

CLAIMS

What is claimed is:

1. A system for predicting network node failure, the system comprising:
 - a network infrastructure comprising a set of network nodes that provide voice and data services over a network to customer premises;
 - a predictive analytics server comprising a controller and machine readable instructions in a data repository to implement
 - a performance extractor to aggregate performance metrics for the network nodes in the network infrastructure, wherein the performance metrics are aggregated from a plurality of data sources;
 - a model constructor to
 - identify input variables related to a fail condition for the network nodes,
 - train a plurality of models to predict the fail condition for the network nodes using a training set from the extracted performance metrics, wherein each of the plurality of models is fit with at least one of the identified input variables, and
 - validate each of the plurality of trained models using a validation set from the extracted performance metrics; and
 - a forecasting engine to
 - define the fail condition for the network nodes,
 - rate each of the validated models according to predefined criteria, and
 - implement a highest rated model of the validated models to predict the fail condition for the network nodes; and

~~— a provisioning server to configure parameters for the network nodes in the network infrastructure according to the prediction of the fail condition to deploy services to maintain the network nodes.~~

2. The system according to claim 1, wherein the forecasting engine is to prioritize a maintenance schedule for the network nodes in the network infrastructure based on a predicted likelihood of the fail condition for each of the network nodes, the predictions being inputted from the highest rated model at least 48 hours prior to the fail condition for a selected network node.

3. The system according to claim 1, wherein the performance extractor is to aggregate performance metrics from a predetermined time frame at least 48 hours prior to the fail condition for a selected network node.

4. The system according to claim 1, wherein to aggregate the performance metrics for the network nodes, the performance extractor is to aggregate performance metrics including at least one of telemetry data, customer data, call interaction data, and field technician data.

5. The system according to claim 1, wherein the performance extractor is to:
detect the occurrence of the fail condition for the network nodes;
flag each day that the fail condition is detected for at least one of the network nodes; and
remove a flag for each flagged day that is consecutive to a first flagged day.

~~6. The system according to claim 1, wherein to identify input variables related to~~

~~the fail condition, the model constructor is to:~~

derive variables from the extracted performance metrics; and

implement a clustering algorithm to select a number of ranked variables, wherein the clustering algorithm ranks the variables according to predefined criteria.

7. The system according to claim 1, wherein the model constructor is to partition the extracted performance metrics into a training set for training the plurality of models and a validation set that is not used for training the plurality of models, wherein the extracted performance metrics are partitioned using a random sampling algorithm.

8. The system according to claim 1, wherein the plurality of models includes a decision tree model, a neural network model, and a logistic regression model.

9. The system according to claim 1, wherein the forecasting engine is to rate each of the plurality of validated models according to predefined criteria including at least one of a predictive accuracy of each of the validated models, an interpretability of an output of each of the validated models, an efficiency of each of the validated models, a stability and robustness of each of the validated models, a scalability of each of the validated models, and a lift of each of the validated models.

10. A method for predicting failure of network nodes in a network infrastructure, the method comprising:

extracting, by a controller of a predictive analytics server, performance metrics for the network nodes from a plurality of data sources;

~~defining a fail condition for the network nodes;~~

~~identifying input variables related to the fail condition for the network nodes,~~
the input variables being derived from the extracted performance metrics;

training a plurality of models to predict the fail condition for the network nodes using a training set from the extracted performance metrics, wherein each of the plurality of models is fit with at least one of the identified input variables;

validating each of the plurality of trained models using a validation set from the extracted performance metrics, wherein the validating includes rating each of the validated models according to predefined criteria; and

selecting a highest rated model of the validated models to predict the fail condition for the network nodes.

11. The method according to claim 10, comprising:

prioritizing a maintenance schedule for the network nodes in the network infrastructure based on a predicted likelihood of the fail condition for each of the network nodes,

wherein the predicted likelihood of the fail condition is inputted from the highest rated model at least 48 hours prior to the fail condition for a selected network node.

12. The method according to claim 10, wherein extracting the performance metrics comprises extracting performance metrics from a predetermined time frame at least 48 hours prior to the fail condition for a selected network node.

13. The method according to claim 10, wherein extracting the performance metrics include at least one of telemetry data, customer data, call interaction data, and field technician data.

