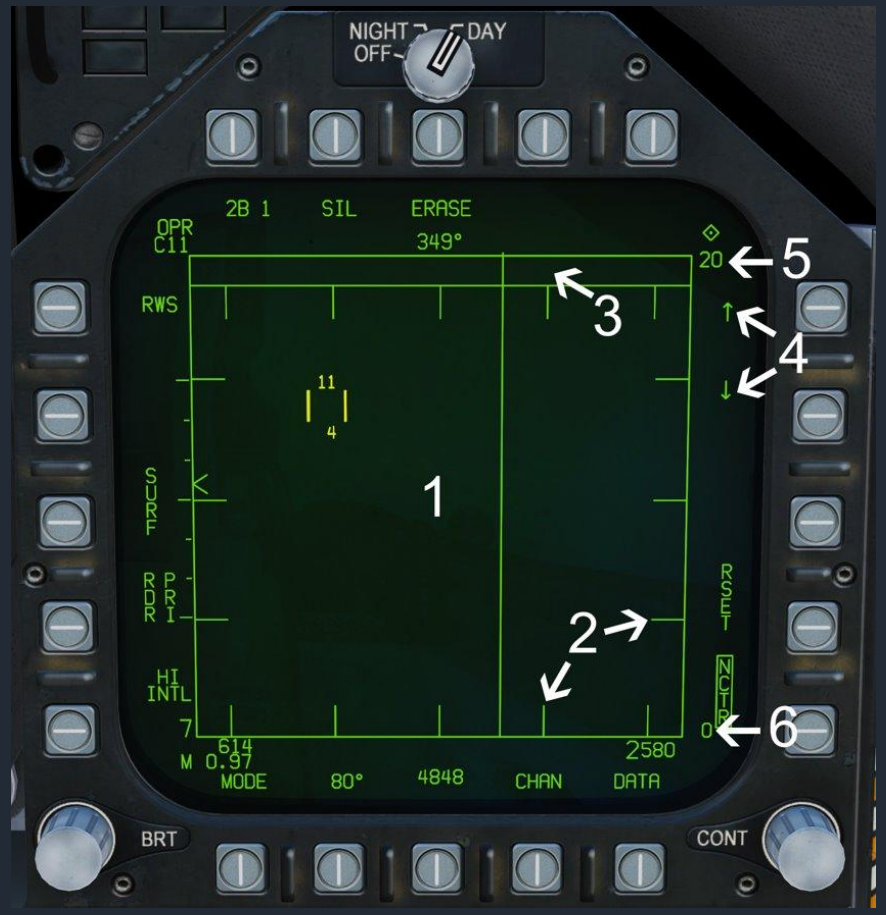
- ***Pulse Repetition Frequency***
  - The number of radar pulses in a given frequency measured in Hz
  - For various sciencey reasons, different PRFs are better at different tasks
- ***High PRF***
  - Best for "hot" contacts or those a long way away
- ***Medium PRF***
  - Best for "cold" contacts opening
  - Also useful for hot contacts within approx. 25mi
- ***Interleaved***
  - HIGH for one sweep, MED for the next, then repeats

AIR-TO-AIR RADAR

- ***ATK RDR*** can be displayed on any DDI
  - Will automatically appear on the right DDI when switching to AA mode
  - Primary method to interact with the RADAR system
- Top-down "B Scope" display; own A/C at the bottom
- We're going to run through some symbology – *it's a lot, don't expect to master it all now*.

ATTACK FORMAT SYMBOLOGY

1. ***Tactical Region*** – 140° B-scope projection
2. ***Scale Marks*** – 30° Azimuth, ¼ Display Range
3. ***Angle Only Track*** (AOT) zone
   "Dugout" Displays angle only tracks
4. ***Range Scale Arrows*** – Sets the Range scale (Zoom)
5. ***Maximum Range Scale*** – Range at the top of the display
6. ***Minimum Range*** – Range at the bottom of the display



ATTACK FORMAT SYMBOLOGY

1. ***Elevation Caret*** – Current elevation of RADAR dish
2. ***B-Sweep Line*** – Current azimuth of RADAR dish
3. ***Elevation Bar Selection*** – Sets and displays number of elevation bars
4. ***Azimuth Width Select*** – Sets and displays horizontal scan volume
5. ***PRF selection*** – Sets and displays Pulse Repetition Frequency
6. ***Target Designation Cursor (TDC)*** – Allows pilot to select a Track file, and displays min and max altitude of scan volume at TDC

ATTACK FORMAT SYMBOLOGY

1. ***A/A WP*** symbol
2. ***Own-ship BULLSEYE***
3. ***TDC BULLSEYE***
4. ***TDC BRAA***

RWS/TWS/STT

- Various modes in which the radar can operate
  - ***BVR Mode*** – Beyond Visual Range
    - Submodes – ***Range While Search (RWS)*** and ***Track While Scan (TWS)***
  - ***ACM*** – Air Combat Maneuvering
  - ***AACQ*** – Automatic Acquisition
  - ***STT*** – Single Target Track
- Today we're going to focus on RWS, TWS & STT

RWS/TWS/STT

- **RADAR MODE SELECTOR** will switch you from RWS to TWS, vice versa

TWS SYMBOLOGY

1. ***Tracks***
2. ***Raw Hits*** – if boxed
3. ***Scan centering mode*** – AUTO follows L&S, MAN follows TDC depress
   I. Bind this OSB (Right DDI OSB 13) on your HOTAS – switch to AUTO once you've locked a contact
4. ***SCAN RAID*** – selects RAID mode
5. ***Raw Hits*** selection
6. ***Expand*** – Branch to EXP TWS
   I. 'Zooms in' on L&S
   II. Can be activated with ***RAID/FLIR***

Note that your ***NWS*** button will toggle between available tracks in TWS! ****

LAUNCH/STEERING CUES

1. ***L&S*** – current Launch and Steering Track
2. ***L&S Heading***
3. ***Differential Altitude***
4. ***Range Caret***
5. ***Closure Rate V_c***

TOPIC 7.2 – AIR TO AIR WEAPONS

"What are the various air-to-air weapons the Hornet carries?"

"What are the key characteristics and capabilities of the AIM-120?"

"What is the difference between a Fox-1 and a Fox-3 missile?"

AIR TO AIR WEAPONS

- Air to Air weapons on the Hornet include:
  - ***M61A2 20mm Gun*** – Shooty-shooty bang-bang
  - ***AIM-9 Sidewinder*** – Heat seeking "dogfight" missiles, most capable and recent model AIM-9X
  - ***AIM-7 Sparrow*** – Older semi-active radar guided AAM
  - ***AIM-120 Advanced Medium Range Air-to-Air Missile*** – A potent Fox-3 weapon, the AMRAAM is our #1 weapon in BVR

FOX-1 V. FOX-3

- ***Fox-1*** refers to a <u>semi-active radar guided missile</u>
  - These missiles require guidance from the launch aircraft up to the point of actually hitting their targets
  - If you can force the jet firing a Fox-1 to break off, weapon defeated!
- ***Fox-3*** refers to an <u>active radar guided missile</u>
  - Even if a Fox-3 missile loses command from the launch aircraft, it will still attempt to track on and hit the target
  - While theoretically "fire and forget," note that <u>it's always better if the launch aircraft can help guide the missile</u> up until the point that it "goes active," or ***PITBULL***

AMRAAM CAPABILITIES

- Missile Performance is dependent on speed and angels
  - You'll get much more range (and a higher P/K!) at Mach 1 and Angels 30 than at 250 knots on the deck
  - As a result there's no hard and fast range at which you should fire an AMRAAM. Various guidance cues help you determine when to launch, but it's a judgement call!
- The AMRAAM is highly capable, ***but it is by no means undefeatable*** – be smart about employing sticks!

AMRAAM SYMBOLOGY

1. *Track*
2. *R_{MAX}*
3. *R_{NE}*
4. *R_{MIN}*
5. *Max Aspect Cue*
6. *ASE Circle and Dot*

AMRAAM SYMBOLOGY

1. ***Fly-out symbol*** – expected position of missile
2. ***Next missile TTA (Time to Active)***
3. ***Maximum Aspect Cue*** – number of degrees, in tens, target would have to turn to defeat the missile

HUD SYMBOLOGY

1. ***L&S Box*** – Bad guy here!
2. ***L&S IFF***
3. ***V_c*** – Closure rate
4. ***Range***
5. ***DT2***

