Joint Deterministic Scheduling Requirements for Industrial
Field/Backhaul Networks
draft-wang-detnet-backhaul-requirements-00

Abstract

    This document analyzes the joint deterministic scheduling
    requirements for industrial field/backhaul networks, mainly
    including the determinacy, time synchronization, compatibility and
    scalability demands.

Status of this Memo

    This Internet-Draft is submitted in full conformance with the
    provisions of BCP 78 and BCP 79.

    Internet-Drafts are working documents of the Internet Engineering
    Task Force (IETF), its areas, and its working groups. Note that
    other groups may also distribute working documents as Internet-
    Drafts.

    Internet-Drafts are draft documents valid for a maximum of six
    months and may be updated, replaced, or obsoleted by other documents
    at any time. It is inappropriate to use Internet-Drafts as reference
    material or to cite them other than as "work in progress."

    The list of current Internet-Drafts can be accessed at
    http://www.ietf.org/ietf/1id-abstracts.txt

    The list of Internet-Draft Shadow Directories can be accessed at
    http://www.ietf.org/shadow.html

    This Internet-Draft will expire on May 17, 2017.

Copyright Notice

Table of Contents

1. Introduction

   Using three industrial wireless networking standards:
   ISA100[ISA100.11a], WirelessHART[WirelessHART] and WIA-PA[WIA-PA], a
   deterministic network can be constructed by industrial field network.
   However, this industrial field networks belonging to small and
   medium-size networks whose network coverage is constant, for example,
   a range of plant. Therefore, Industrial backhaul network can be
   introduced to make the industrial field network access higher-level
   network, or transit to other industrial field networks. Thus, a new
   architecture network, the deterministic industrial field networks
   - backhaul network is proposed in this draft. Some questions of
   deterministic network have been described in the draft [draft-finn-
   detnet-problem-statement-04], and architecture and application have
   been illustrated in [draft-finn-detnet-architecture-04] and [draft-
   bas-usecase-detnet-02] separately.

   Used in industrial production, it has a very high demand on the
   network data packet loss ratio, low jitter and deterministic and so
   on. Besides, due to the backhaul network is heterogeneous with field

Network. The backhaul industry network, has a centralized controller, can schedule network resources such as bandwidth and cache. However, for some industrial field networks such as ISA100, WirelessHART, these networks have their own system manager. At the same time, there are some networks which have no system manager. Therefore, it is an issue to be studied about how to carry out joint scheduling.

2. Network Structure

As shown in the figure 1, it is a typical deterministic industrial field networks - backhaul networks structure. The field network is composed of ISA100, which is the standard of the international industrial wireless network. This network standard uses TDMA mechanism to make the network time slot, and provides the deterministic guarantee for the data. Then the field networks can be access to industrial backhaul networks. At the other end of industrial backhaul networks, can be another industrial field networks, and can also be access to the Internet application, or into enterprise information management system like MES/ERP.

```
+------------------------+

|      ISA100 field      |

|   wireless network     | ------------+

+------------------------+             |

                           +--------------------+    +-----------+

                           | Industrial backhaul |    |Internet or|

                           |      network        | ---|  MES/ERP  |

                           +--------------------|     +-----------+

+------------------------+             |

|      ISA100 field      | ------------+

|   wireless network     |

+------------------------+
```
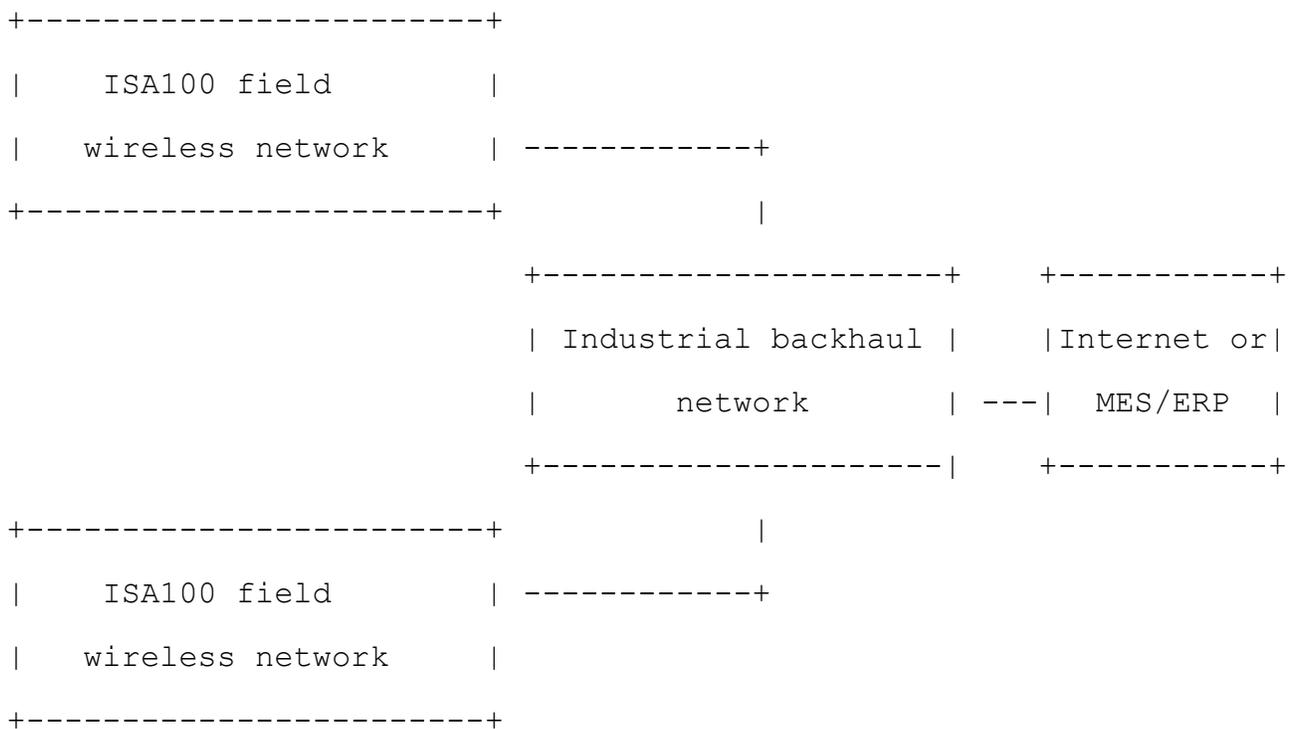
Figure 1. Typical network structure