~~14. The method according to claim 10, wherein defining the fail condition comprises:~~

~~detecting the occurrence of the fail condition for the network nodes;~~

~~flagging each day that the fail condition is detected for at least one of the network nodes; and~~

~~removing a flag for each flagged day that is consecutive to a first flagged day.~~

15. The method according to claim 10, wherein identifying input variables related to the fail condition comprises:

deriving variables from the extracted performance metrics; and

implementing a clustering algorithm to select a number of ranked variables, wherein the clustering algorithm ranks the variables according to predefined criteria.

16. The method according to claim 10, wherein training the plurality of models to predict the fail condition comprises training a decision tree model, a neural network model, and a logistic regression model.

17. The method according to claim 10, the predefined criteria includes at least one of a predictive accuracy of each of the validated models, an interpretability of an output of each of the validated models, an efficiency of each of the validated models, a stability and robustness of each of the validated models, a scalability of each of the validated models, and a lift of each of the validated models.

18. A non-transitory computer readable medium on which is stored machine readable instructions to predict failure in network nodes of a network infrastructure,
~~the machine-readable instructions executable by a controller to:~~

~~extract performance metrics for the network nodes from a plurality of data sources, wherein the extracted performance metrics include at one of telemetry data, customer data, call interaction data, and field technician data;~~

~~define a fail condition for the network nodes;~~

~~identify input variables related to the fail condition for the network nodes, the input variables being derived from the extracted performance metrics;~~

~~train a plurality of models to predict the fail condition for the network nodes using a training set from the extracted performance metrics, wherein each of the plurality of models is fit with at least one of the identified input variables;~~

~~validate each of the plurality of trained models using a validation set from the extracted performance metrics, wherein the validating includes rating each of the validated models according to predefined criteria;~~

~~select a highest rated model of the validated models to predict the fail condition for the network nodes; and~~

~~prioritize a maintenance schedule for the network nodes based on a predicted likelihood of the fail condition for each of the network nodes.~~

19. The non-transitory computer readable medium of claim 18, wherein to define the fail condition, the machine readable instructions are further executable by the processor to:

~~detect the occurrence of the fail condition for the network nodes;~~

~~flag each day that the fail condition is detected for at least one of the network nodes; and~~

~~remove a flag for each flagged day that is consecutive to a first flagged day.~~

~~20. The non-transitory computer readable medium of claim 18, wherein to train~~

~~the plurality of models to predict the fail condition, the machine-readable instructions~~
~~are further executable by the processor to train a decision-tree model, a neural-~~
~~network model, and a logistic regression model.~~

CLAIMS

1. A system for predicting network node failure, the system comprising:
a network infrastructure comprising a set of network nodes that
5 provide voice and data services over a network to customer premises;
a predictive analytics server comprising a controller and machine readable
instructions in a data repository to implement
a performance extractor to aggregate performance metrics for the network
nodes in the network infrastructure, wherein the performance metrics are
10 aggregated from a plurality of data sources;
a model constructor to identify input variables related to a fail condition
for the network nodes,
train a plurality of models to predict the fail condition for the network
nodes using a training set from the extracted performance metrics, wherein each
15 of the plurality of models is fit with at least one of the identified input variables,
and validate each of the plurality of trained models using a validation set from
the extracted performance metrics; and
a forecasting engine to define the fail condition for the network nodes,
rate each of the validated models according to pre-defined criteria, and
20 implement a highest rated model of the validated models to predict the fail
condition for the network nodes; and
a provisioning server to configure parameters for the network nodes in the
network infrastructure according to the prediction of the fail condition to deploy
services to maintain the network nodes.

2. The system according to claim 1, wherein the forecasting engine is to
prioritize a maintenance schedule for the network nodes in the network
infrastructure based on a predicted likelihood of the fail condition for each
of the network nodes, the predictions being inputted from the highest rated

model at least 48 hours prior to the fail condition for a selected network node.

3. The system according to claim 1, wherein the performance extractor is to aggregate performance metrics from a predetermined time frame at least 48 hours prior to the fail condition for a selected network node.

4. The system according to claim 1, wherein to aggregate the performance metrics for the network nodes, the performance extractor is to aggregate performance metrics including at least one of telemetry data, customer data, call interaction data, and field technician data.

5. The system according to claim 1, wherein the performance extractor is to:
detect the occurrence of the fail condition for the network nodes;
flag each day that the fail condition is detected for at least one of the network nodes; and
remove a flag for each flagged day that is consecutive to a first flagged day.

6. The system according to claim 1, wherein to identify input variables related to the fail condition, the model constructor is to:
derive variables from the extracted performance metrics; and
implement a clustering algorithm to select a number of ranked variables, wherein the clustering algorithm ranks the variables according to predefined criteria.

