

**International Consortium
for Telemetry Spectrum**

**Encroachment Threats
to Aeronautical Telemetry
in the USA: Update #14**

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- **Global mobile data traffic grew 63 percent in 2016 from 2015**
 - 7.2 exabytes (1B Gigabyte) from 4.4 exabytes per month
 - Expect 7 fold increase by 2021 to 49 exabytes per month
 - North America expects a 5 fold increase
- **Average smartphone usage grew 38 percent in 2016**
 - Represented 81 percent of total mobile traffic
 - Will grow to total of 86% of mobile traffic by 2021
- **Mobile video traffic accounted for 60 percent of total mobile data traffic in 2016**
 - Over three-fourths (78 percent) of the world's mobile data traffic will be video by 2021

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U.S. National Broadband Plan (17 Mar 2010)

GOALS

1. At least 100 million U.S. homes should have affordable access to actual download speeds of at least 100 megabits per second and actual upload speeds of at least 50 megabits per second by the year 2020.
2. The United States should lead the world in mobile innovation, with the fastest and most extensive wireless networks of any nation.
3. Every American should have affordable access to robust broadband service, and the means and skills to subscribe if they so choose.
4. Every American community should have affordable access to at least 1 gigabit per second broadband service to anchor institutions such as schools, hospitals, and government buildings.
5. To ensure the safety of the American people, every first responder should have access to a nationwide, wireless, interoperable broadband public safety network.
6. To ensure that America leads in the clean energy economy, every American should be able to use broadband to track and manage their real-time energy consumption.

PROGRESS TO DATE

- 102.5M U.S. households with fixed broadband internet access as of Dec 2015 (up from 82.5M in 2010) (ITU, Dec 2015)

...but...

- U.S. Q1 2016 average speed was 15.3 Mbps (global rank 16), with peak speeds of 67.8 Mbps (global rank 22) (Akamai, Jun 2016)
- Cost is the major reason (43%) that most people in the U.S. cite for not having broadband connections (Pew Survey, Jun/Jul 2015)

