realwireless
independent wireless experts

Coexistence of PDV proposals with Sensus FlexNet systems

Summary of analysis for FCC

July 24, 2015

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Introduction

- Real Wireless is an independent wireless advisory firm engaged by Sensus to analyse the potential impact of PDV proposed rules on existing Sensus FlexNet systems
- We have followed and agree with PDV's approach to modelling the impact of out of band emissions
- However the parameters used are inappropriately optimistic for protecting sensitive systems for CII M2M application
- In consultation with Sensus and Southern Company we have adopted more representative parameters for two scenarios:
  - A **moderate** case
  - A **challenging** case

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Our understanding of existing FlexNet and proposed PDV systems

FlexNet

- Long-range
- High reliability
- Narrowband
- Mainly noise-limited
- Fixed links
- Critical Information Infrastructure
- Thousands of base stations, tens of millions of endpoints
- Time-sensitive data

PDV

- LTE-based
- Wideband
- Mobile and fixed terminals (at higher than standard powers)
- Nationwide
- No guard band

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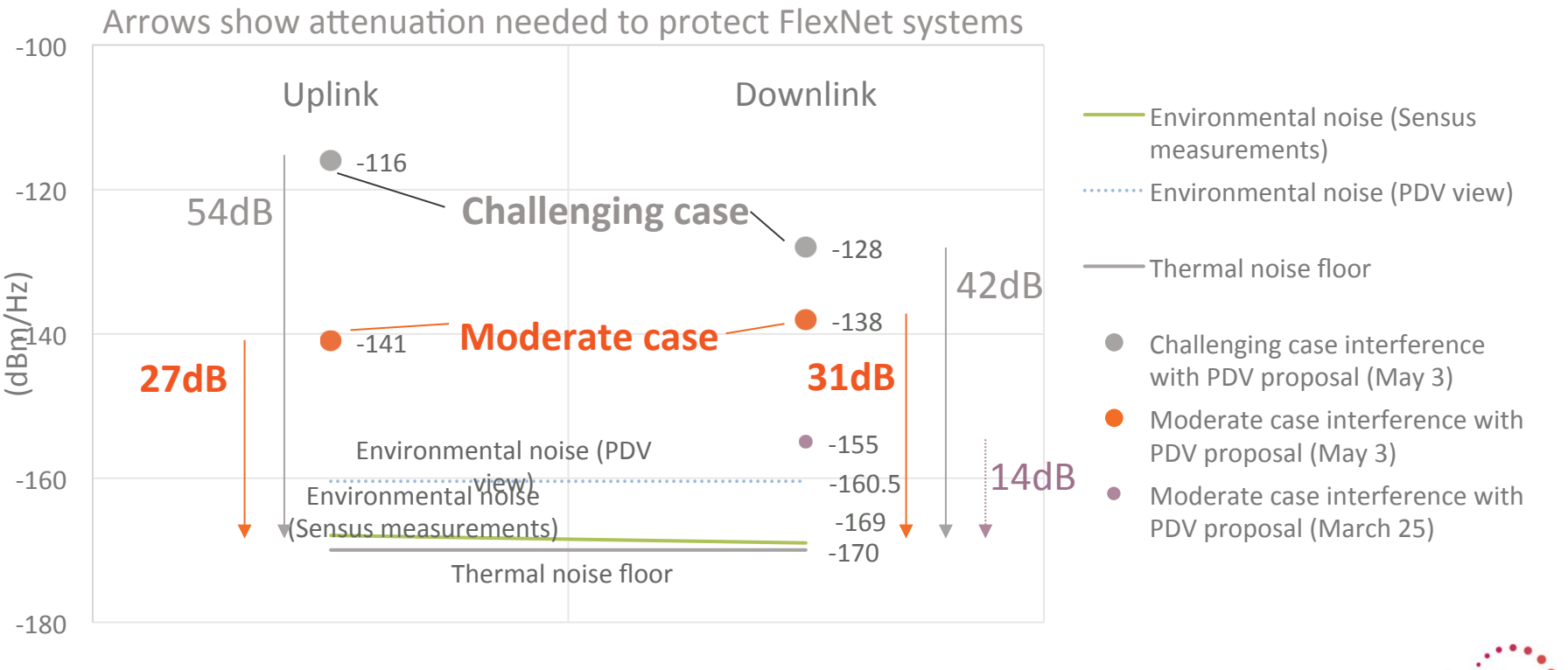
Summary of findings

