

# ***GPS "SMART" BOMBS***

***Another Slice of the Pie***



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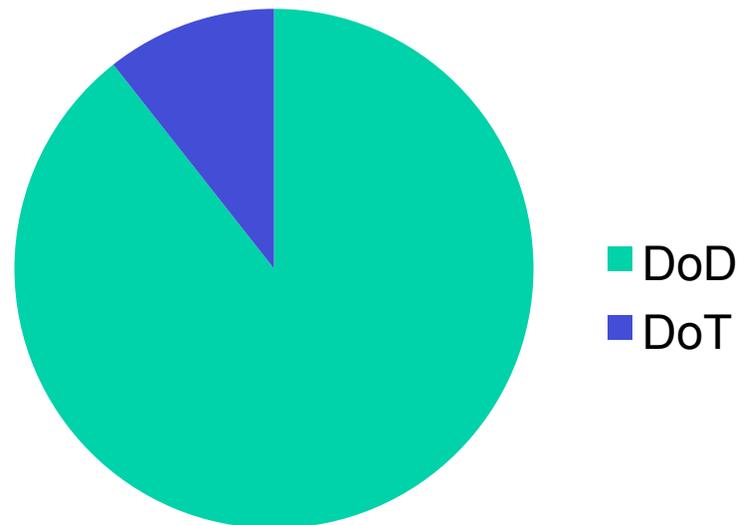




# MUCH Bigger Slice of the Pie?



- **GPS Budget Numbers from GPS.gov for 2015:**
  - **Defense Appropriations: \$1,035 million**
  - **Transportation Appropriations: \$123 million**
    - (Final amount unclear, used Senate Committee Mark numbers)



- **We spend a lot of time talking about civil uses of GPS (which is good!) but I wanted to give the audience some exposure to what else is out there**



# What We're Going to Talk About



- **Intro to Air Force Test Center (AFTC)**
- **Intro to me**
- **Why GPS “smart” bombs?**
- **A sampling of GPS “smart” bombs in the USAF inventory**
  - **Joint Direct Attack Munition (conventional)**
  - **Small Diameter Bomb (glide)**
  - **Joint Air-to-Surface Stand-off Missile (powered)**
  - **Enhanced GBU/Laser JDAM (hybrid)**
  - **Massive Ordnance Penetrator (penetrator)**
- **B-2 video**
- **F-22 video**



# Edwards' Role in the AF



**Air Force Materiel Command**  
“Deliver and support agile war-winning capabilities”

**Wei's Translation:**

“Buy what we need for today and tomorrow”