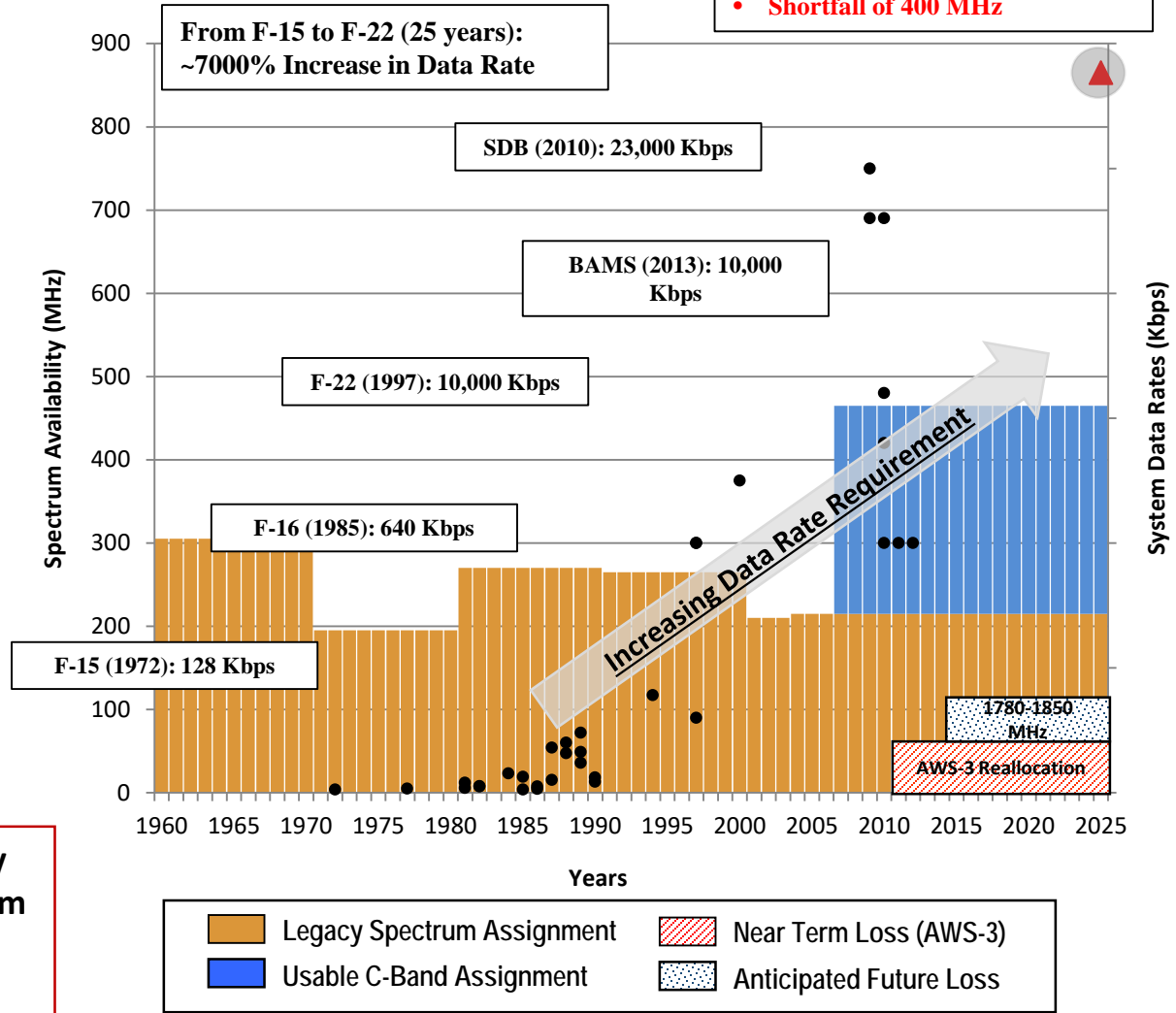
BOTTOM LINE

We need to be more aggressive in order to meet these goals (especially in light of industry's plan to use wireless technology for the "last mile" connection).

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- DoD Requirement of 865 MHz by 2025
- 465 MHz Currently Available
- **Shortfall of 400 MHz**

- Increased complexity of weapon systems coupled with decreased availability of telemetry spectrum limits testing at national ranges (complexity of tests, data downlinks)
 - Available spectrum will be further reduced by potential loss of 1780-1850 MHz and sharing spectrum with commercial users
- Large amounts of data collected onboard system and analyzed post-test
- Continued investment in advanced RF and network technologies can partially mitigate the loss of spectrum
 - Advanced modulation schemes
 - Networked telemetry
 - Non-traditional portions of the RF spectrum (e.g. C-band, Ka/Ku-Band)



Increased Weapon System Complexity and Reductions in Available RF Spectrum Limit the Amount and Types of T&E Missions a Range Can Support

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Advanced Wireless Services – 3 (AWS-3) Spectrum Auction Value