- Our analysis takes a conservative, realistic view of coexistence parameters
- PDV's analysis adopts highly optimistic parameters



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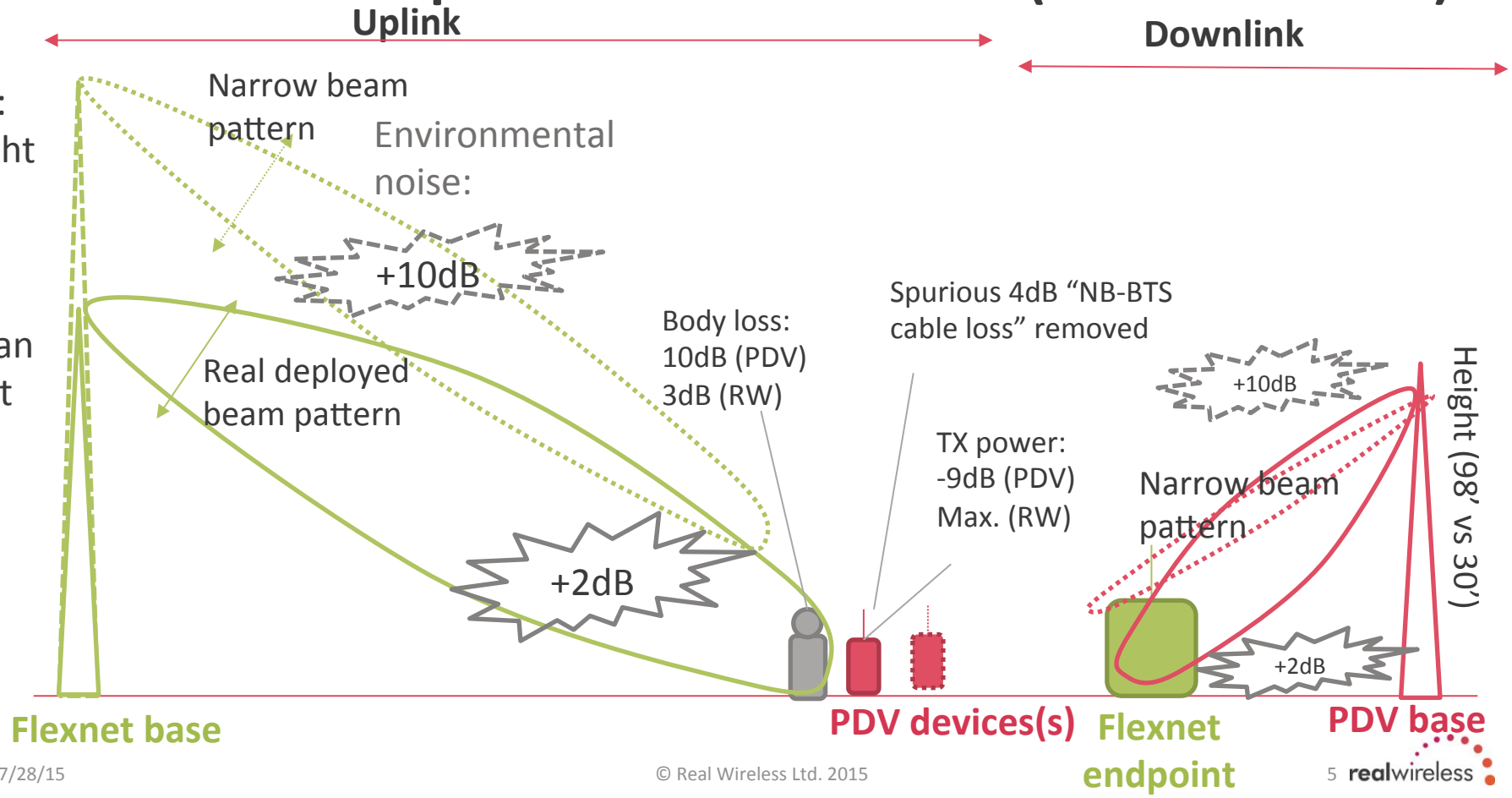
Main sources of parameter differences (moderate case)