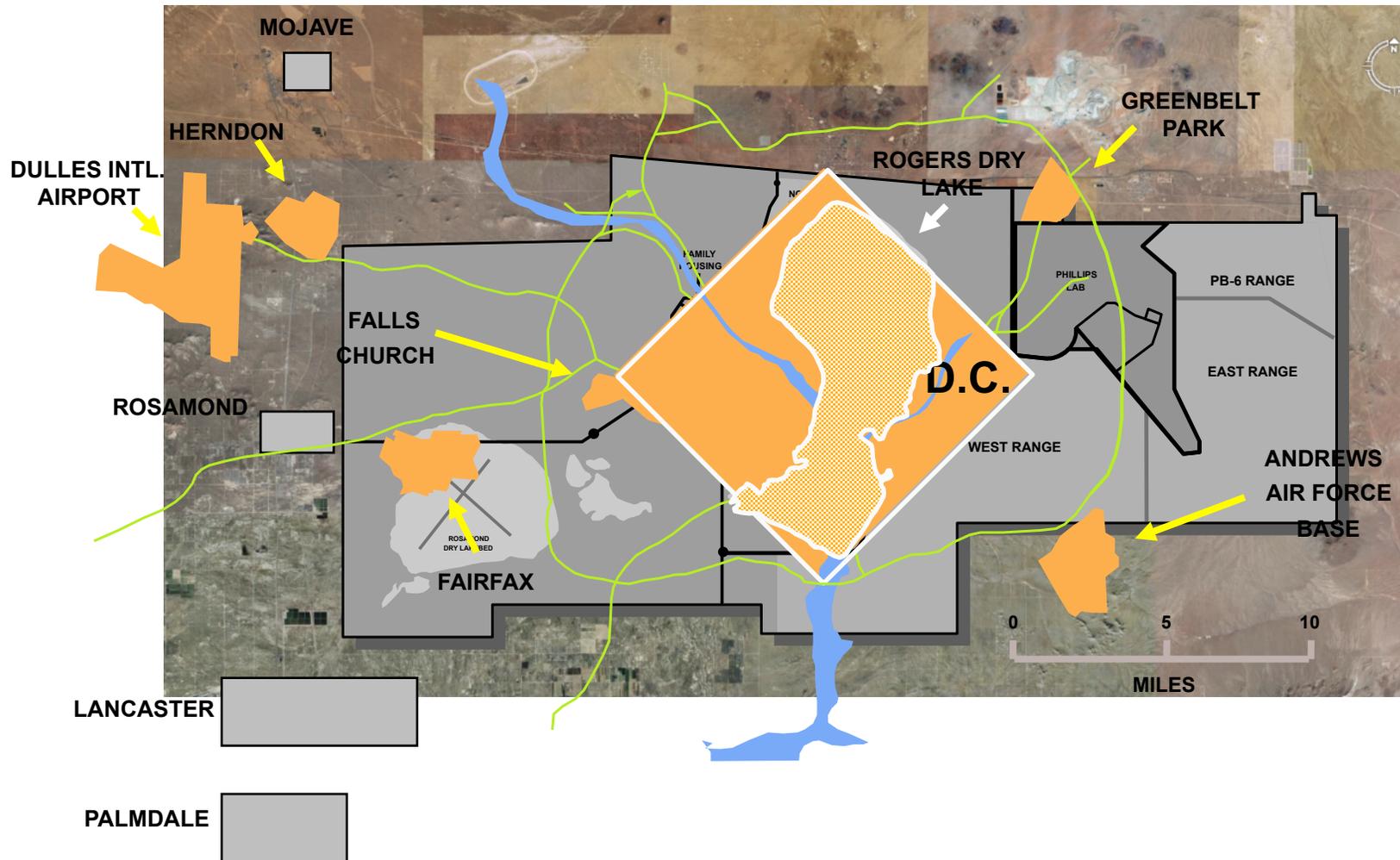
**Edwards Air Force Base**  
“Conducts developmental test and evaluation of air, space and cyber systems to provide timely, objective and accurate information to decision makers”

**Wei's Translation:**

“Does it work? How well?”



# Air Force Flight Test Center





# Why There?



- **Rodgers and Rosamond dry lakebeds**
- **68 miles of lakebed runways**
- **Plenty of restricted airspace**
- **1/6<sup>th</sup> of CA airspace is restricted or military operating area (MOA)**



# Air Force Test Center History



- The historic home of American flight test



**1942**

**21st  
Century**



**1947**

**1990's**



**1949**

**1960's  
& 70's**

**1980's**





# Currently Testing...





# About Me...



- **BSAE from UCLA**
- **F-16 Weapons Integration Engineer**
  - Air-to-Ground Smart Bombs
  - Air-to-Air Missiles
  - Suppression of Enemy Air Defense (SEAD)
- **MSAAE from Stanford GPS Lab**
- **F-22 Weapons Integration Engineer**
  - Air-to-Air Missiles
  - Air-to-Ground Smart Bombs
- **B-1/B-2 Electronic Warfare Engineer**
- **JSF Air-to-Air Tactics Instructor**





# Why GPS “Smart” Bombs



- **Thanh Hoa Bridge in the Vietnam War**
  - Strategically important to the North Vietnamese
  - US leadership wanted the bridge destroyed
- **The first attack...of many**
  - 79 aircraft, 32 “not very smart” missiles, **1200 bombs total!**
  - Estimated that 300 bombs hit or indirectly damaged target
  - None hit with enough precision to bring down the bridge
  - **Bridge still standing, 2 aircraft lost**