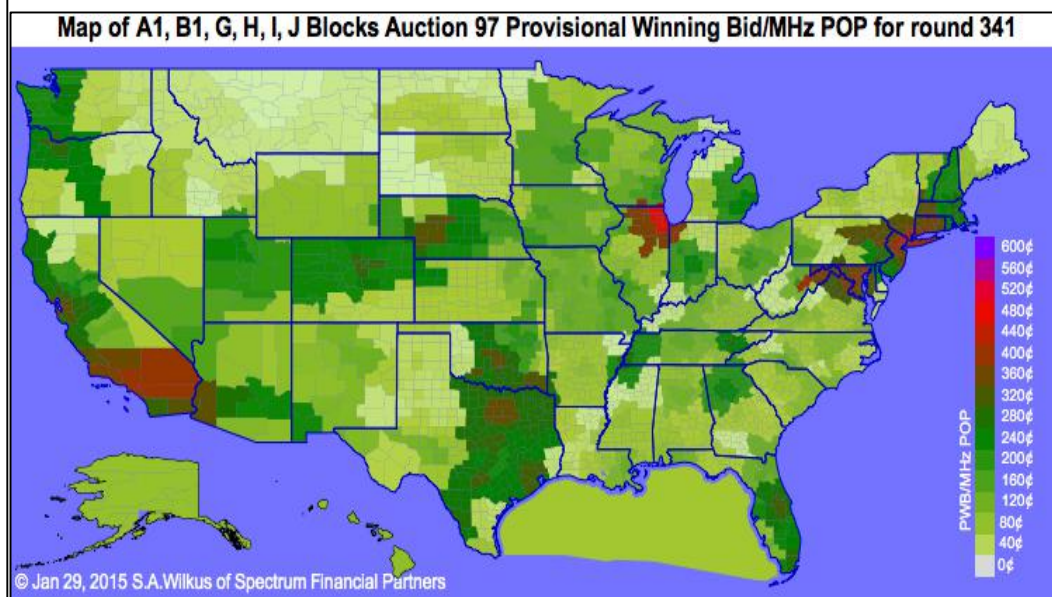
\$50B

\$40B

\$30B

\$20B

\$10B



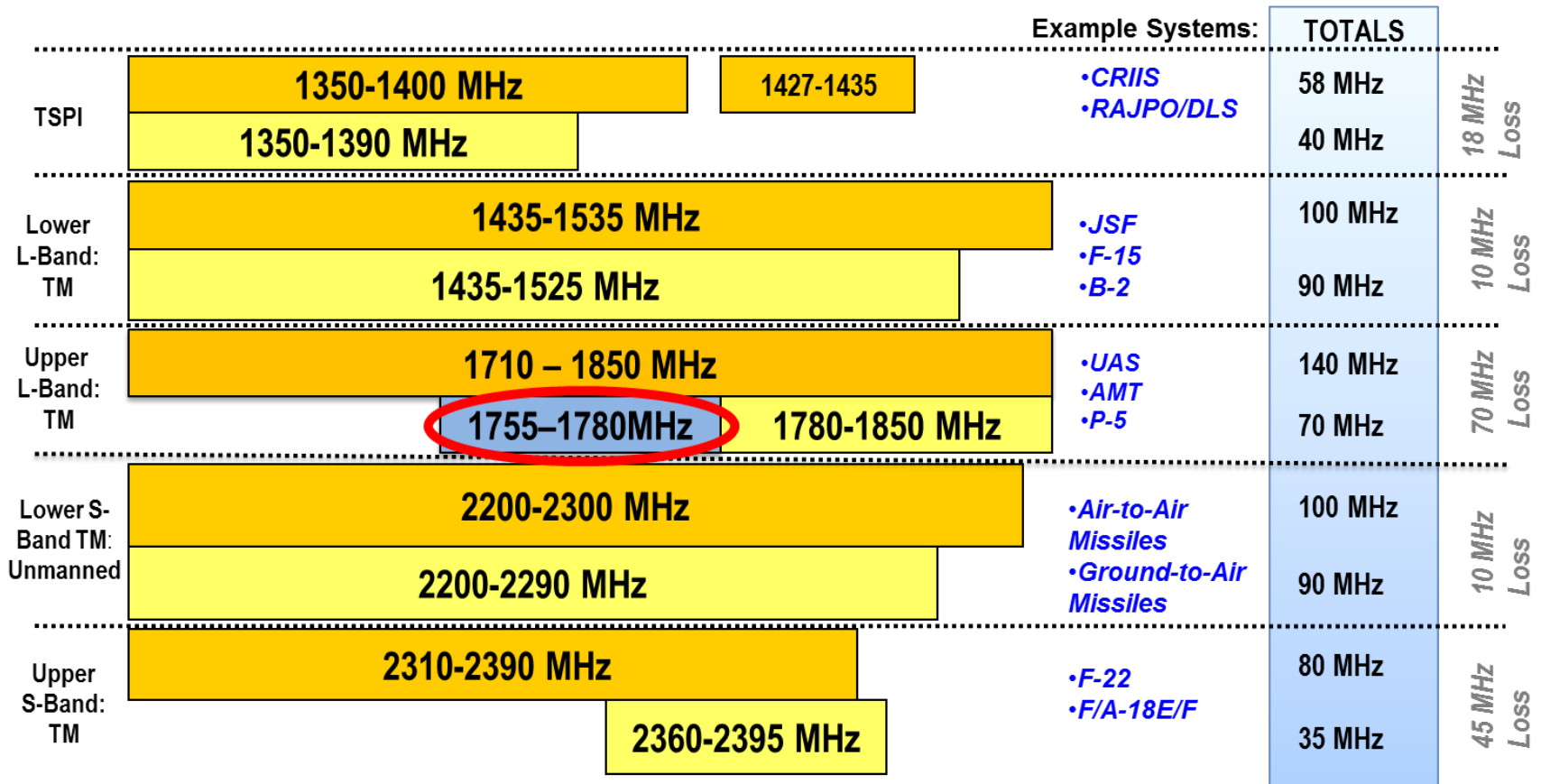
Total Winning Bids*
\$44.89B

Optimistic Predictions
~\$18B

FCC Reserve Price
~\$10B

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AWS-3 Spectrum Auction (1750-1780 MHz) T&E RF Spectrum Allocations – TSPI, L-Band, S-Band



