

hydrology model. This spacing was primarily dictated by the range of the aircraft. For the SNOTEL multipass flights, each red line represents five flight lines offset by 100m. These measurements will provide sufficient coverage for us to compare repeat lines with the SNOTEL sensors. The orange square consists of variable terrain. The NE and SW portions of the area consists of various levels of vegetation and relief. The relatively flat and tree-less area in the middle will help us verify snow depth measurements in the vegetated and steep terrain. We plan to fly three parallel tracks across this area with five repeat lines per track. Finally, the blue lines represent relatively flat and tree-less valleys that feed into the stream gauge locations. The length of each valley will be flown once. Ideally, all flights will be flown at 500 m above the highest terrain on a given flight line.

<image002.png>

They have requested that we coordinate and obtain a written consent from you for the 12.2 -12.7 bands prior to the issuance of this permit. I have attached the proposed flight lines in and around Black Hills.

Please feel free to contact me via email or at the number below with any questions.

Thank you for your time.

Best Regards,

Jennifer

Jennifer Laverentz
Administrative Manager
Center for Remote Sensing of Ice Sheets
2335 Irving Hill Road Rm. 334
Lawrence, Kansas 66045
Phone (785) 864-7722
Fax (785) 864-7753
cresis.ku.edu

<Flight_Test_1_From
Matlab_Code.kml><Flight_Test_2_From_Matlab_Code.kml><Flight_Test_3.kml
>

From: [Londono, Jaime](#)
To: [Laverentz, Jennifer](#)
Cc: [BandaSchulz, Jose](#); [Minea, Alison](#)
Subject: RE: Request for permission to radiate for Snow Radar
Date: Monday, December 16, 2019 12:11:17 PM

Dear Jennifer,

We agree with your temporary testing for the period of January to February for the operational conditions that you have set forth in your E-mail. If the testing causes any interference into the EchoStar/DISH satellite services your organization will suspend the testing and EchoStar and your organization agrees to work out a plan to resolve these interference issues prior to continuing the testing.

Best regards,

Jaime Londono

*VP, Advanced Programs
and Spectrum Management*

From: Laverentz, Jennifer <jenlav@ku.edu>
Sent: Thursday, December 12, 2019 1:36 PM
To: Londono, Jaime <Jaime.Londono@echostar.com>
Subject: FW: Request for permission to radiate for Snow Radar

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Jamie,

Please see attached and below.

Jennifer

From: Arnold, Emily J <earnold@ku.edu>
Sent: Thursday, December 12, 2019 2:27 PM
To: Laverentz, Jennifer <jenlav@ku.edu>
Subject: RE: Request for permission to radiate for Snow Radar

Hi Jennifer,

Please forward my response to Jaime (answers in red below). I'm happy to answer any other questions he might have.

From: Laverentz, Jennifer <jenlav@ku.edu>
Sent: Thursday, December 12, 2019 12:50 PM

To: Arnold, Emily J <earnold@ku.edu>

Subject: FW: Request for permission to radiate for Snow Radar

From: Londono, Jaime <Jaime.Londono@echostar.com>

Sent: Thursday, December 12, 2019 12:47 PM

To: Laverentz, Jennifer <jenlav@ku.edu>

Cc: BandaSchulz, Jose <Jose.BandaSchulz@echostar.com>

Subject: RE: Request for permission to radiate for Snow Radar

Jennifer,

Can you please provide me some information on the transmit antenna:

- Is it directional or Omni antenna

Directional

- If it directional what are sidelobes, off-axis gain performance

First sidelobes are on the order of -10 dB in the E-plan and -20 dB in the H-plane @ ~60 deg. I have attached the datasheet of the antenna for your reference.

- The transmit power of 0.1 W that is at the output of the antenna.

Correct

- I guess the antenna is pointed straight to the ground.

Correct

Should not be a problem giving you an answer by tomorrow. In the event we cannot work out all the all the details, we should be able to provide you a response that will allow you to get back to the FCC by Friday. Our response could be structured in a way that indicates that EchoStar agrees to this temporary testing and that your organization agrees that if the testing causes any interference into the EchoStar/DISH satellite services your organization will suspend the testing and EchoStar and yourselves agrees to work out a plan to resolve these interference issues so that you can continue your testing. (We will continue to exchange details if required).

