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ATLANTA, GA
OCTOBER 11-14
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2021 Fall Technical Forum
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Operational Transformation

Machine Learning and Proactive Network Maintenance: Transforming Today's Plant Operations

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2021 Fall Technical Forum
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VIRTUAL EXPERIENCE
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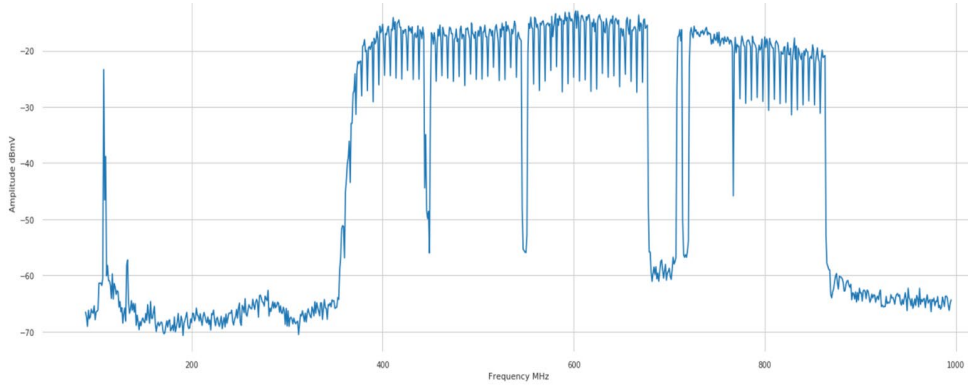
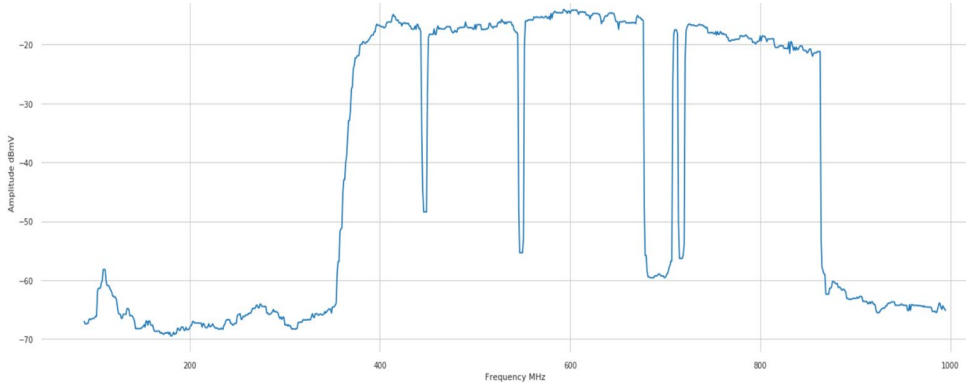
Agenda

- How are successfully implementing machine learning with PNM?
- Integration ML with Spectral Impairment Detection (SID)
- Clustering FBC Data
- Making FBC Data Actionable in the Field
- Clustering RxMER Data & Making it Actionable in the Field
- The Future of ML – Supervised Learning
- Wrap up