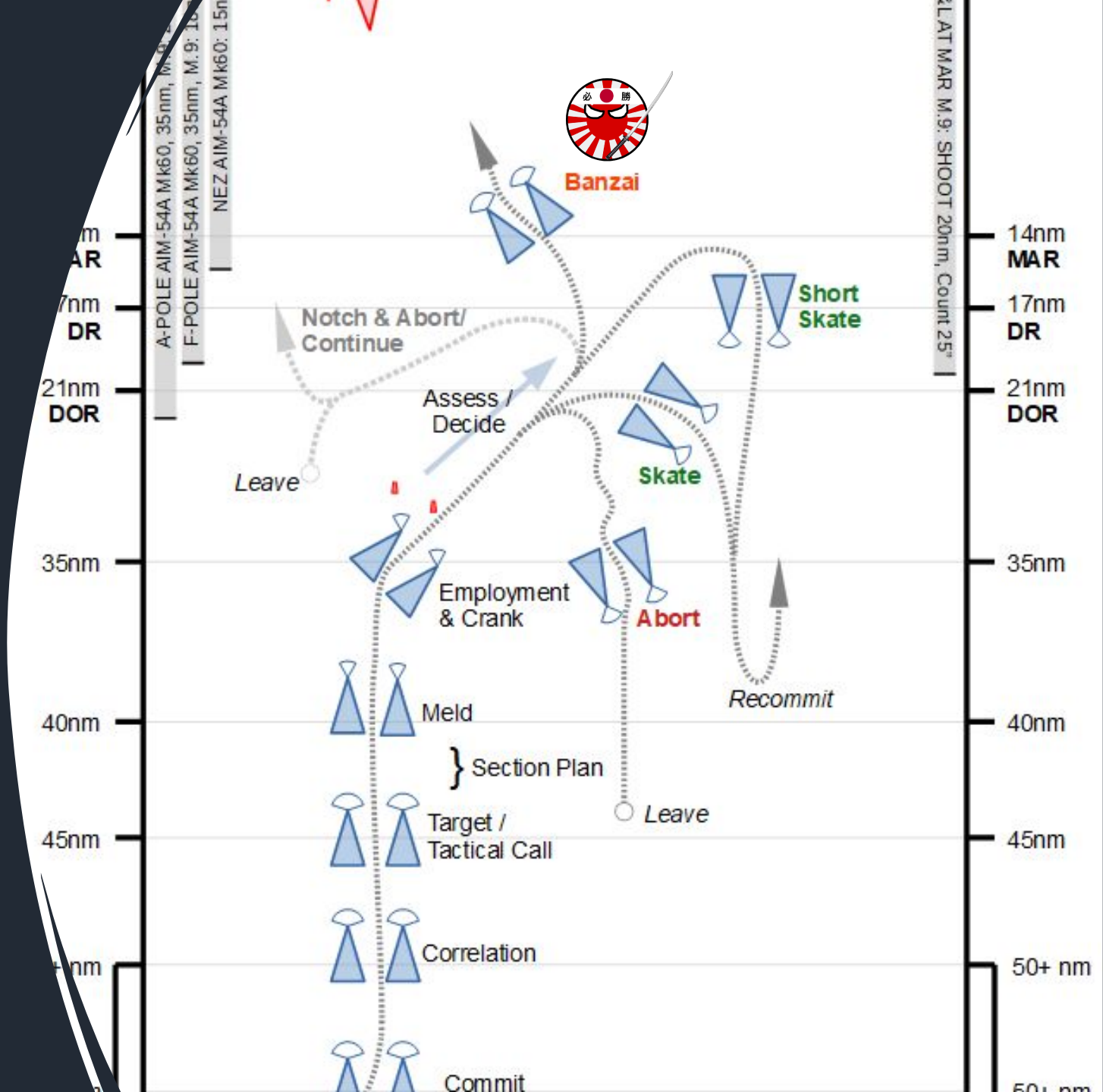
HUD SYMBOLOGY – AIM-120 SELECTED

1. ***ASE Circle & Dot***
2. ***Target Aspect Pointer***
3. ***Target Range*** – Tape Winds CCW
4. R_{AERO}
5. R_{MAX} – Max Missile Launch Range
6. R_{NE} – "Guaranteed Kill" Range
7. R_{MIN} – Min Missile Launch Range
8. ***0 Range***

Time to activation of missile (ex. 19ACT) is displayed below RNG when a missile is fired, will switch to TTG when weapon goes Pitbull (ex 11TTG)

TOPIC 7.3 – PUTTING IT TOGETHER

"How do I actually put all this shit into practice to kill a guy?”



EMPLOYING AIR-TO-AIR MISSILES

- Coming into an A2A engagement, recommended page setup is as follows:
  - ***AZ/EL on the left***
  - ***Radar on the right***
  - ***SA on the AMPCD***

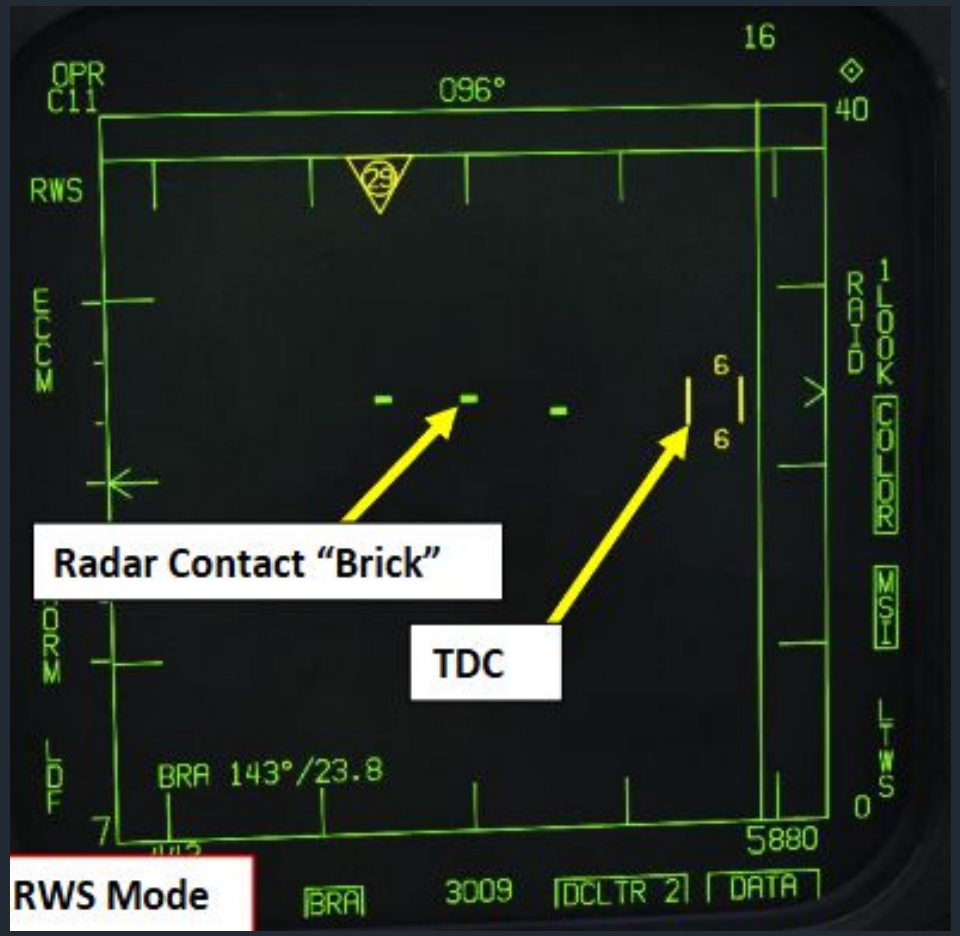
EMPLOYING AIR-TO-AIR MISSILES

- **FIND** – There is something out there
- **FIX** – I know where in space that something is
- **TRACK** – I know that something's position & velocity
- **TARGET** – I can employ weapons
- **ENGAGE** – I am/have employed weapons
- **ASSESS** – I know the effect of my weapons

<u>This week, we'll be focusing on those first 5.</u>

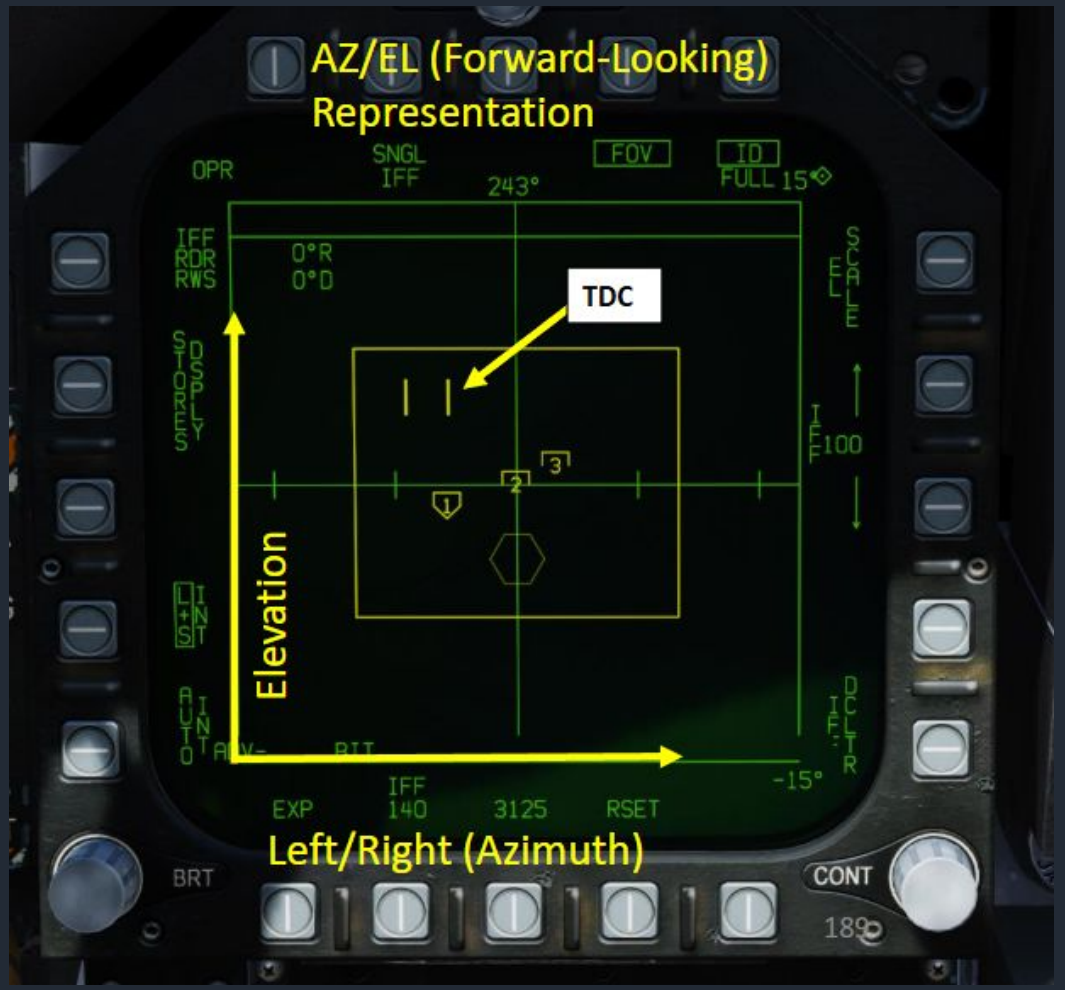
STEP 1 – FIND

- First question – ***how do I know there's nothing in front of me?***
- First answer – RADAR
  - Scan where you're told to scan!
  - If you're told to look coaltitude, how do you know that you're looking in the right place?
- Second answer – DATALINK
  - If you have D/L you don't have to worry where the tracks are