Historic RF Spectrum Allocations
 Current RF Spectrum Allocations

TSPI: Time, Space, Position Information
 TM: Telemetry

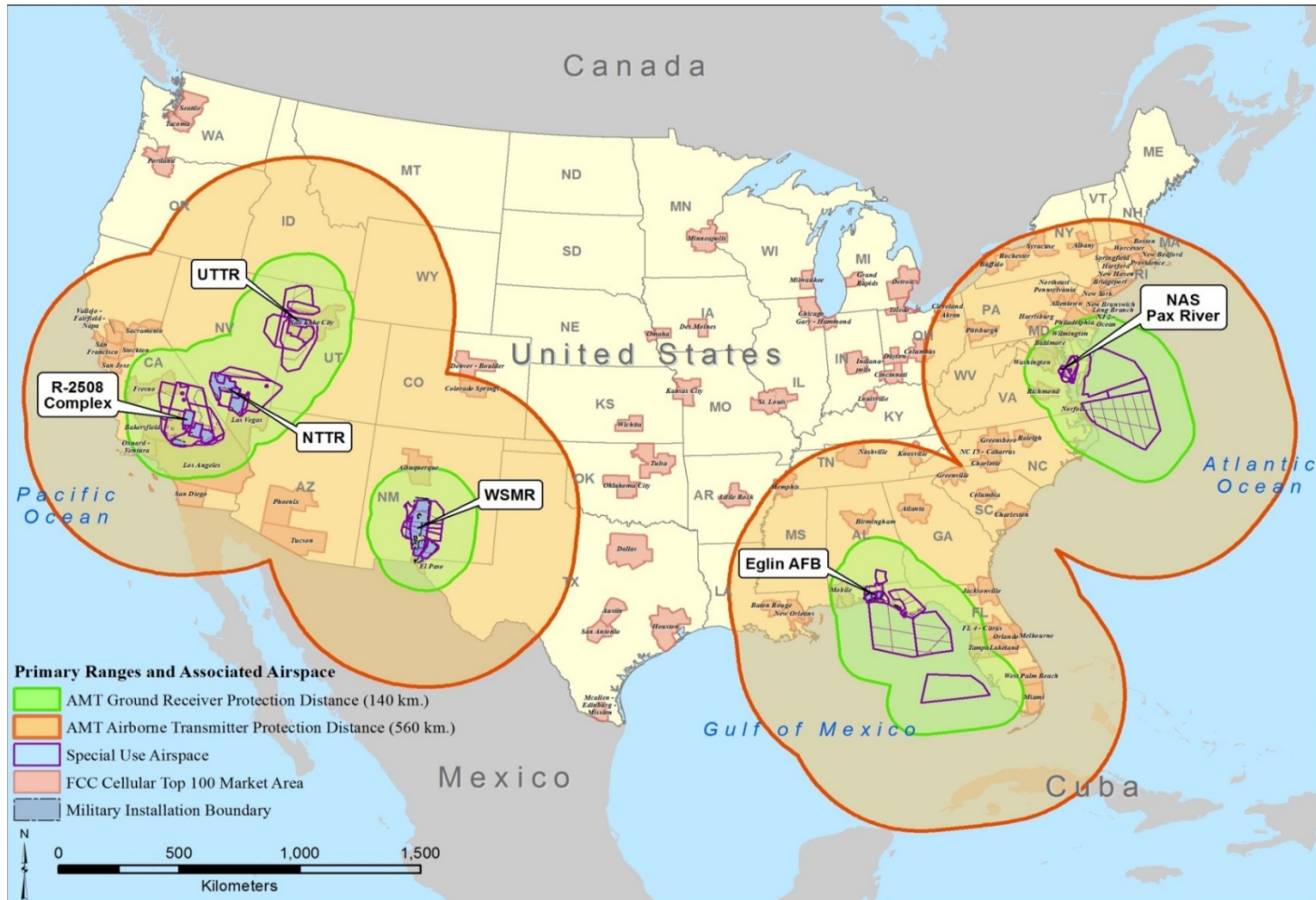
325 MHz Available

AWS-3 Spectrum Loss 2014; To Be Vacated NLT 2Q FY26

153 MHz Lost (32% Reduction)

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1755-1780 MHz Transition Plan DOD AMT Receiver & Airborne Transmitter Protection Distance



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- **Vacate the 1755-1780 MHz band in a timely and smooth transition**
- **Compatible air and ground capabilities between SW and Gulf Ranges**
 - Edwards and Eglin jets can be supported at each others Test Ranges
 - Maintain compatibility in step with shared Navy and Army Test Ranges SRF upgrades
- **Continue to operate in remaining spectrum by operating efficiently and effectively.**
 - **Multi-Band**
 - **Multi- Mode**
 - **Controlled in real-time**
 - **Spectrum Monitoring**