Processing Raw Data with Machine Learning





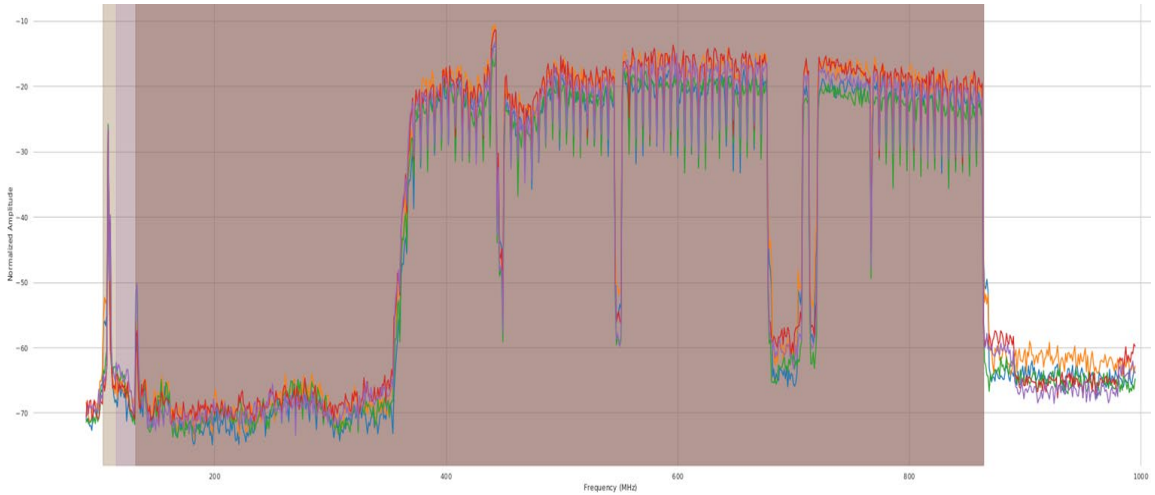

```
data = [x[::DOWNSCALING_FACTOR] for x in df[cluster_col].values.tolist()]
df['cluster'] = DBSCAN(eps=EPS_DBSCAN, min_samples=MIN_SAMPLES_IN_CLUSTER).fit(data).labels_
```

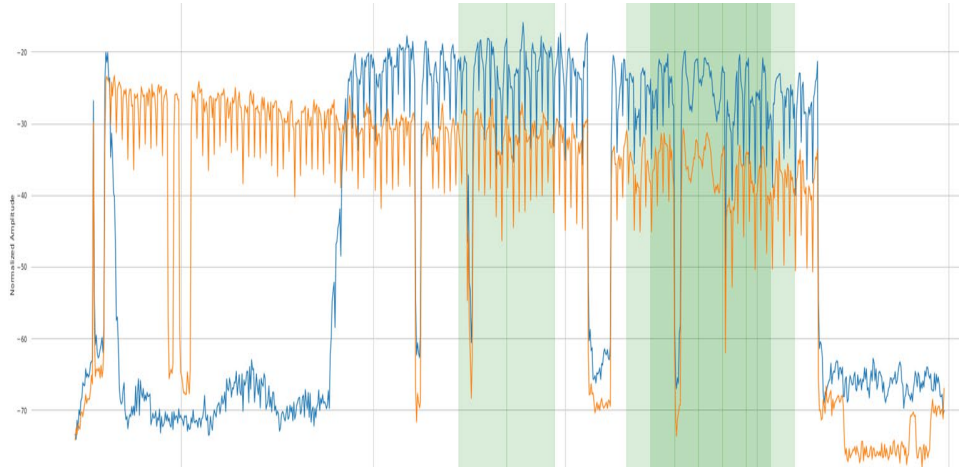
Nothing new, please drive through

Getting OSP Clusters – But what do they mean?

In home (top) clusters and good clusters (bottom)

Clustering with SID Overlay (wave & suckout)





But SID is so inaccurate, right?