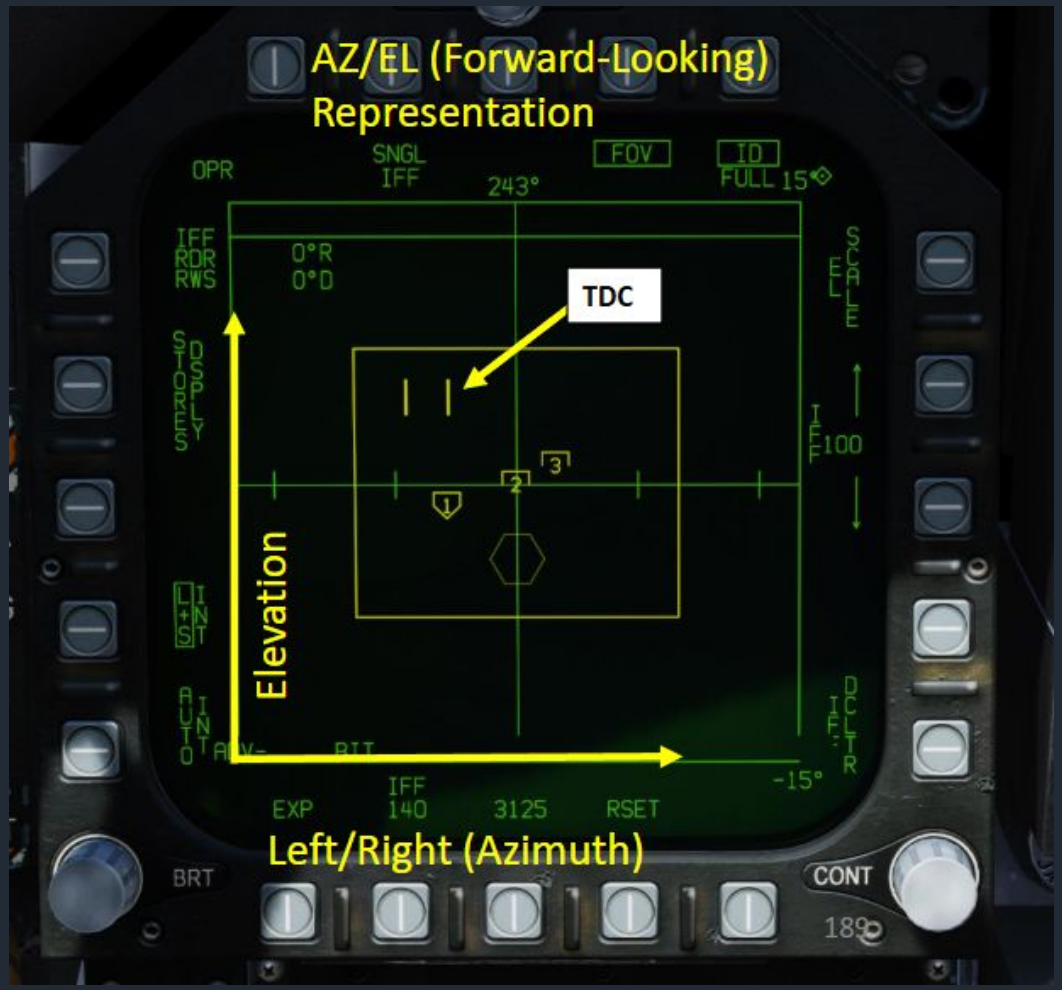
STEP 2 – FIX

- Second Question – ***“I know where this thing is. How do I keep it found?”***
- ***AZ/EL*** is a great tool here – *where am I looking, where is the guy I’m looking for, and how do I keep him within that?*



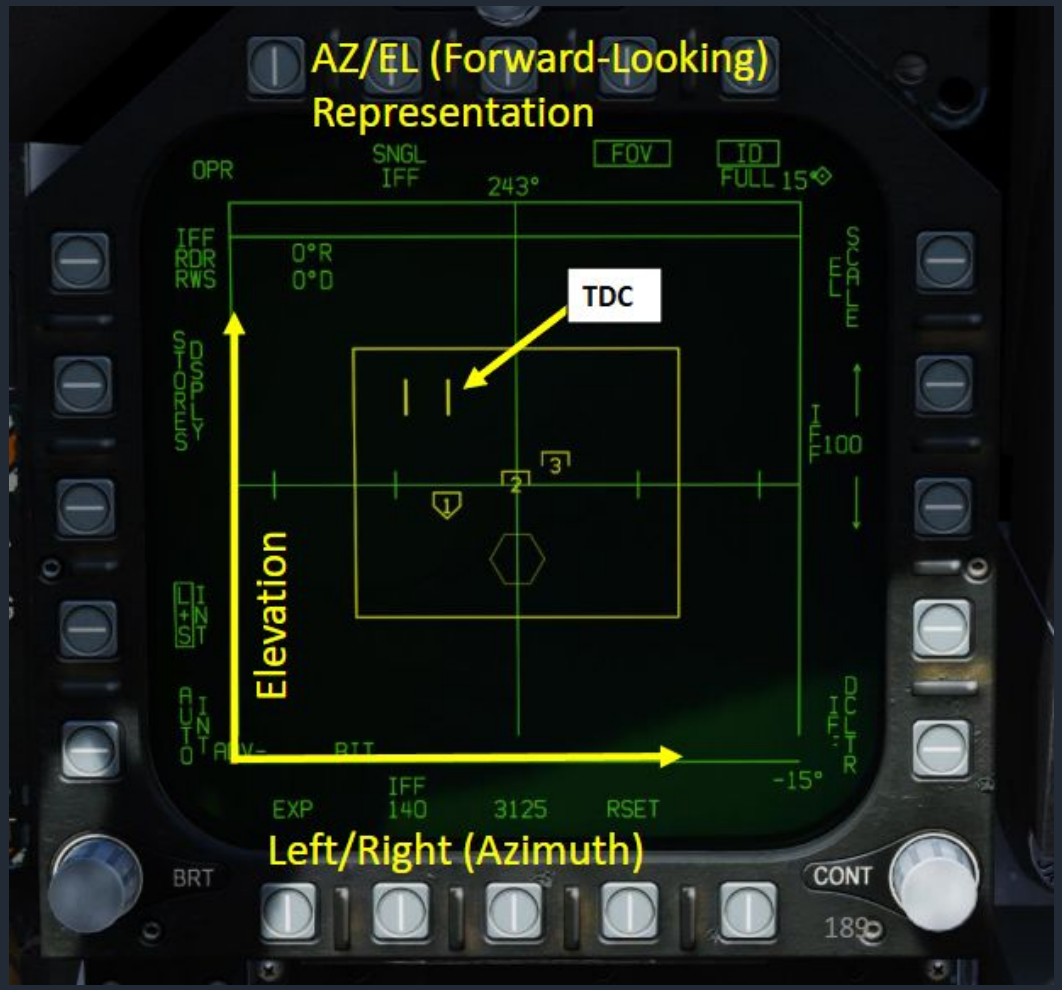
STEP 2 – FIX

- Think back to the flashlight analogy – AZ/EL shows us where the flashlight is looking/how big it is
- Here's some guidelines to configure a bigass flashlight
  - **BAR** – 4's a good place to start
  - **ELEVATION** – Assigned by FL/SL
  - **AZIMUTH** – 140
  - **RANGE** – 80



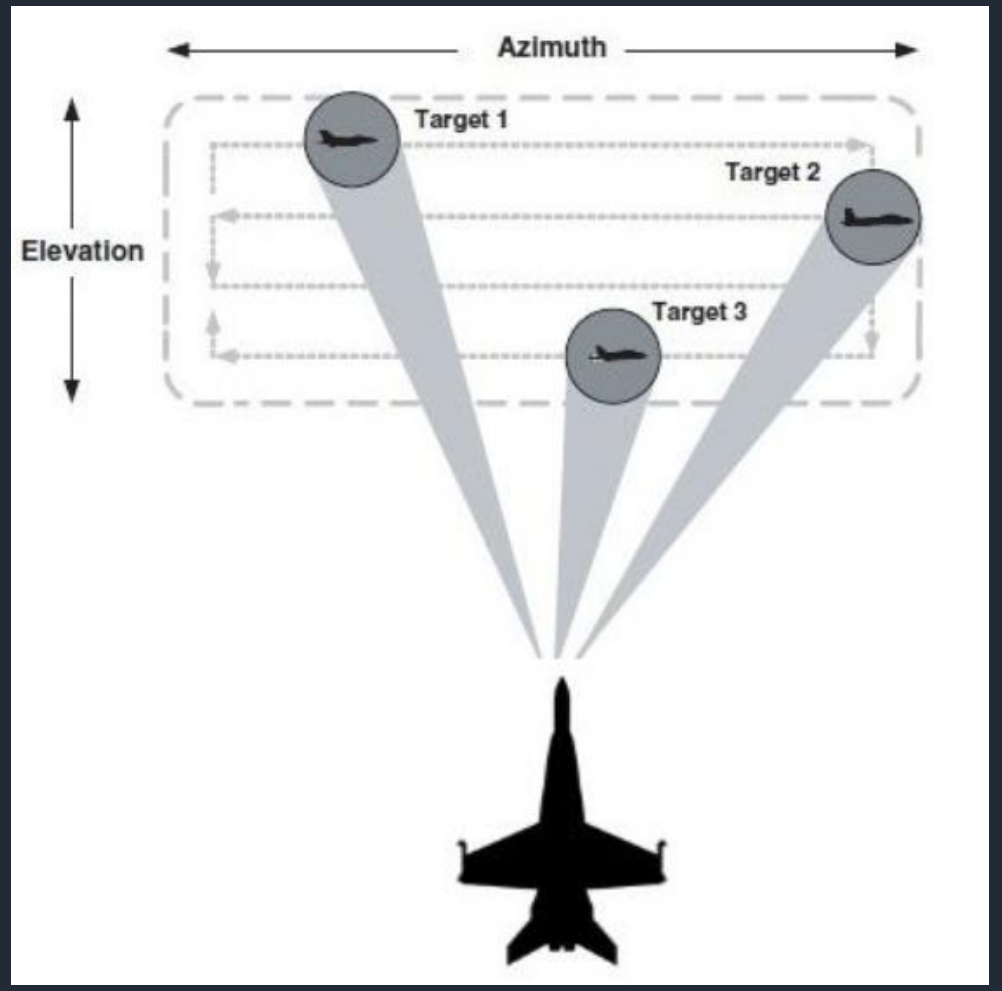
STEP 2 – FIX

- Let’s say you have datalink tracks but the radar refuses to track them itself
  - Curse, moan, bitch, etc
- AZ/EL is a great way to see why this is happening
  - “Oh, he’s down at this altitude, but I’m not scanning down there, let me adjust”



STEP 3 – TRACK

- Third Question – ***"Where will this asshole be in the future?"***
- By this point you have:
  - Found & fixed the target
  - ***Put it in TWS***
  - Go to TWS Auto
  - Make sure you've still actually got the target/targets fixed!