Thus, in such a network structure, the former field network nodes
deployed in a plant can communicate with the field network nodes
deployed in another plant through the industrial backhaul network.
At the same time, the Internet and information management system can
manage the sensor nodes of the field network remotely through the
industrial backhaul network.

3. Joint scheduling requirements

3.1. Determinacy

The data of industrial field network directly related to the
monitoring and control of industrial production process, so the
requirement of data determinism is very high, need data to arrive at
a certain time. Industrial field network-backhaul network is also a
kind of network which is mainly used in the process of industrial
production, so also need to meet the needs of the data determinism
in the joint scheduling.

3.2. Time Synchronization

Since the industrial field/backhaul network is a converged network
and need some scheduling methods to ensure deterministic data stream.
So it requires high time synchronization accuracy between devices in
the network. The time synchronization accuracy should be in a range
of 10ns to 10ms according to different network applications. At
present, the existing time synchronization protocol include IEEE1588
and IEEE802.1 As, which is developed by following Time Sensitive
Networking (TSN) Task Group

3.3. Compatibility

Industrial field network and backhaul network are both heterogeneous
networks. Industrial field networks such as ISA100, WirelessHART
usually have built-in systems management, which can allocate network
communication resources to conduct deterministic scheduling. Some
field networks have no system manager. While industrial backhaul
network is able to control the network with central controller, so
some mechanisms, interfaces, etc. will be necessary when conducting
joint scheduling to be compatibility with industrial field/backhaul
network.

3.4. Scalability

Generally, the field network data cannot be transmitted across
domain or across network, while in the deterministic industrial
field/backhaul network, the characteristic of cross-networks should

be supported. So data scalability should be ensured during joint
scheduling process.

4. Security Considerations

This memo includes no request to IANA.

5. IANA Considerations

This memo includes no request to IANA.

6. References

6.1. Normative References

6.2. Informative References

[ISA100.11a]
          ISA/IEC, "ISA100.11a, Wireless Systems for Automation,
          also IEC 62734", 2011, <
          http://www.isa100wci.org/enUS/Documents/PDF/3405-ISA100-
          WirelessSystems-Future-brochWEB-ETSI.aspx>.

[WirelessHART]
          www.hartcomm.org, "Industrial Communication Networks -
          Wireless Communication Network and Communication Profiles
          - WirelessHART - IEC 62591", 2010.

[WIA-PA]
          CN-GB. GB/T 26790.1-2011. Industrial wireless networks WIA
          specification.Part 1: WIA System architecture and
          communication specification for process automation (WIA-
          PA)[S]. China: CN-GB, 2011.

[I-D.finn-detnet-problem-statement]
          Finn, N. and P. Thubert, "Deterministic Networking Problem
          Statement", draft-finn-detnet-problem-statement-04 (work in
          progress), October 2015.

[I-D.finn-detnet-architecture]
          Finn, N., Thubert, P., and M. Teener, "Deterministic
          Networking Architecture", draft-finn-detnetarchitecture-03
          (work in progress), March 2016.

[I-D.bas-usecase-detnet]
          Kaneko, Y., Toshiba and Das, S, "Building Automation Use
          Cases and Requirements for Deterministic Networking", draft-
          bas-usecase-detnet-00 (work in progress), April 2016.

[IEEE802.1AS-2011]
          IEEE, "Timing and Synchronizations (IEEE 802.1AS-2011)", 2011,
          <http://standards.ieee.org/getIEEE802/download/802.1AS-
          2011.pdf>.

Authors' Addresses

    Heng Wang
    Chongqing University of Posts and Telecommunications
    2 Chongwen Road
    Chongqing, 400065
    China

    Phone: (86)-23-6248-7845
    Email: wangheng@cqupt.edu.cn

    Ping Wang
    Chongqing University of Posts and Telecommunications
    2 Chongwen Road
    Chongqing, 400065
    China

    Phone: (86)-23-6246-1061
    Email: wangping@cqupt.edu.cn

    Hang Yang
    Chongqing University of Posts and Telecommunications
    2 Chongwen Road
    Chongqing, 400065
    China

    Phone: (86)-23-6246-1061
    Email: 18716322620@163.com