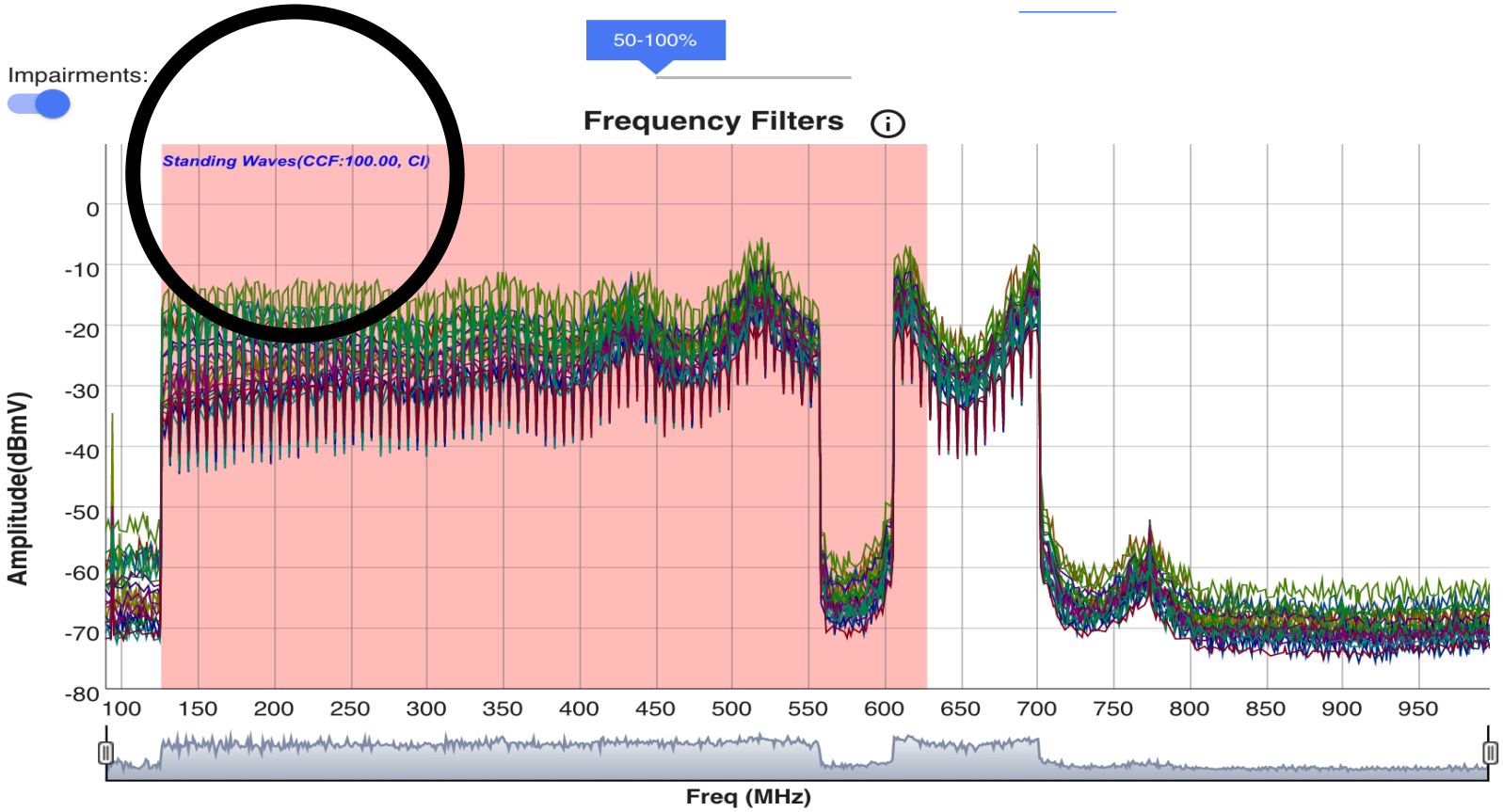
Coming together – We find water in cable!

FBC Correlation Group

Select Zone

Enter at least 3 characters to search node or correlation

Node	Correlation	Modem Count	Impairements
Muirfield Digital	CBR8: Muirfield Digital Cluster	30	Standing Waves,Suckout
Freewood Digital	CBR8: Freewood Digital Cluster 0	26	Standing Waves
Digital	Digital Cluster 1	26	Adjacency
	CBR8:		



CCF : Correlated Confidence Factor, CF : Confidence Factor, CI : Correlated Impairments