STEP 4 – TARGET***

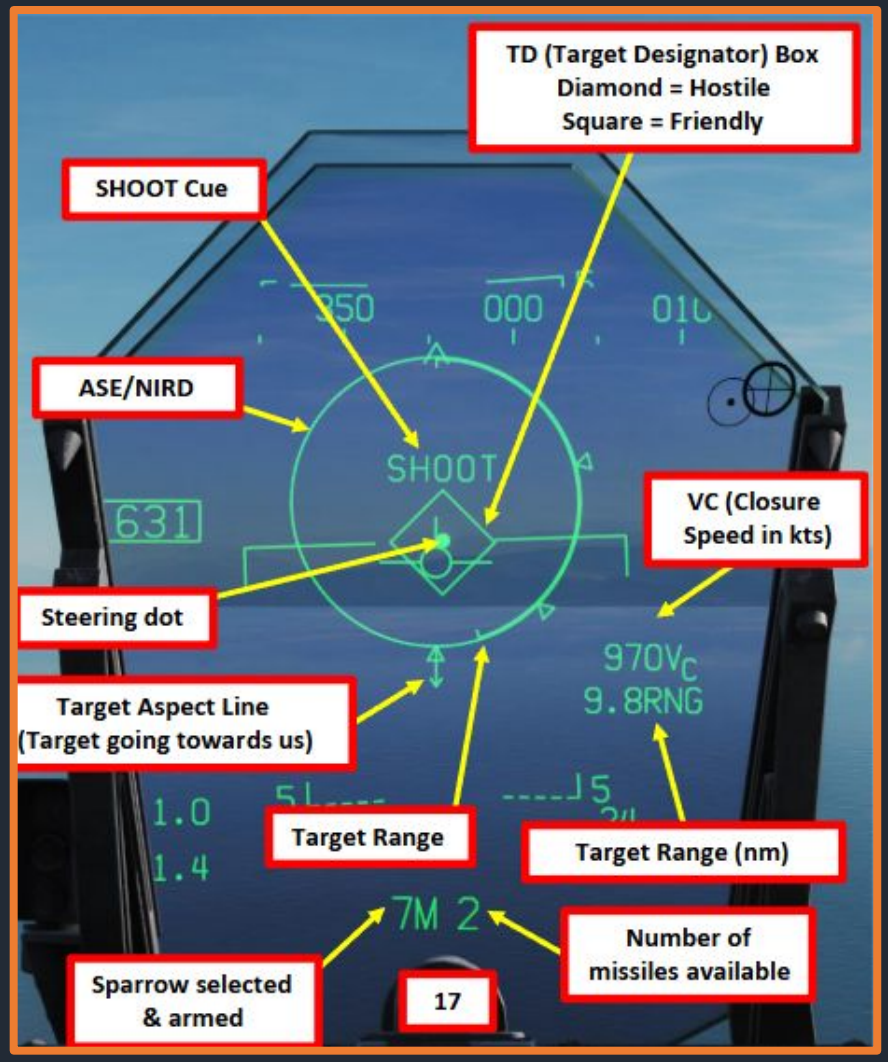
- Fourth Question – ***“What do I need to do to be able to employ weapons? Am I looking at the right asshole?”***
- Step through available TWS tracks (NWS) to make sure the one you want is under the trigger
- TDC depress to select your DT2
  - Alternatively, castle switch towards your radar DDI

STEP 4 – TARGET

- You know the HUD symbology. Watch it, wait for the shot
- At this point, be thinking ***“what remains before I can shoot?”***
  - COMMUNICATE WITH LEAD - “I need to do XYZ to launch”

STEP 5 – ENGAGE

- Fifth Question – ***“Should I squeeze the trigger?”***
  - **R**ange – In range?
  - **A**spect – Is he pointing at me? If he’s cold, the fuck am I doing?
  - **I**dentification – Is this guy declared hostile? ~~Don’t ask Knuckles too much about this one~~
  - **D**ot – Am I putting the missile in the best position it can be?

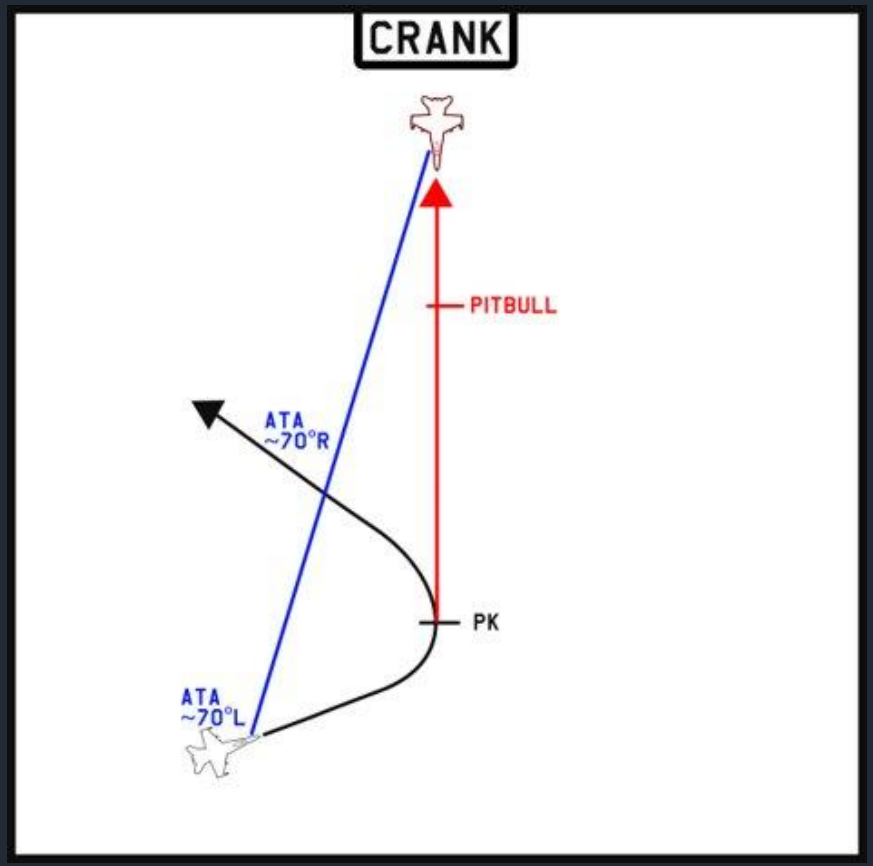


HOW NOT TO SOUND LIKE AN ASS

- There are plenty of communications throughout a BVR engagement. This week we'll keep it simple.
- ***"Sting 1-1, Fox 3, cranking left/right"***

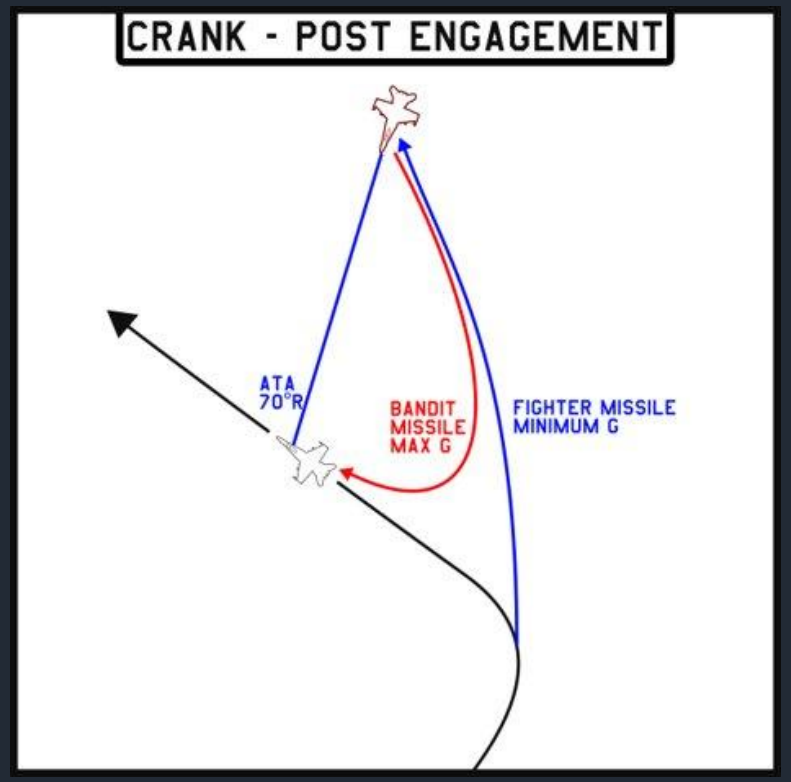
THE CRANK

- Big Idea: *Once you fire a missile, it's generally inadvisable to fly directly at the guy you just shot at*
  - Range closes and you set yourself up to be hit by a return shot – at best, you both miss and you wind up in a dogfight at the merge!
- A ***crank*** is a maneuver that puts the bandit at the ***gimbal limit*** of the radar
  - This allows the fighter's radar to keep supporting the missile (vital in a Fox-1 environment!) while also reducing closure rate between fighter and bandit
  - In the Hornet, this is about 70 degrees