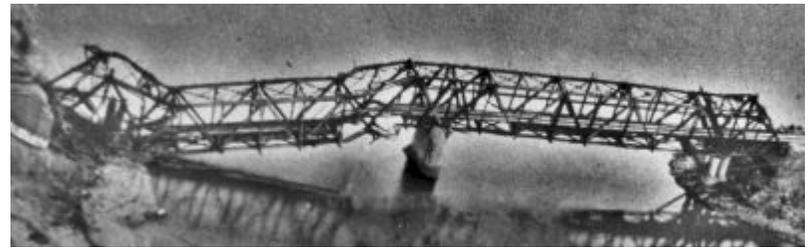
[https://en.wikipedia.org/wiki/Thanh\\_H%C3%B3a\\_Bridge](https://en.wikipedia.org/wiki/Thanh_H%C3%B3a_Bridge)



# Why GPS “Smart” Bombs



- **Thanh Hoa Bridge in the Vietnam War**
  - Bridge is finally destroyed using F-4s carrying an early version of the laser guided bomb (BOLT-117)
  - Clearly precision guided munitions are the way effectively attack targets!



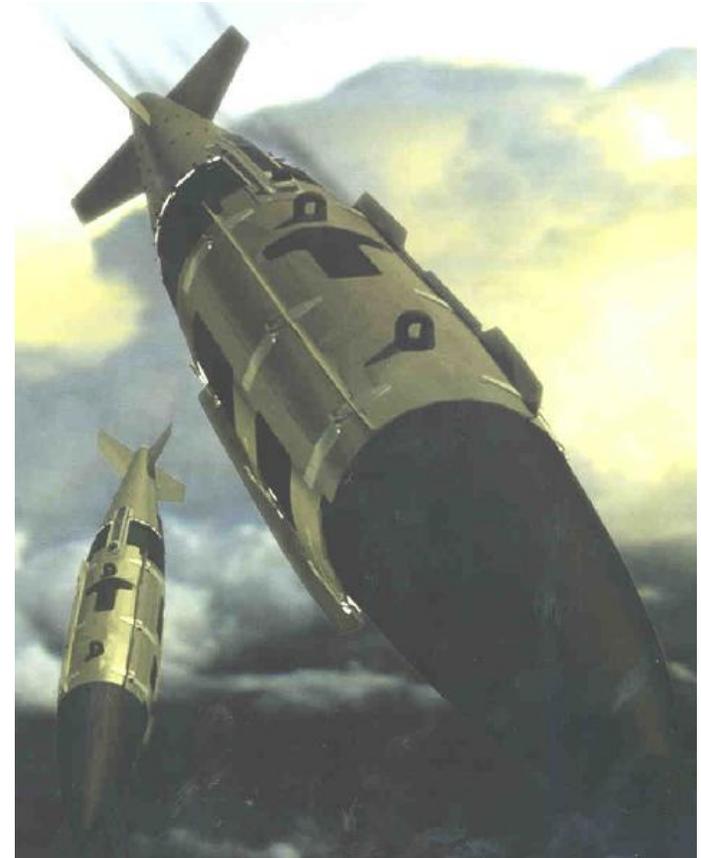
- **Laser Guided Bombs (LGBs) have limitations**
  - Need a laser designator to remain on until impact, exposing air or ground forces to enemy fire
  - Can be blocked or scattered by weather (clouds, rain, fog), sand, or smoke
  - Requires line-of-sight (LOS)
- **GPS bombs do not have any of these limitations!**



# GPS “Smart” Bombs



- Why do you keep putting “Smart” in quotes?
- They really should be called GPS obedient bombs
- They are really good at going where they are told to go
- Not so good at finding their target if told to go to the wrong place
- Bottom line: Give it good coordinates!





# Let's Take a Tour



- **Joint Direct Attack Munition (JDAM)**
- **Conventional smart bomb (GPS + INS)**
- **99.9% of the time when you hear “Smart Bomb” they’re talking about a JDAM**
- **Can be carried by virtually all USAF fighters and bombers**
- **Costs is \$20-30k per tailkit (not including warhead)**

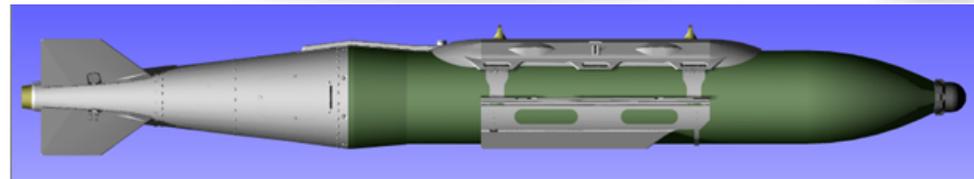




# Let's Take a Tour



- Comes in 500lb, 1000lb, and 2000lb variants
- “Smart” tailkit attached to various “dumb” warheads
- 2000lb general purpose
- 2000lb penetrator
- 500lb general purpose





# JDAM Video



- Everyone likes to watch stuff blowing up!