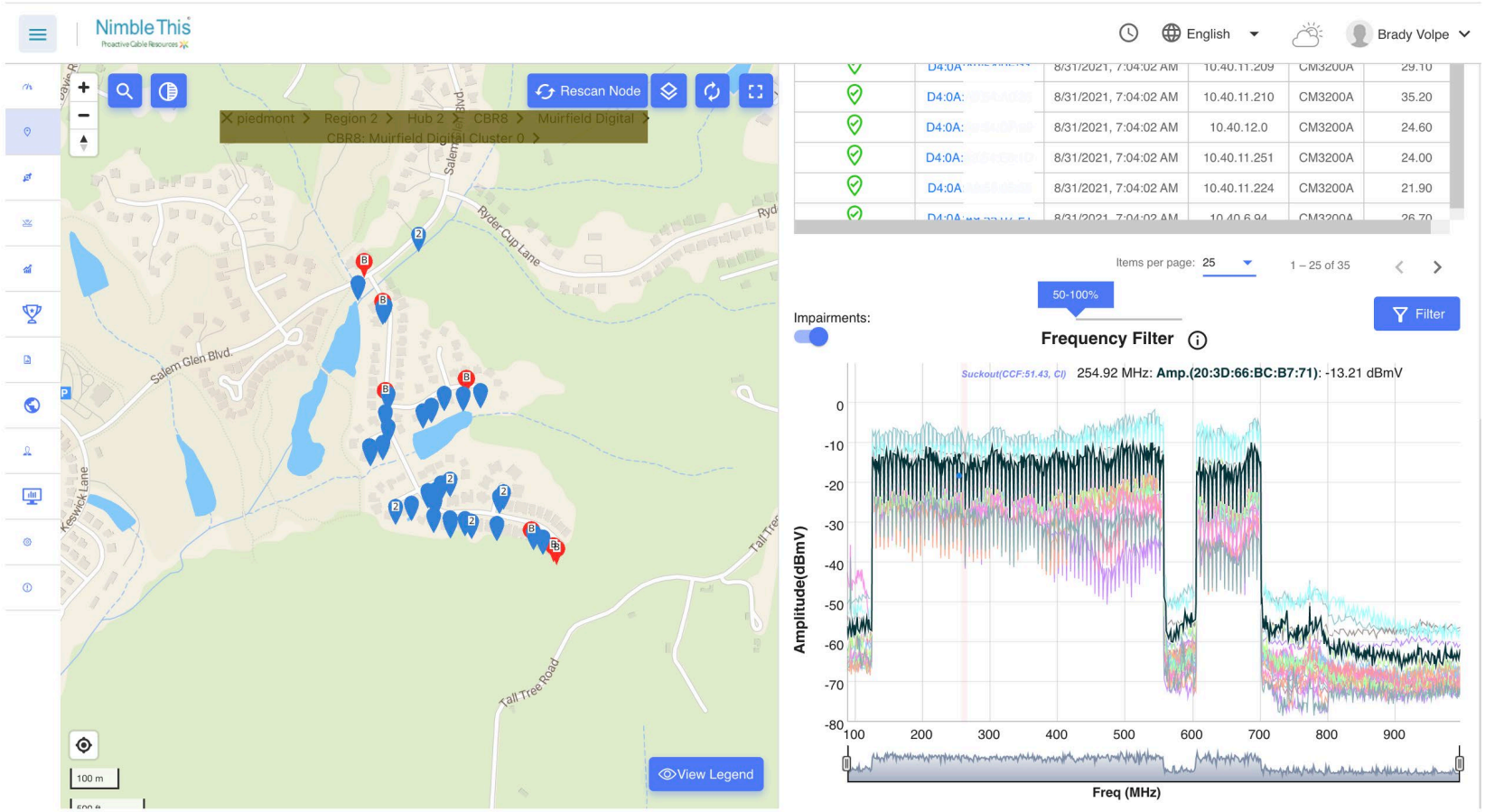
Make it Actionable

FBC Correlation Group

Select Zone

Enter at least 3 characters to search node or correlation

Node	Correlation	Modem Count	Impairments
Main Digital	CBR8: Main Digital Cluster 0	47	Adjacency
Second Digital	CBR8: Second Digital Cluster 0	37	Adjacency
Local Digital	CBR8: Local Digital Cluster 0	36	Standing Waves
Murry Digital	CBR8: Murry Digital Cluster 0	35	Suckout
Jeanette Digital	CBR8: Jeanette Digital Cluster 0	23	Adjacency
Sanchez Digital	CBR8: Sanchez Digital Cluster 0	23	Adjacency,Standing Waves