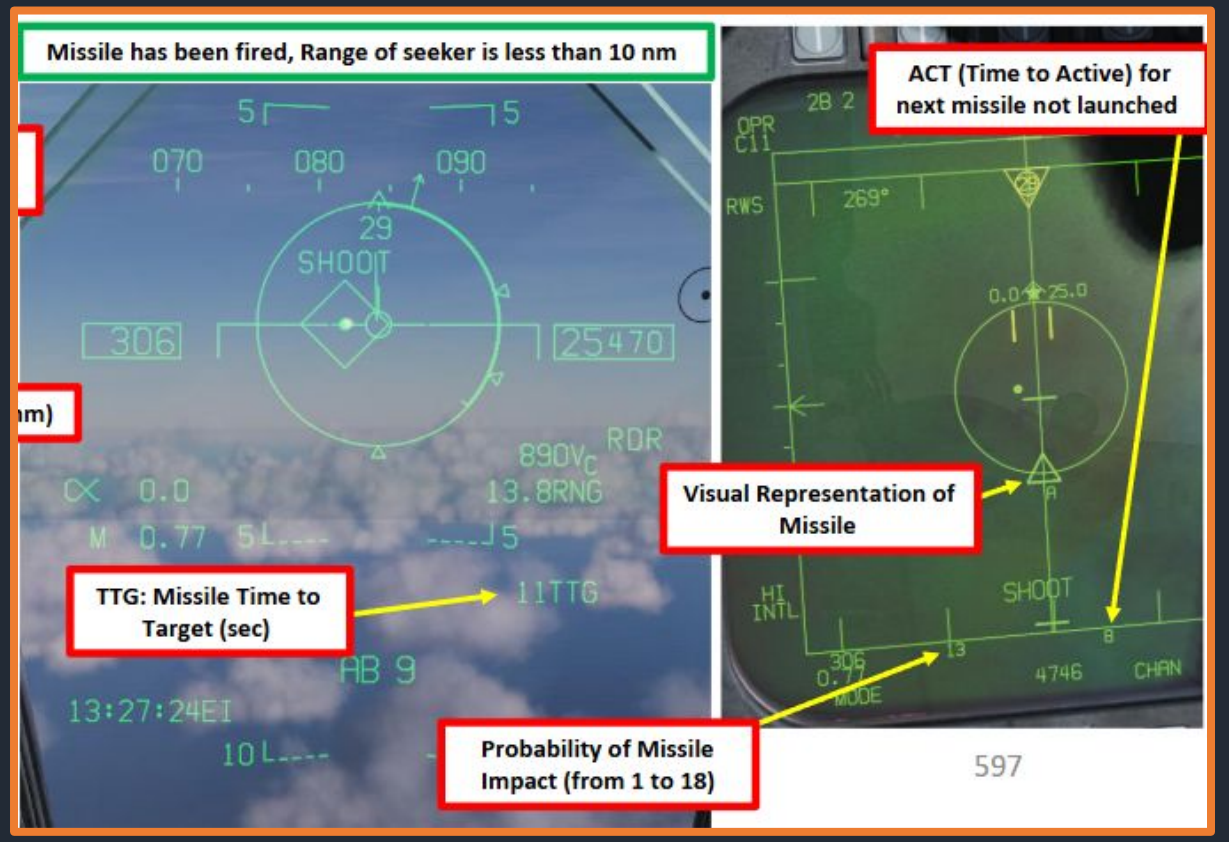
THE CRANK

- In addition to minimizing closure, the crank results in the bandit's missile having to pull more G
- Cranking also positions the fighter more effectively for a defensive turn or a potential reengagement
- ***Cranking gives you options!***



WHAT TO DO AFTER THE SHOT

- Big Idea: Support the shot (CRANK), once it's active turn cold.
- ***<u>Avoid taking it to the merge.</u>*** Once it goes active, turn cold!



FEAR NOT, FOR DOG IS MY COPILOT

Saturated yet?

Relax briefly.

<u>Please enjoy this picture of an adorable dog in an airplane.</u>

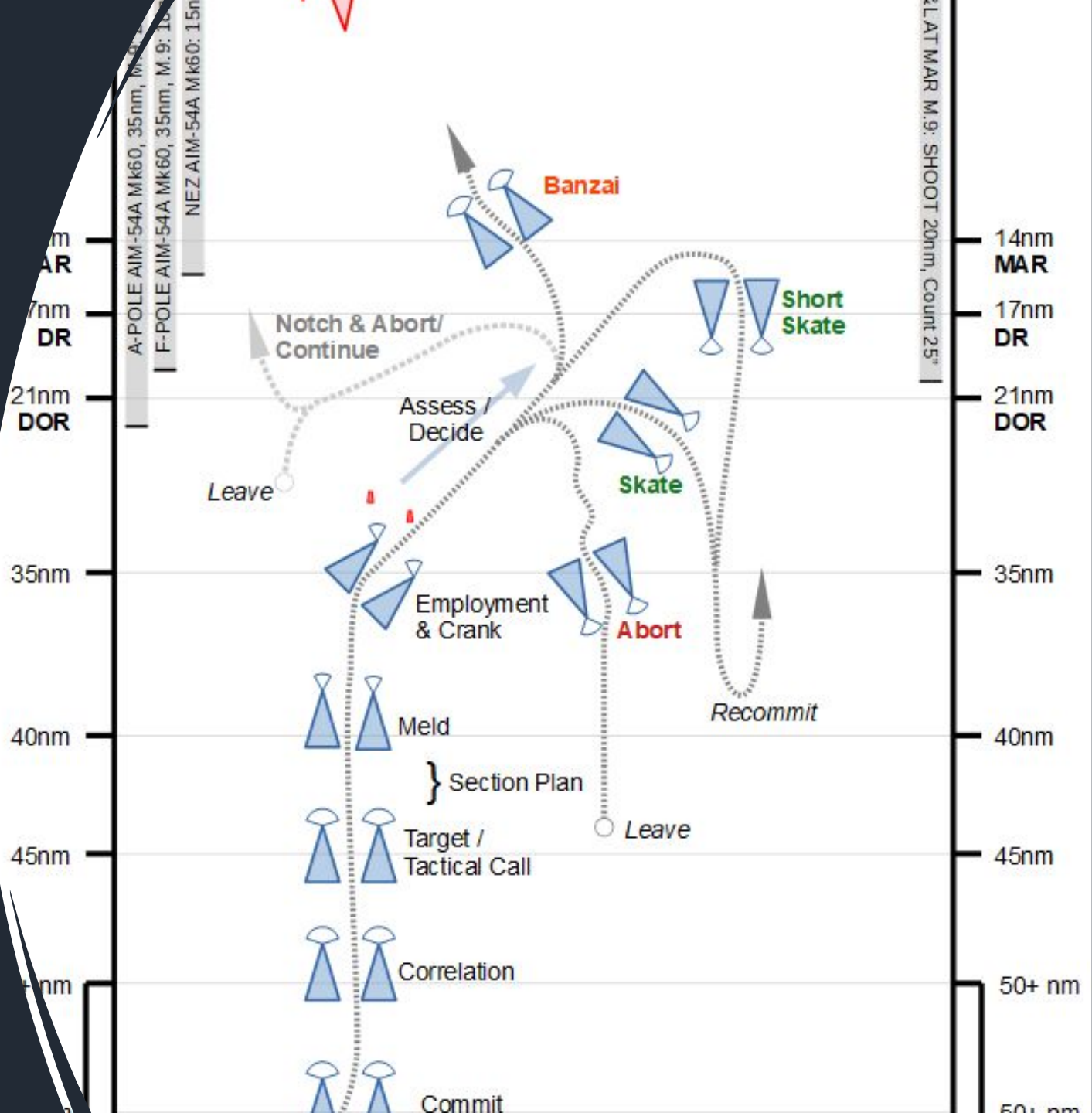
Let's continue! Don't look so excited.

TOPIC 7.4 – BVR 201

"What are the steps to the BVR timeline?"

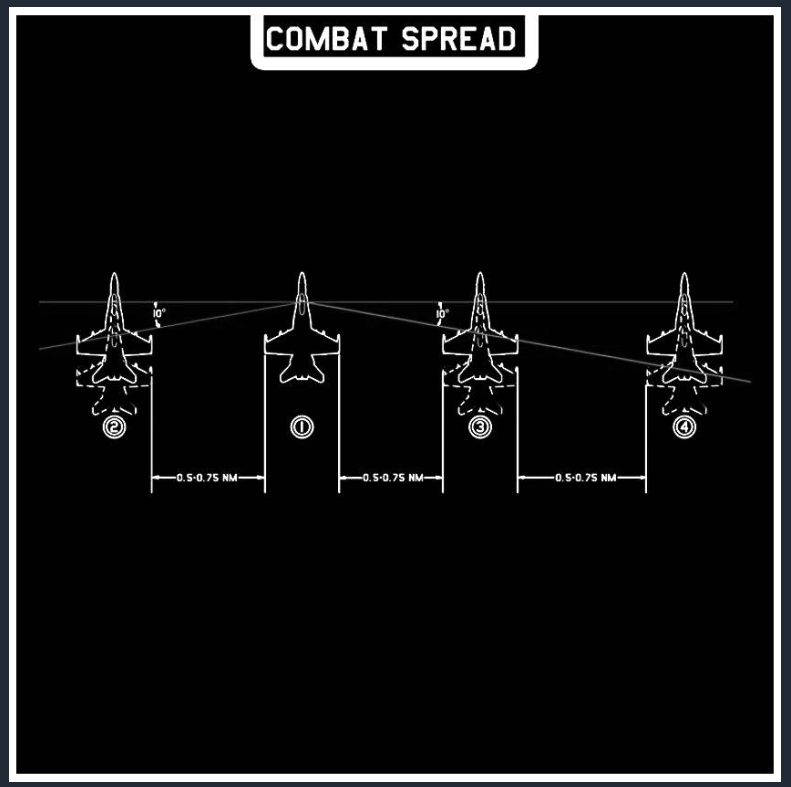
"Why is the BVR timeline important?"

"How do I maximize survivability in a BVR engagement?"