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Ground Systems Upgrades

- Telemetry receivers will be replaced or modified to be more band agile and capable of supporting more bandwidth efficient modulation methods. Other capabilities will be considered to maintain TM data quality.
 - Telemetry antenna systems will be modified to be band agile, and desensitized to commercial operations in the 1755-1780 MHz band, and be bi-directional capable to control test article AMT transmitters.
- **Band Agile**
 - 1435-1525 MHz
 - 1780-1850 MHz
 - 2200-2395 MHz
 - 4400-4940 MHz
 - 5091-5150 MHz
 - **Modulations**
 - PCM/FM
 - SOQPSK
 - ARTM CPM
 - **Filters**
 - TBD for LTE OOB NASCTN study and Adjacent Band Interference (ABI) Edwards RCC Lab study
 - **Coding (selectable)**
 - Space Time Coding (STC)
 - Low Density Parity Check (LDPC)
 - **Real-time Controlled**
 - Command and Control of AMT transmitters

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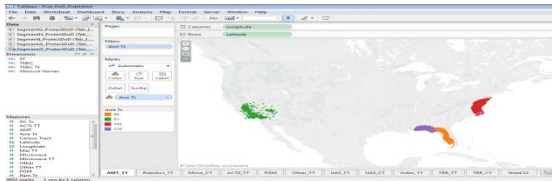
Airborne Systems Upgrades

- Test Articles (aircraft) will require modifications
 - Multi-Band Multi-Mode transmitters to improve frequency agility and implement bandwidth efficient modulation methods
 - Transceivers to facilitate control of AMT transmitter parameters
- **Band Agile**
 - 1435-1525 MHz
 - 1780-1850 MHz
 - 2200-2395 MHz
 - 4400-4940 MHz
 - 5091-5150 MHz
- **Modulations**
 - PCM/FM
 - SOQPSK
 - ARTM CPM
- **~Any power**
 - Nominally 5-20 W
 - Split to Upper and Lower Ants
- **Coding (selectable)**
 - STC
 - LDPC
- **Real-time Controlled**
 - Will interface Command and Control System with Transmitter

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Shared Use Prior to AMT Migration via A New WEB-based Coordination Portal

- FCC Public Notice (DA 14-1023, 18 July 2014) provided guidance regarding coordination between Federal/non-Federal shared use of the 1755-1780 MHz band. This coordination between the commercial LTE users and the current DoD AMT operations will be done through a **Portal**.



This image provides graphical depiction of the coordination zones associated with DoD AMT systems operating in the 1755-1780 MHz band.

- Exclusion zones that are laid out will protect AMT from the AWS-3 LTE deployments proposed for operation within the coordination zones of an existing DoD AMT station. These zones are varied depending on locale (roughly 80 kilometers for our Edwards AFB) from the boundaries of our restricted airspace and warning areas. The DoD Portal is being set up to coordinate and facilitate industry requests to deploy systems INSIDE these exclusion zones prior to the completion of our transition out of the 1755-1780 MHz band into the 1780-1850 MHz band (i.e., 102 months after our initial receipt of auction migration funds in June 2016.)

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What Happens If We Say “NO”? 1

- For example, if AT&T comes in and proposes to deploy a 4G/LTE network within 60-80 kilometers of our Edwards AFB before 2022, if the data/final analysis flashes RED we will say “NO.” Our ability to say “NO” is directly related to the approved Service Transition plans that were approved by NTIA, FCC and the Office of Management and Budget (OMB). OMB approved these plans on behalf of the White House.
- The political pressure will be there but a significant amount of pressure by the FCC and OMB is protecting us as well. The DoD Chief Information Office is using the fact that the NTIA, FCC & OMB approved these Service transition plans (per Public Law) and will insist they uphold those agreements.

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What Happens If We Say “NO”? 2

- When DoD/a service does not support the carrier request (“NO”) and the carrier still pursues access, this will key a separate process to get the National Advanced Spectrum and Communications Test Network (NASCTN) involved to see if there is anything that can be done to accommodate compatible operations with the incumbent Federal systems.
- The NASCTN was established by the Department of Commerce in 2015 in order to organize a trusted, collaborative national network and capability for Federal, academic, and commercial spectrum users that would provide testing, modeling and analysis necessary to develop and deploy spectrum-sharing technologies and inform future spectrum policy and regulations.

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QUESTIONS?