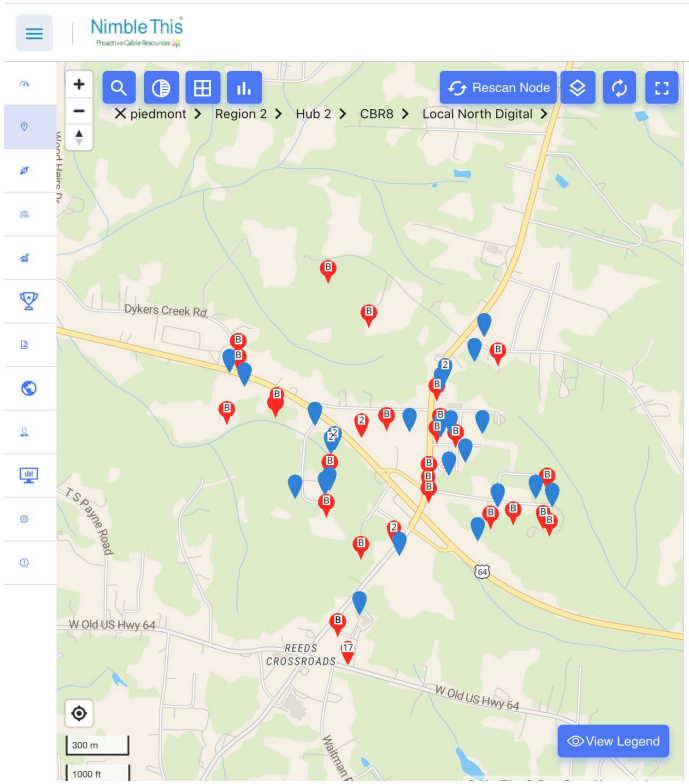
ML Making RxMER Data Actionable

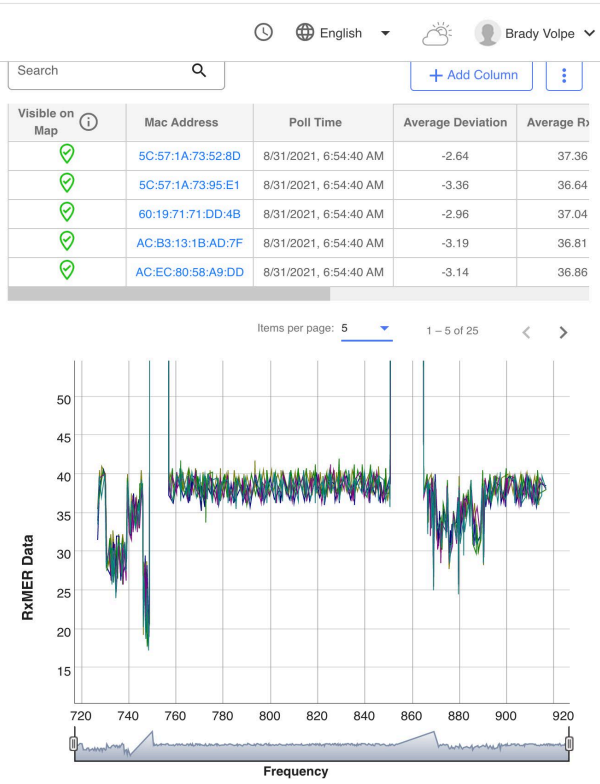
RxMER Correlation Group

Select Zone

Enter at least 3 characters to search node or correlation

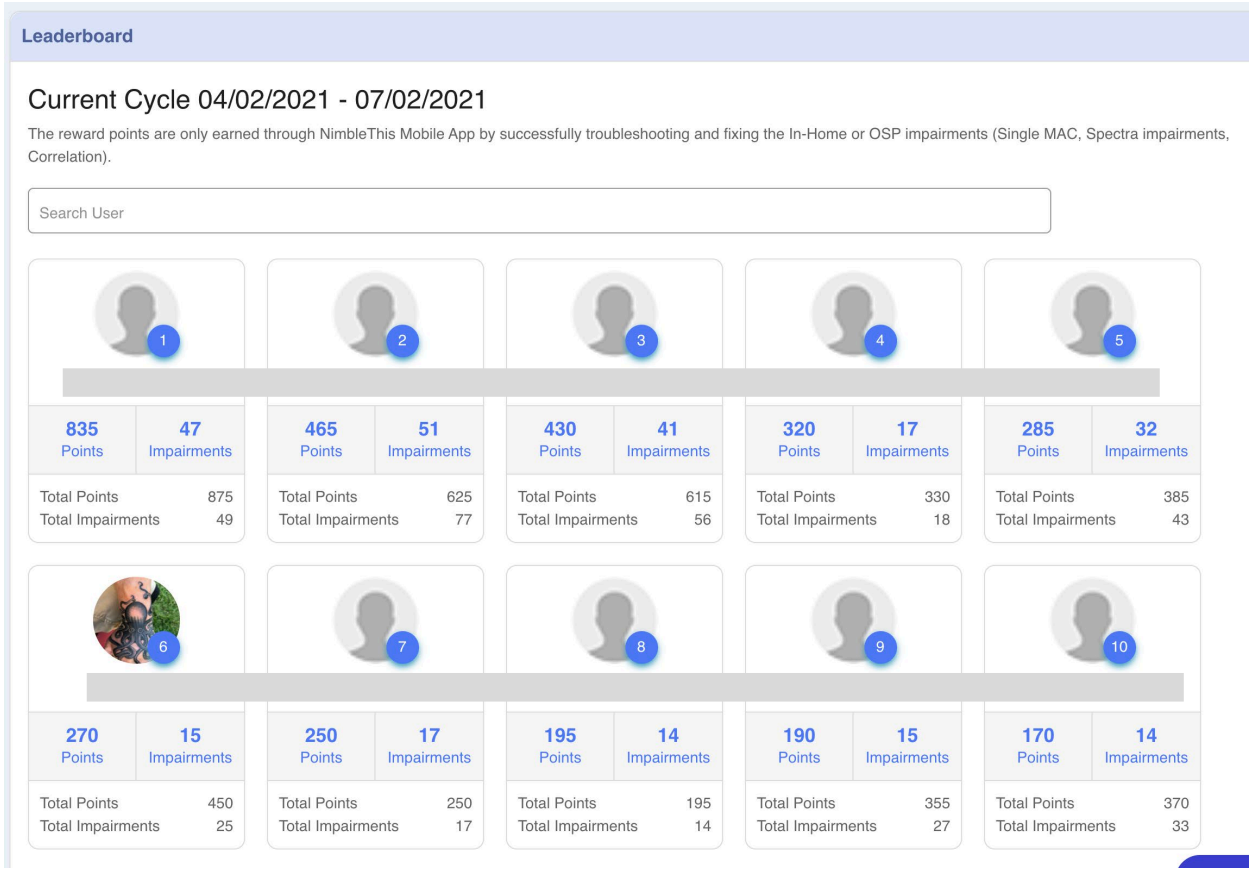
Node	Correlation	Modem Count	Average RxMER
North Digital	CBR8: North Digital Cluster 0 :Average RxMeR 40.78	5	40.78





The Future – Supervised Learning

- Users are our most valuable resource to label impairments
- Users are incentivized via gamification
- Impairments are fixed and impairments are labeled
- Labeled data is fed back to ML models which which soon be used to tell technicians what the likely root cause is (i.e., bad drop, connector, etc.)



Wrap it up

- Looking at individual FBC data is great, but…
- Individual FBC data does not show trends
- ML + FBC is now showing us where to roll trucks → This saves $$$ and time
- Our algorithms are applicable to other data, such as RxMER for DOCSIS 3.1
- Greatest benefit from ML → Making things actionable
- Future is supervised learning… with some help

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Thank You!

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