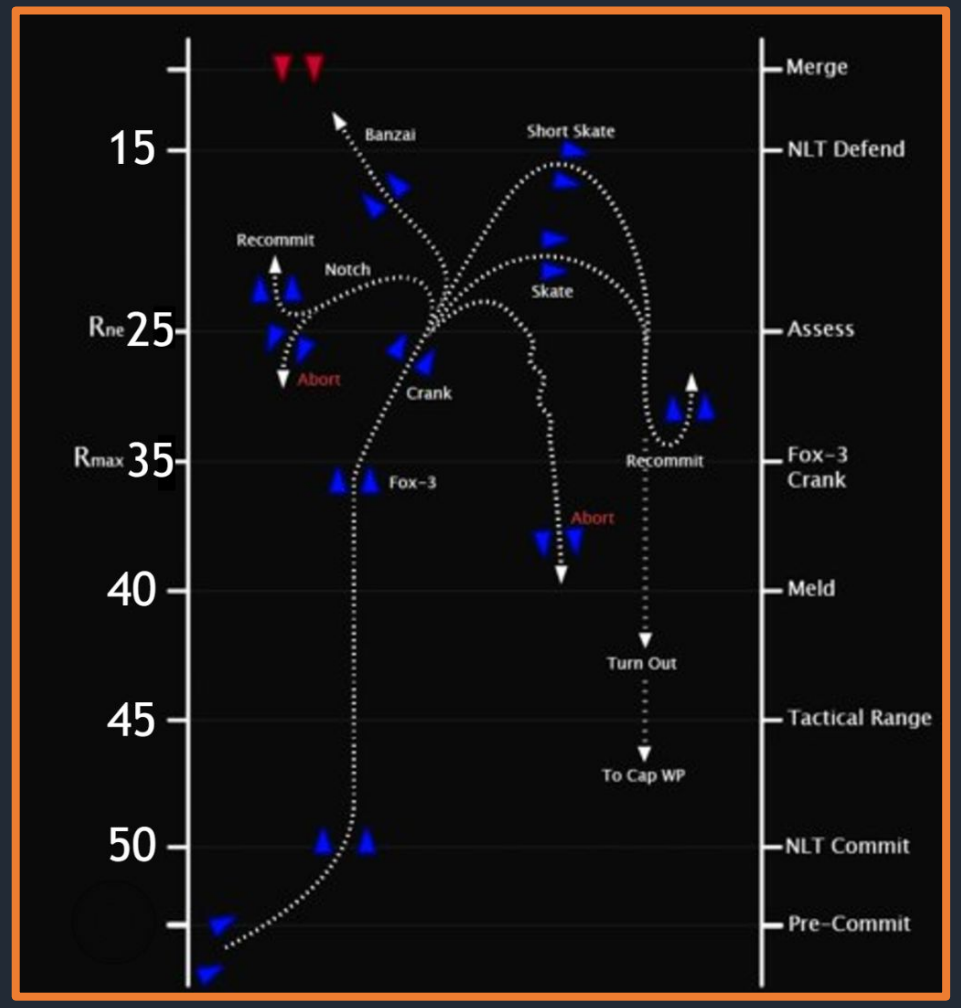
FORMATION

- BVR is flown in ***combat spread*** formation
  - Allows for simultaneous launches
  - Helps maintain deconfliction as the flight goes through the BVR timeline
  - This gets tricky when the flights start maneuvering as missiles start flying, but do the best you can to maintain position!



THE BVR TIMELINE

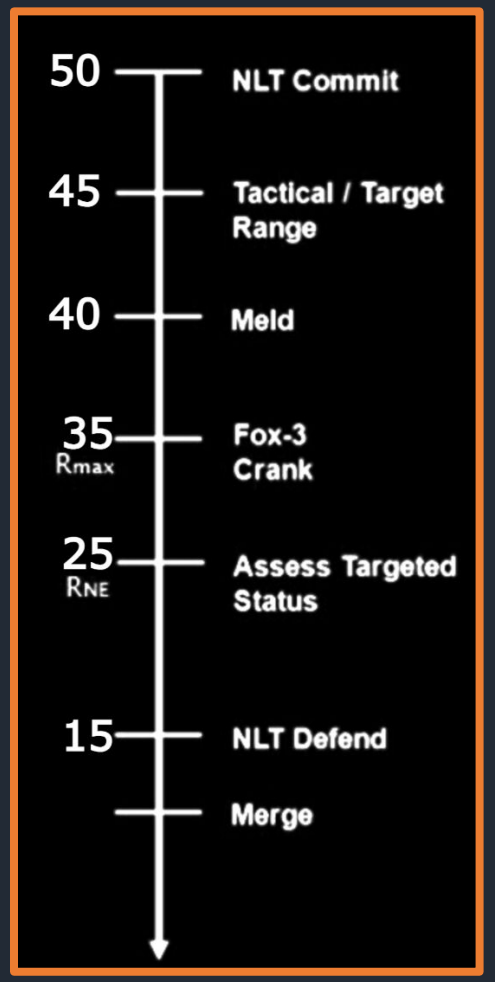
- The ***BVR Timeline*** is a series of steps that a flight follows throughout a BVR engagement
  - Maximizes flight safety
  - Maximizes P/K
- The BVR Timeline is a ***reference***, not a set of hard and fast numbers that never change
  - We'll give you some example data today, but just know that like everything BVR, the answer to a question of "when does XYZ happen?" is "it depends"



AIM-120 BVR TIMELINE

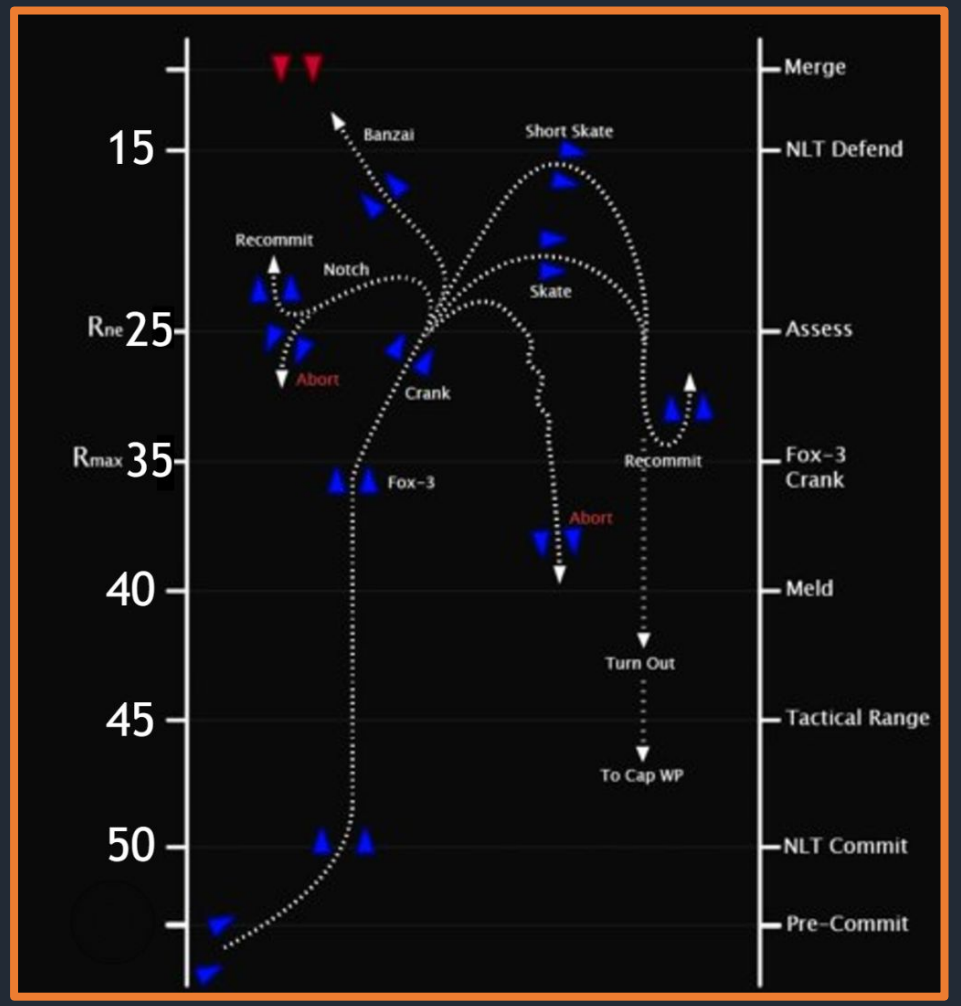
- ***NLT Commit*** – 50 miles
- ***Tactical*** – 45 miles
- ***Meld*** – 40 miles
- R_{MAX} – Approx 35 miles
- R_{NE} – Approx 25
- ***NLT Defend/MAR*** – 15 miles

<u>But Knuckles, what the fuck are all of these steps?</u>



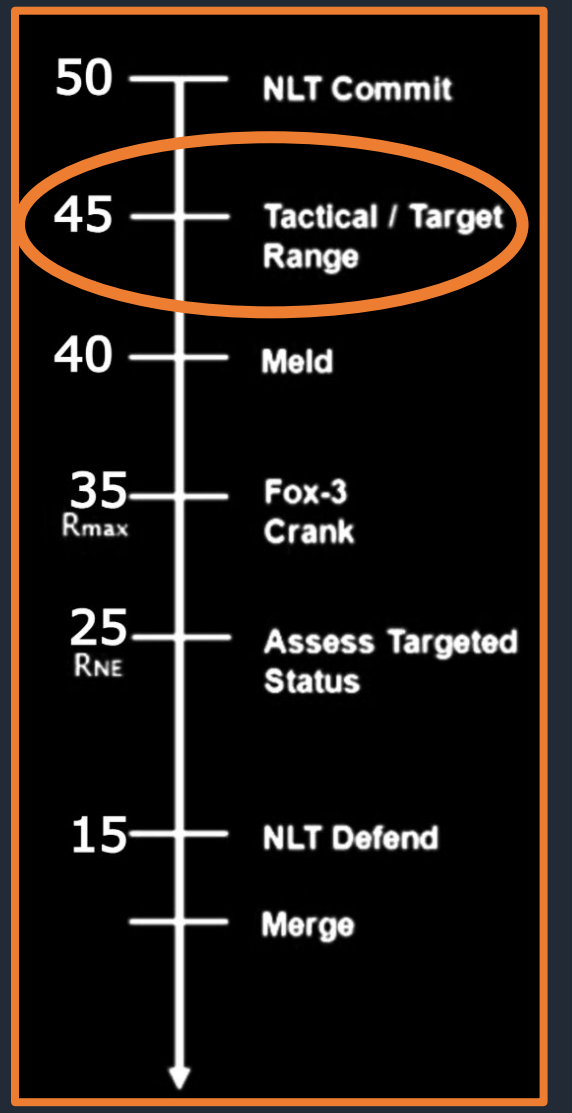
THE BVR TIMELINE

- ***No-Later-Than Commit*** – "Commit" call on big voice (AWACS channel)
  - This lets everyone know you're engaging!
- ***Tactical Range*** – Must be in formation, altitude, and speed
- ***Meld*** – Fighters must have ***SORTED*** (who's shooting who?) and have RADAR set for engagement
- ***FOX-3 Crank*** – FOX-3 shot and crank occurs
- ***Assess*** – Fighters decide next course of action
- ***NLT Defend/Minimum Abort Range*** – Fighters must go defensive to avoid return fire
- ***Merge*** – Enter WVR combat