# Let's Take a Tour



- **Small Diameter Bomb (SDB)**
- **Gliding smart bomb (GPS + INS) in the 250lb class**
- **Wing kit for increased stand off range**
- **Can navigate a series of waypoints and fly in along a designated 2D or 3D route**
- **Some variants have special warhead designed for low collateral damage**





# SDB Video



- In America, we like explosions and country music!





# Let's Take a Tour



- **Joint Air-to-Surface Standoff Missile (JASSM)**
- **Powered cruise missile in the 2000lb class**
- **Wing kit and turbojet engine for greatly increased standoff range compared to glide-only weapons**
- **Can navigate a series of waypoints and fly in along a designated 2D or 3D route**
- **IR seeker for precision strike during terminal phase of flight**





# Let's Take a Tour



- Enhanced Guided Bomb Unit (EGBU) or Laser JDAM (LJDAM)
- Hybrid GPS/Laser guidance
- Combines the advantages of both while negating the disadvantages
- Primarily adds the ability to go after moving targets





# Let's Take a Tour



- **Massive Ordnance Penetrator (MOP)**
- **30,000lb class penetrator**
- **JDAM on lots of steroids!**
- **Previously, the largest penetrator was in the 5,000lb class**
- **MOP has a 5,000lb warhead in a 30,000lb weapon**



<http://www.globalresearch.ca/obamas-plan-b-the-30000-pound-bomb-that-could-be-used-against-irans-nuclear-facilities-boggles-the-mind/5459403>



[https://en.wikipedia.org/wiki/Massive\\_Ordnance\\_Penetrator](https://en.wikipedia.org/wiki/Massive_Ordnance_Penetrator)



# B-2 Video



- Why drop 1 bomb when you can drop 80?

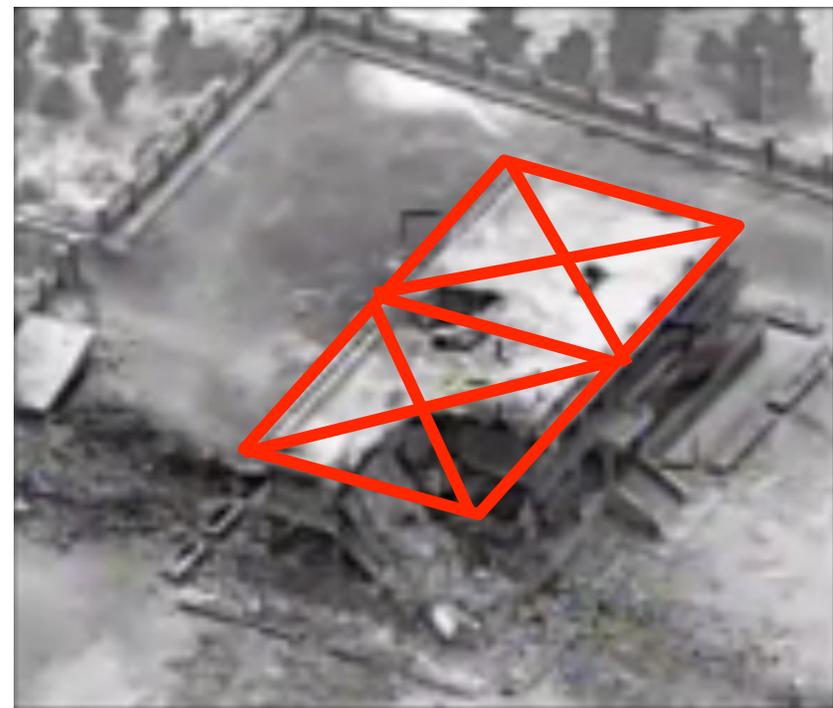




# F-22 Strike Video



- GPS smart bombs currently in action
- From the official US Central Command Youtube account
- <https://www.youtube.com/watch?v=0bpakeG9x7o>



***Any Questions?***