Best regards,

Jaime

From: Laverentz, Jennifer <jenlav@ku.edu>

Sent: Monday, December 9, 2019 3:26 PM

To: Londono, Jaime <Jaime.Londono@echostar.com>

Cc: BandaSchulz, Jose <Jose.BandaSchulz@echostar.com>

Subject: RE: Request for permission to radiate for Snow Radar

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Jamie,

Thank you. We are anxious to start the field test in Lawrence right after the New Year. Please let Dr. Arnold or me know if you have any further questions.

Jennifer

From: Londono, Jaime <Jaime.Londono@echostar.com>
Sent: Thursday, December 5, 2019 3:41 PM
To: Laverentz, Jennifer <jenlav@ku.edu>
Cc: BandaSchulz, Jose <Jose.BandaSchulz@echostar.com>
Subject: RE: Request for permission to radiate for Snow Radar

Dear Jennifer,

We will take a look at this and will back to you.

Best regards,

Jaime Londono

*VP, Advanced Programs
and Spectrum Management*

From: Laverentz, Jennifer <jenlav@ku.edu>
Sent: Wednesday, December 4, 2019 1:09 PM
To: Londono, Jaime <Jaime.Londono@echostar.com>
Subject: Request for permission to radiate for Snow Radar

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Jamie,

I am following up on our two requests for testing our Snow Radar for our NOAA grant. The FCC has requested that we coordinate and obtain a written consent from you for the 12.2 -12.7 bands prior to the issuance of this permit.

Please feel free to contact me via email or at the number below with any questions.

Thank you for your time.

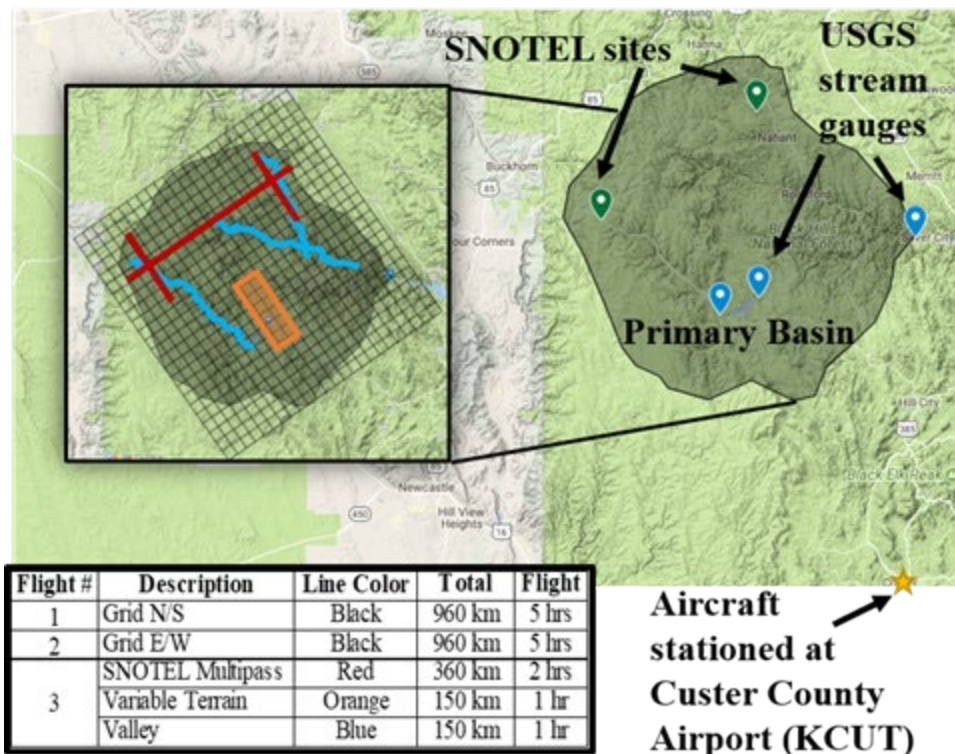
Best Regards,

Jennifer

Jennifer Laverentz
Administrative Manager
Center for Remote Sensing of Ice Sheets
2335 Irving Hill Road Rm. 334
Lawrence, Kansas 66045
Phone (785) 864-7722
Fax (785) 864-7753
crisis.ku.edu