7. The system according to claim 1, wherein the model constructor is to partition the extracted performance metrics into a training set for training the plurality of models and a validation set that is not used for training the plurality

of models, wherein the extracted performance metrics are partitioned using a random sampling algorithm.

8. The system according to claim 1, wherein the plurality of models includes a decision tree model, a neural network model, and a logistic regression model.

9. The system according to claim 1, wherein the forecasting engine is to rate each of the plurality of validated models according to predefined criteria including at least one of a predictive accuracy of each of the validated models, an interpretability of an output of each of the validated models, an efficiency of each of the validated models, a stability and robustness of each of the validated models, a scalability of each of the validated models, and a lift of each of the validated models.

10. A method for predicting failure of network nodes in a network infrastructure, the method comprising:

extracting, by a controller of a predictive analytics server, performance metrics for the network nodes from a plurality of data sources;

defining a fail condition for the network nodes;

identifying input variables related to the fail condition for the network nodes, the input variables being derived from the extracted performance metrics;

training a plurality of models to predict the fail condition for the network nodes using a training set from the extracted performance metrics, wherein each of the plurality of models is fit with at least one of the identified input variables;

validating each of the plurality of trained models using a validation set from the extracted performance metrics, wherein the validating includes rating each of the validated models according to predefined criteria; and

selecting a highest rated model of the validated models to predict the fail condition for the network nodes.

11. The method according to claim 10, comprising:

prioritizing a maintenance schedule for the network nodes in the network infrastructure based on a predicted likelihood of the fail condition for each of the network nodes,

wherein the predicted likelihood of the fail condition is inputted from the highest rated model at least 48 hours prior to the fail condition for a selected network node.

12. The method according to claim 10, wherein extracting the performance metrics comprises extracting performance metrics from a predetermined time frame at least 48 hours prior to the fail condition for a selected network node.

13. The method according to claim 10, wherein extracting the performance metrics include at least one of telemetry data, customer data, call interaction data, and field technician data.

14. The method according to claim 10, wherein defining the fail condition comprises:

detecting the occurrence of the fail condition for the network nodes;
flagging each day that the fail condition is detected for at least one of the network nodes; and

removing a flag for each flagged day that is consecutive to a first flagged day.

15. The method according to claim 10, wherein identifying input variables related to the fail condition comprises:

deriving variables from the extracted performance metrics; and
implementing a clustering algorithm to select a number of ranked
variables, wherein the clustering algorithm ranks the variables according
to predefined criteria.

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16. The method according to claim 10, wherein training the plurality of
models to predict the fail condition comprises training a decision tree model,
a neural network model, and a logistic regression model.

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17. The method according to claim 10, the predefined criteria includes at
least one of a predictive accuracy of each of the validated models, an
interpretability of an output of each of the validated models, an efficiency of
each of the validated models, a stability and robustness of each of the validated
models, a scalability of each of the validated models, and a lift of each of the
validated models.

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18. A non-transitory computer readable medium on which is stored
machine readable instructions to predict failure in network nodes of a
network infrastructure, the machine readable instructions executable by a
controller to:

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extract performance metrics for the network nodes from a plurality of
data sources, wherein the extracted performance metrics include at one of
telemetry data, customer data, call interaction data, and field technician data;

define a fail condition for the network nodes;

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identify input variables related to the fail condition for the network nodes,
the input variables being derived from the extracted performance metrics;

train a plurality of models to predict the fail condition for the network
nodes using a training set from the extracted performance metrics, wherein each
of the plurality of models is fit with at least one of the identified input variables;

validate each of the plurality of trained models using a validation set from the extracted performance metrics, wherein the validating includes rating each of the validated models according to predefined criteria;

select a highest rated model of the validated models to predict the fail condition for the network nodes; and

prioritize a maintenance schedule for the network nodes based on a predicted likelihood of the fail condition for each of the network nodes.

19. The non-transitory computer readable medium of claim 18, wherein to define the fail condition, the machine readable instructions are further executable by the processor to:

detect the occurrence of the fail condition for the network nodes;

flag each day that the fail condition is detected for at least one of the network nodes; and

remove a flag for each flagged day that is consecutive to a first flagged day.

20. The non-transitory computer readable medium of claim 18, wherein to train the plurality of models to predict the fail condition, the machine readable instructions are further executable by the processor to train a decision tree model, a neural network model, and a logistic regression model.