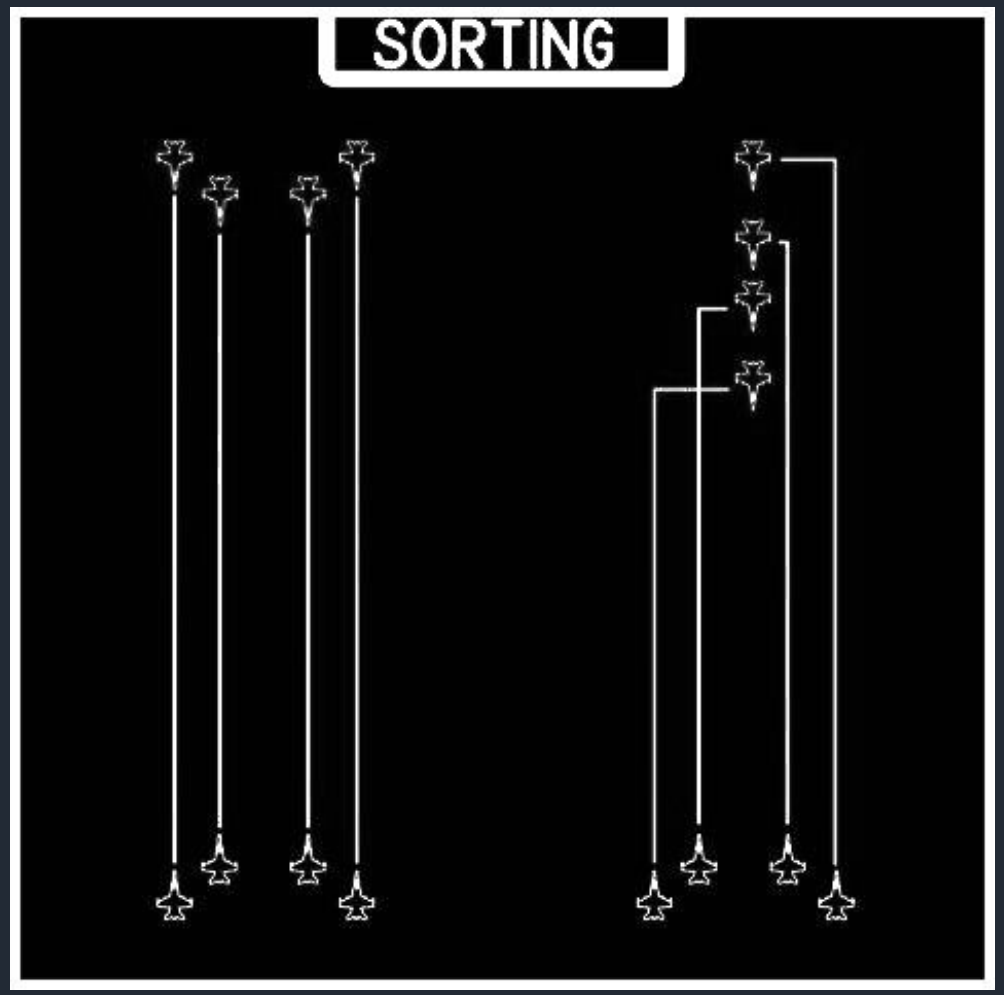
THE COMMIT BRIEF

- Between ***COMMIT*** and ***MELD***, Lead will give a ***Commit Brief***
- FL calls
  - ***Sort*** instructions
  - ***Crank Direction*** or ***PINCER*** (SOP)
  - ***Abort Plan***



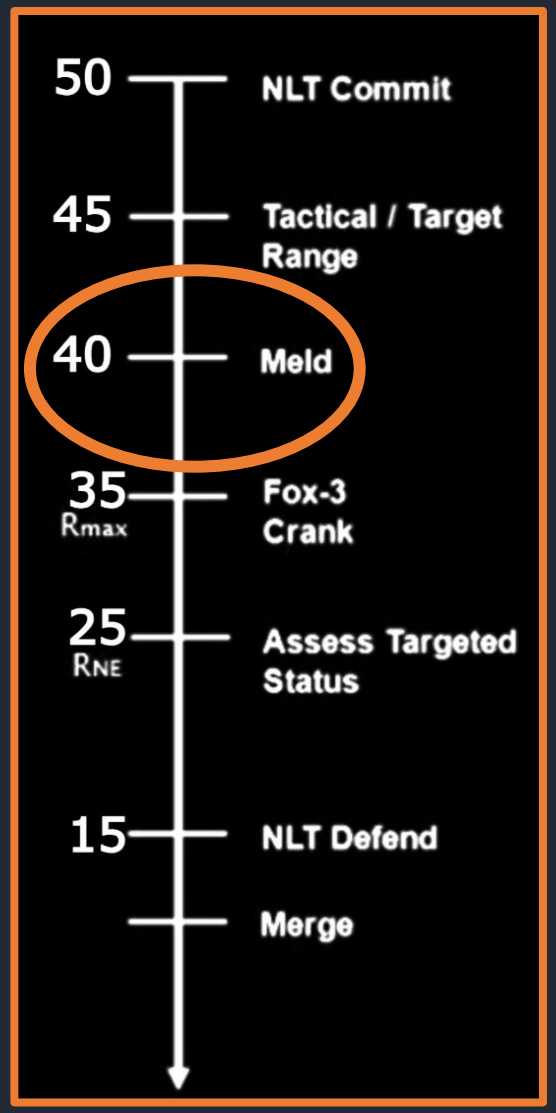
SORTING

- To be accomplished once COMMITTED but before MELD
- FL will call ***"SORT"***
- Unless otherwise briefed, flight will sort:
  - Left-to-right
  - Close-to-far
- Wingmen report ***"SORTED"***



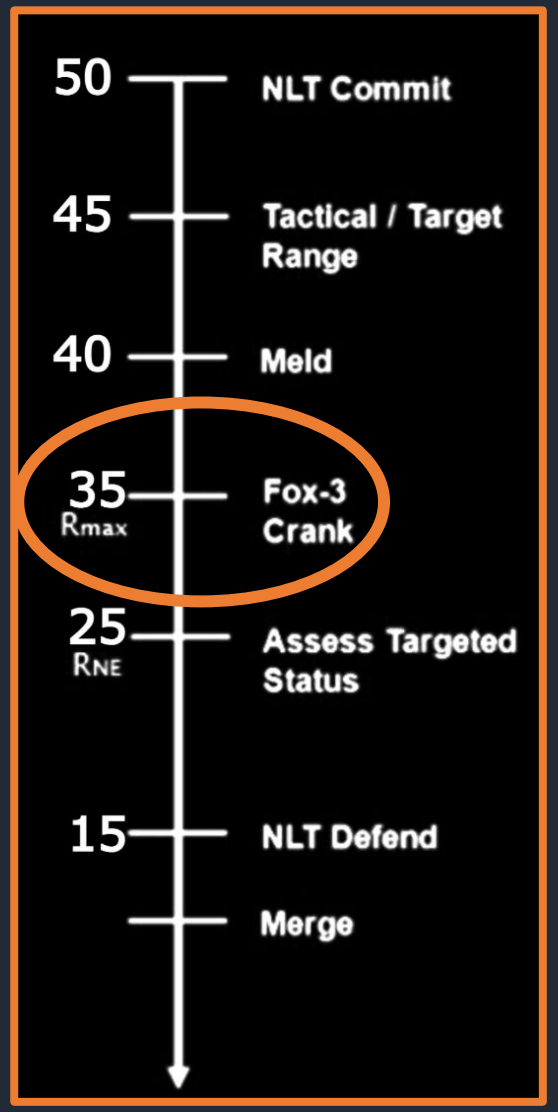
MELD

- FL will call ***MELD***
- Fighters stop searching and focus on locking up assigned bandits
- Fighters confirm radar & weapons prepared for engagement
- ***MASTER ARM*** on!



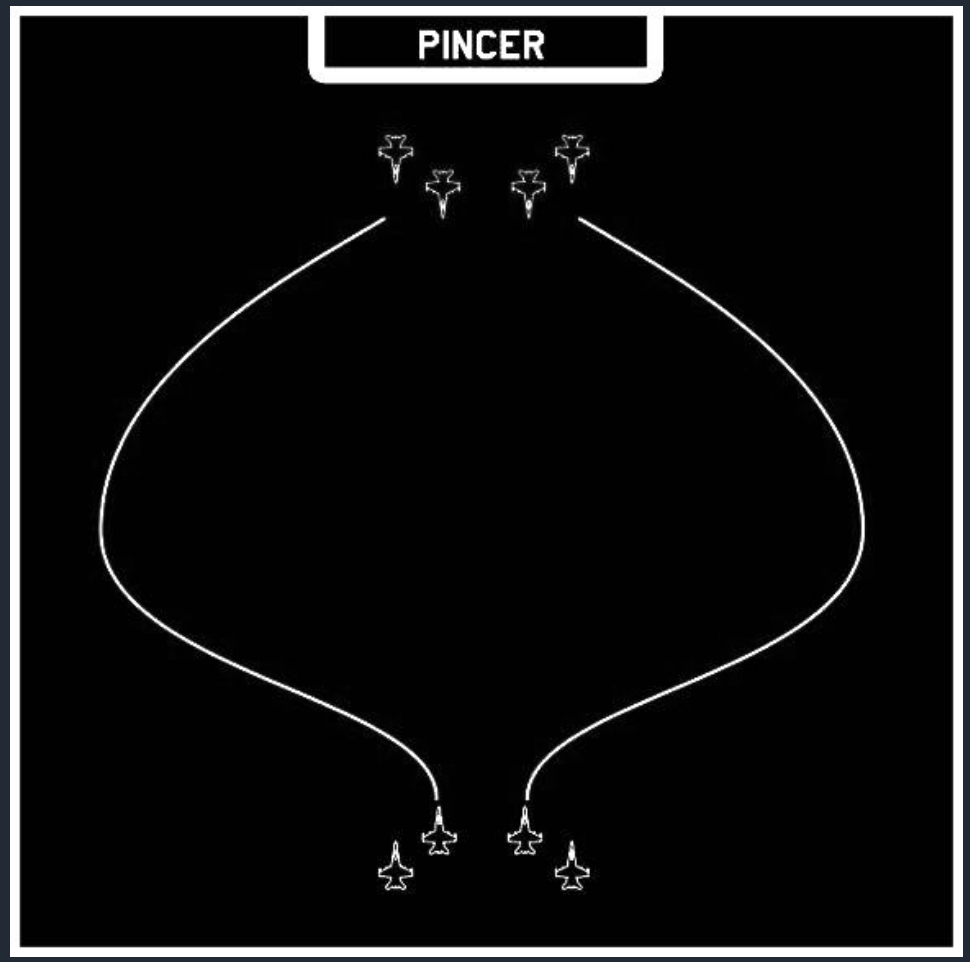
FOX-3 & CRANK

- Take the shot!
- After taking the shot, crank in briefed direction and focus on the gameplan!