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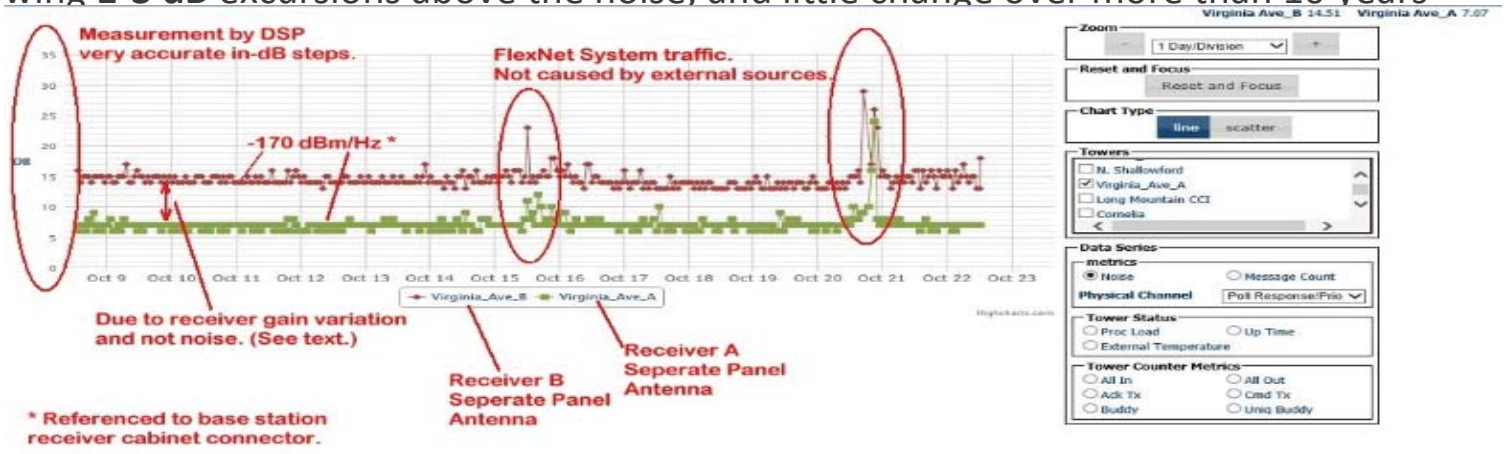
Environmental noise margin

- The basic noise floor seen at a Sensus base station is at thermal noise PSD (kT = -174dBm/Hz) plus the base station system noise figure (4dB based on Sensus data) i.e. **-170 dBm/Hz**
- The noise floor *may* be raised at individual sites by environmental noise
- PDV has included a noise margin of 10dB, resulting in a 9.5 dB noise rise to **-160.5 dBm/Hz** based on their reading of a collection of generalised studies noting: "*studies…were difficult to find...deliver values from a limited amount of samples…had to be extrapolated*" suggesting a low confidence in their chosen value.
- Sensus have made explicit measurements at several base stations over several years showing **1-3 dB** excursions above the noise, and little change over more than 10 years