Proposed Locations: Measurements will be conducted within a 17 mile radius of (44° 4'56.25"N, 103°49'3.42"W). The KU Cessna C-172 will fly three types of missions (KML files with preliminary way points attached) of approximately 4-5 hours each, as indicated in the table in the figure and illustrated by the inset image. Flights 1 and 2 construct a grid of flight lines spaced 1.5 km that will be used for assimilation into the hydrology model. This spacing was primarily dictated by the range of the aircraft. For the SNOTEL multipass flights, each red line represents five flight lines offset by 100m. These measurements will provide sufficient coverage for us to compare repeat lines with the SNOTEL sensors. The orange square consists of variable terrain. The NE and SW portions of the area

consists of various levels of vegetation and relief. The relatively flat and tree-less area in the middle will help us verify snow depth measurements in the vegetated and steep terrain. We plan to fly three parallel tracks across this area with five repeat lines per track. Finally, the blue lines represent relatively flat and tree-less valleys that feed into the stream gauge locations. The length of each valley will be flown once. Ideally, all flights will be flown at 500 m above the highest terrain on a given flight line.



They have requested that we coordinate and obtain a written consent from you prior to the issuance of this permit. I have attached the proposed flight lines in and around Black Hills.

Please feel free to contact me via email or at the number below with any questions.

Thank you for your time.

Best Regards,

Jennifer

Jennifer Laverentz
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 Lawrence, Kansas 66045
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Jessica B. Lyons
Assistant Vice President -
Senior Legal Counsel

AT&T Services, Inc.
1120 20th Street NW, Suite 1000
Washington, D.C. 20036
Phone 202 457-2100
jessica.lyons@att.com

December 5, 2019

Jennifer Laverentz
University of Kansas
2335 Irving Hill Rd.
Lawrence, KS 66045

Re: University of Kansas Experimental License Application

Dear Ms. Laverentz,

AT&T Mobility LLC, on behalf of its affiliates (collectively "AT&T") has reviewed the University of Kansas CReSIS' ("KU") proposal to conduct aircraft-mounted radar systems to measure snow depth in the Black Hills National Forest and Lake Clinton.¹ KU proposes a series of brief flights that would test radars operating between 2 and 18 GHz. This frequency range overlaps several licenses held by AT&T Mobility, as well as the 12.2-12.7 GHz receive band used by DIRECTV. AT&T consents to this testing subject to the conditions and limitations below.

First, AT&T's consent is conditioned on KU's adherence to the technical parameters both included in its draft experimental license applications and set forth in part below:

	Lake Clinton Test	Black Hills National Forest Test
Test Location	Within a .5 mile radius of (38°55'12.7"N 95°20'59.9"W), altitude TBD but ideally at 500m above highest terrain on flight line	Within a 17 mile radius of (44° 4'56.25"N, 103°49'3.42"W), altitude TBD but ideally at 500m above highest terrain on flight line
Radar Operating Frequency	2-18 GHz	2-18 GHz
Radar Output Power	0.1W	0.1W
Radar Sweep Duration	250 us	250 us
Radar Pulse Repetition Frequency	2 KHz	2 KHz

¹ See 2042-EX-ST-2019 and 2021-EX-ST 2019.

Second, AT&T's consent is conditioned on KU's confining its testing to the 2-18 GHz band, and on its intermittent use of this spectrum for testing purposes only, as outlined in KU's request.

Third, AT&T's consent is conditioned on KU's receipt of valid experimental authorizations for its respective tests from the Federal Communications Commission, and on KU's adherence to the terms of its licenses and any conditions specified by the FCC. AT&T's consent is void upon the expiration or revocation of either experimental authorization.

Fourth, AT&T's consent is subject to the condition that KU immediately cease transmissions in the event of interference to AT&T's network. To facilitate compliance with this condition, KU has supplied the following 24/7 point of contact that will receive notice of interference and facilitate resolution of interference issues.

Dr. Emily J. Arnold
1530 W. 15th St
Lawrence, KS 66045-7618
earnold@ku.edu
(913) 481-5263

AT&T's consent is subject to the conditions and limitations set forth in this letter, as well as KU's acknowledgment of same.

Please contact the undersigned with any questions.

Sincerely,

/s/ Jessica B. Lyons

Jessica B. Lyons
Counsel to AT&T Mobility LLC and
DIRECTV



Jennifer Laverentz
Administrative Manager, University of
Kansas CReSIS