PINCER

- ***Pincer***: Maneuver in which elements or A/C crank in opposite directions
  - Achieves all goals of crank
  - Creates more problems for bandit to solve
  - Provides max mutual support

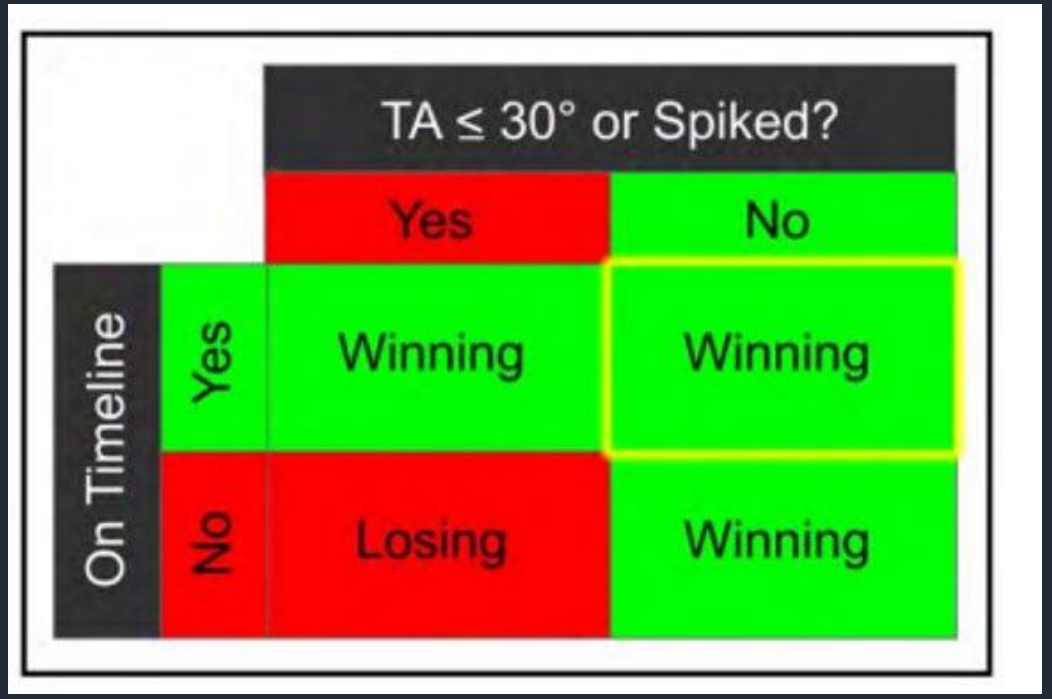


PINCER

- During a Pincer, flight members will report bandit actions with brevity
  - ***BANDITS IN*** – Bandits have turned to intercept heading
  - ***BANDITS OUT*** – Bandits have turned away from fighters
  - ***BANDITS BROKE*** – Bandits have gone DEFENSIVE
- *Why not "BANDITS DEFENSIVE?"*

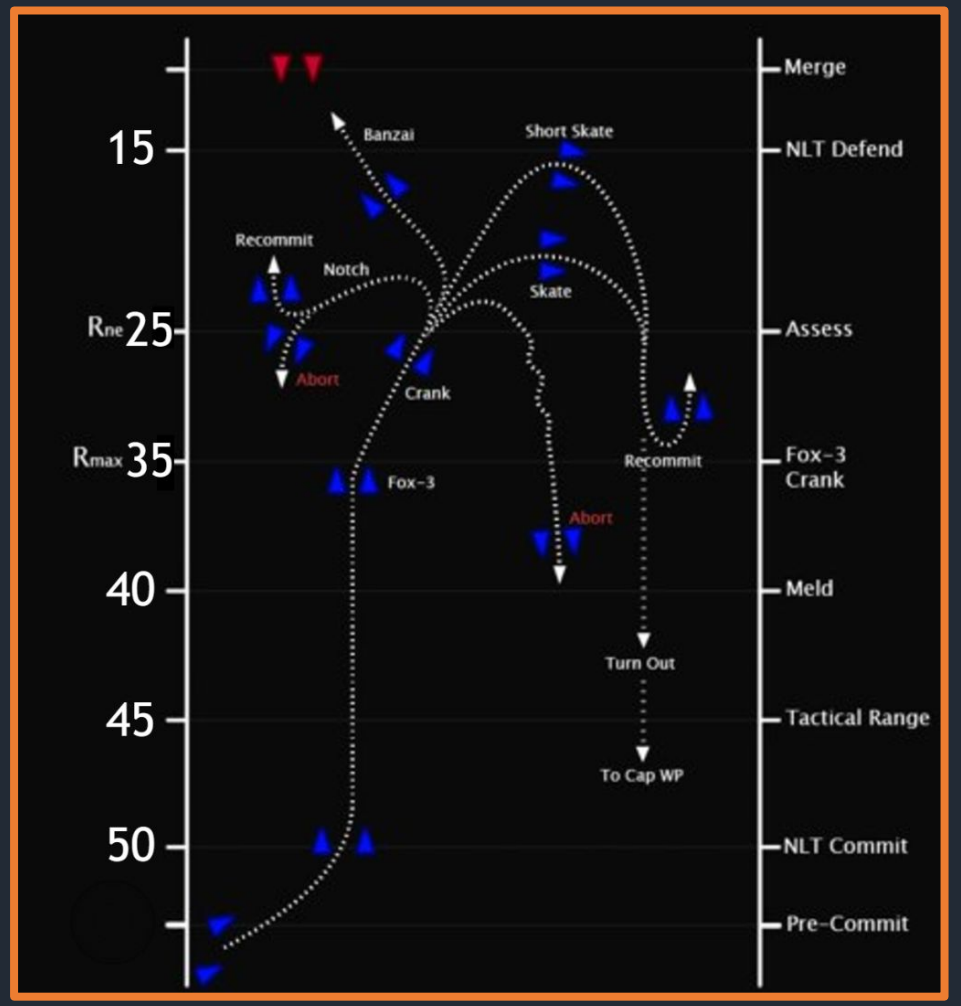
WINNING OR LOSING REVIEW

- During the assess phase, each pilot asks, "*Am I Winning or Losing*?"
- The answer is based on target aspect, enemy radar spikes and position on the timeline



TACTICS & GAMEPLANS

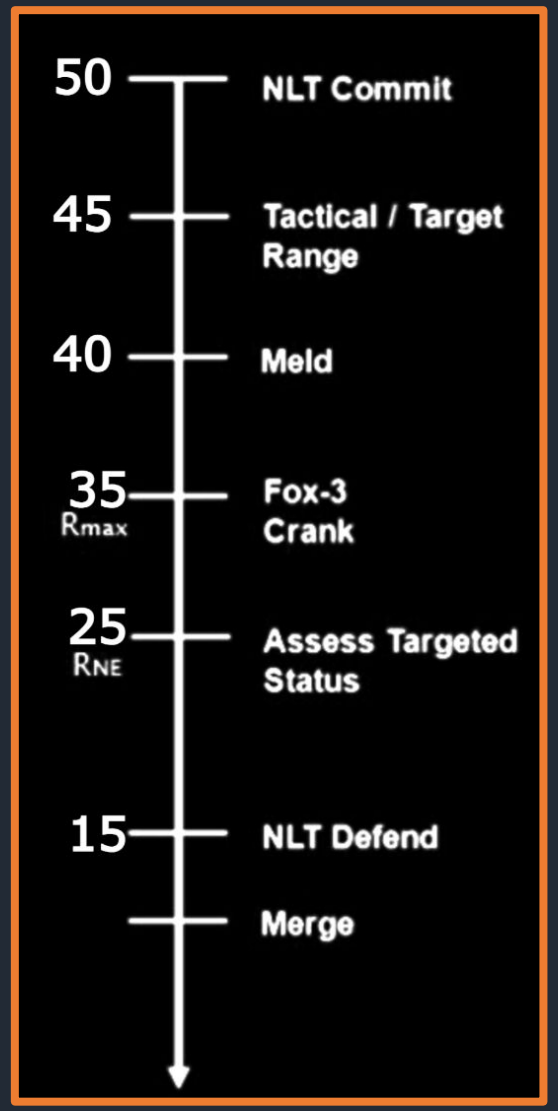
- ***Skate*** – General tactic if on-timeline
  - Continuing crank while supporting inbound missiles
  - Begin "launch and leave" – once the weapon goes pitbull, turn out and flow away from the hostiles
  - Can ***Short Skate***, get closer to target before turn out
- ***If Winning:***
  - Turn out and assess
  - If at a workable range, can ***recommit***; generally only if bandits have turned cold
- ***If Losing:***
  - ***Abort!*** Go defensive, notch the missile, assess
- ***Banzai!***
  - ***To the merge!*** Very rarely done unless necessary, or FL (usually if it's Prince) has the raging bloodlust



LET'S REVIEW THIS AGAIN!

- ***NLT Commit*** – 50 miles
- ***Tactical*** – 45 miles
- ***Meld*** – 40 miles
- R_{MAX} (Fox-3 and crank!) – Approx. 35 miles high & fast
- R_{NE} (Assess!) – Approx 25
- ***NLT Defend/MAR*** – 15 miles

Understand that these ranges can depend on altitude and threats– if you're up at Angels 30, or against a Flanker vs a Mig-28, your MAR is a lot further out than 15 miles!



WHAT QUESTIONS DO WE HAVE?

Don't tell me you don't have any, you bunch of liars.