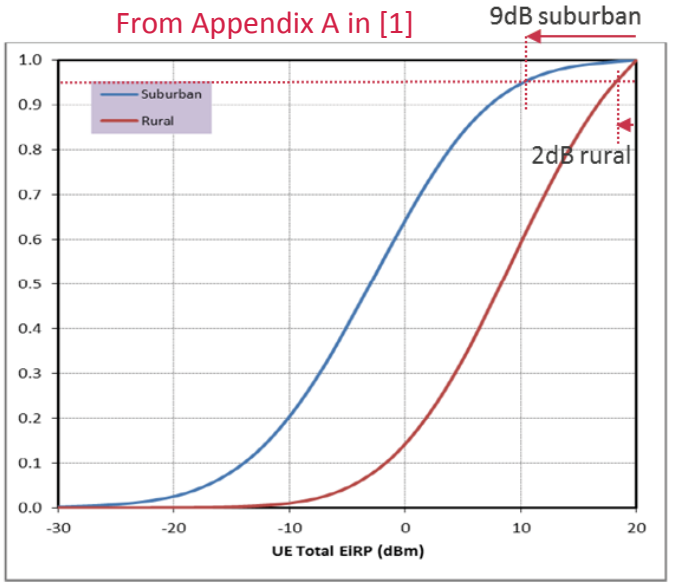


Impact: 8-10dB higher susceptibility to interference

LTE UE power backoff

- PDV have assumed that the transmit power of the UE is reduced by **9dB**, citing an NTIA CSMAC report [1] on coordinating satellite Earth stations with LTE
- The calculations related to the statistics of *mobile* UEs distributed over a wide coverage area and many cells.
- They do not capture the impact of interferers with fixed locations, where interference may persist over long periods, transmitting at or close to maximum power
- PDV have chosen the suburban curve. Many FlexNet systems operate in rural areas. The rural backoff value is closer to 2dB
- PDV have chosen the 95% probability level.
- Hence we believe it is appropriate to evaluate interference based on **0-2dB backoff**

From Appendix A in [1]



[1] NTIA CSMAC WG-1 Final Report link

Impact : 7-9 dB worse interference

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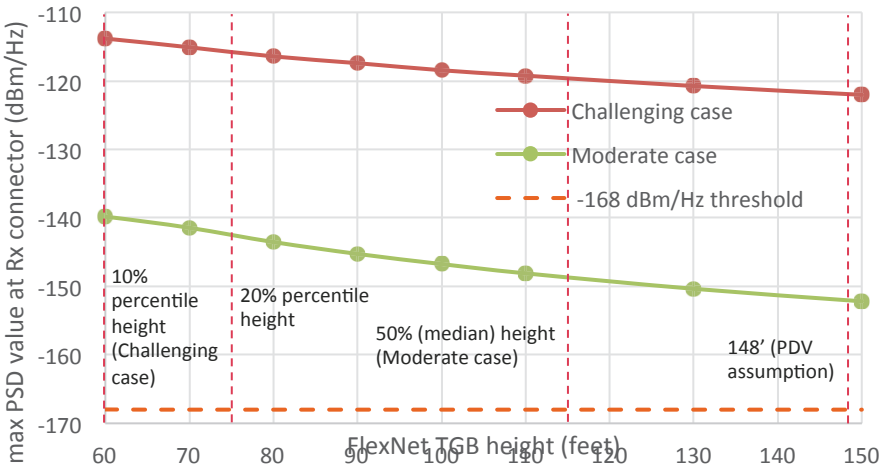
Effect of FlexNet base antenna height

- We have varied the height of the Sensus TGB base station to determine the sensitivity to this parameter
- The graph shows the value of the highest PSD encountered at any distance for a given TGB antenna height
- There is around 10 dB of variation between the PDV assumption and our challenging case (which represents protection of 90% of all Sensus TGBs)
- There is around 5dB of variation between our moderate and challenging cases
- This points to the potential for a site-specific protection level
- However in all cases the PSD remains above the required protection level



Impact :5-10 dB worse interference

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Summary of findings

1. We **agree broadly with PDV's calculation methodology**
2. We found that **the interference threshold proposed by PDV is inappropriate** - our review of field measurements conducted by Sensus suggests a threshold around **-168 dBm/Hz** rather than the -**160 dBm/Hz** proposed by PDV
3. We have conducted a detailed review of the calculation parameters proposed by PDV and found that in many cases **the parameters are inappropriate**, resulting in a far greater level of interference than PDV has suggested
4. The table below summarises our findings regarding the extra attenuation needed even in moderate cases **tens of dB extra attenuation is needed**
5. Additionally the **test conditions for specifying emission limits need to be properly specified** to account for the measured characteristics of real LTE devices: this could create a 7dB increase in emissions compared with the test conditions specified by PDV

Interference mode	Rule proposal		Challenging Case	Moderate Case
Uplink	03-May	PSD dBm/Hz	-116	-141
		Extra attenuation needed (dB)	54 dB	**27 dB**
Downlink	25-Mar	PSD dBm/Hz	-146	-155
		Extra attenuation needed (dB)	24 dB	14 dB
	03-May	PSD dBm/Hz	-128	-138
		Extra attenuation needed (dB)	42 dB	**31 dB**

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