

**DIN EN ISO 16484-5**

ICS 35.240.99; 91.140.01

Einsprüche bis 2012-07-29  
Vorgesehen als Ersatz für  
DIN EN ISO 16484-5:2011-03

**Entwurf**

**Systeme der Gebäudeautomation –  
Teil 5: Datenkommunikationsprotokoll (ISO/FDIS 16484-5:2012);  
Englische Fassung FprEN ISO 16484-5:2012, nur auf CD-ROM**

Building automation and control systems –  
Part 5: Data communication protocol (ISO/FDIS 16484-5:2012);  
English version FprEN ISO 16484-5:2012, only on CD-ROM

Systèmes d'automatisation et de gestion technique du bâtiment –  
Partie 5: Protocole de communication de données (ISO/FDIS 16484-5:2012);  
Version anglaise FprEN ISO 16484-5:2012, seulement en CD-ROM

**Anwendungswarnvermerk**

Dieser Norm-Entwurf mit Erscheinungsdatum 2012-05-29 wird der Öffentlichkeit zur Prüfung und Stellungnahme vorgelegt.

Weil die beabsichtigte Norm von der vorliegenden Fassung abweichen kann, ist die Anwendung dieses Entwurfes besonders zu vereinbaren.

Stellungnahmen werden erbeten

- vorzugsweise als Datei per E-Mail an [nhrs@din.de](mailto:nhrs@din.de) in Form einer Tabelle. Die Vorlage dieser Tabelle kann im Internet unter [www.din.de/stellungnahme](http://www.din.de/stellungnahme) oder für Stellungnahmen zu Norm-Entwürfen der DKE unter [www.dke.de/stellungnahme](http://www.dke.de/stellungnahme) abgerufen werden;
- oder online im Norm-Entwurfs-Portal des DIN unter [www.entwuerfe.din.de](http://www.entwuerfe.din.de), sofern dort wiedergegeben;
- oder in Papierform an den Normenausschuss Heiz- und Raumluftechnik (NHRS) im DIN, 10772 Berlin (Hausanschrift: Burggrafenstr. 6, 10787 Berlin).

Die Empfänger dieses Norm-Entwurfs werden gebeten, mit ihren Kommentaren jegliche relevanten Patentrechte, die sie kennen, mitzuteilen und unterstützende Dokumentationen zur Verfügung zu stellen.

Gesamtumfang 1037 Seiten

Normenausschuss Heiz- und Raumluftechnik (NHRS) im DIN

## Nationales Vorwort

Dieses Dokument (FprEN ISO 16484-5:2012) wurde vom Technischen Komitee ISO/TC 205 „Building environment design“ in Zusammenarbeit mit dem Technischen Komitee CEN/TC 247 „Gebäudeautomation und Gebäudemanagement“ (Sekretariat: SNV, Schweiz) unter Beteiligung deutscher Experten erarbeitet.

Das zuständige deutsche Gremium ist der Arbeitsausschuss NA 041-03-68 AA „Gebäudeautomation und -kommunikation (SpA CEN/TC 247/WG 4)“ im Normenausschuss Heiz- und Raumlufttechnik (NHRS).

Dieses Dokument (FprEN ISO 16484-5:2012) übernimmt den englischen Originaltext des ANSI/ASHRAE Standard 135 „BACnet — A Data Communication Protocol for Building Automation and Control Networks“, Ausgabe 2008. In derselben Weise sollen zwischenzeitlich veröffentlichte bzw. noch zu veröffentlichende Änderungen und Erweiterungen von ANSI/ASHRAE Standard 135 bei der Fortschreibung von EN ISO 16484-5 übernommen werden. Der Inhalt dieses Dokumentes befindet sich auf der beiliegenden CD-ROM.

Der NHRS war für das DIN Deutsches Institut für Normung e. V. an der Erstellung dieser Norm beteiligt. Da davon auszugehen ist, dass die Fachleute der Kommunikationstechnik sich bereits mit der englischen Fassung befasst haben, wurde von einer Übersetzung ins Deutsche abgesehen. Nach dem DIN-Präsidiumsbeschluss 13/1983 ist insbesondere auf dem Gebiet der Informatik die Veröffentlichung in Englisch zulässig, insbesondere wenn dadurch Fehler bei der Übertragung vermieden werden können.

Dieses Dokument (FprEN ISO 16484-5:2012) stellt ein Kommunikationsverfahren zur Verfügung, mit dem Geräte der Gebäudeautomation untereinander Informationen austauschen können, unabhängig von der gebäudetechnischen Anlage, zu der sie gehören. Das in dieser Norm spezifizierte Protokoll kann universell für den Datenaustausch von Geräten und Systemen in der Gebäudeautomation sowohl zum allgemeinen Einsatz, als auch für anwenderspezifische Lösungen eingesetzt werden.

Für die in diesem Dokument zitierten Internationalen Normen wird im Folgenden auf die entsprechenden Deutschen Normen hingewiesen:

ISO/IEC 9545     siehe     DIN ISO/IEC 9545

## Änderungen

Gegenüber DIN EN ISO 16484-5:2011-03 wurden folgende Änderungen vorgenommen:

- a) Inhalt technisch überarbeitet.

## **Nationaler Anhang NA** (informativ)

### **Anwendungsbereich**

#### **1 Anwendungsbereich**

Dieser Teil von ISO 16484 legt Datenkommunikationsdienste und -protokolle für Geräte, die zur Überwachung und Steuerung von Anlagen der Heizungs-, Lüftungs-, Klima- und Kältetechnik (HLKK) und sonstigen Anlagen im Gebäude eingesetzt werden, fest. Des Weiteren legt dieser Teil eine abstrakte, objektorientierte Darstellung von Informationen, die zwischen derartigen Geräten übermittelt werden, fest und erleichtert somit die Anwendung und Nutzung von digitaler Steuertechnik in Gebäuden. Anwendungsbereich und Einsatzgebiet sind außerdem in Abschnitt 2 der beigefügten ANSI/ASHRAE Publikation beschrieben.

## Nationaler Anhang NB (informativ)

### Begriffe und Abkürzungen

Im Folgenden wird ISO 16484-5:2012, Abschnitt 3 ins Deutsche übersetzt. Die Benennung der folgenden Begriffe und Abkürzungen ist identisch mit der Benennung in der englischen Fassung.

### 3 Begriffe und Abkürzungen

Für die Anwendung dieses Dokuments gelten die folgenden aus Internationalen Normen übernommenen bzw. für die vorliegende Norm definierten Begriffe.

#### 3.1 Aus Internationalen Normen übernommene Begriffe

Die folgenden in dieser Norm verwendeten Begriffe sind in Internationalen Normen bzw. Norm-Entwürfen zur Kommunikation offener Systeme (open system interconnection, OSI) definiert. Diese Definitionen sind an dieser Stelle unter Verweisung auf die entsprechende Norm erneut aufgeführt. Abschnitt 25 enthält die Titel aller im vorliegenden Abschnitt und an weiteren Stellen in dieser Norm genannten nationalen und internationalen Normen. Kursiv dargestellte Wörter oder Wortgruppen beziehen sich auf Begriffe, die an anderer Stelle im vorliegenden Abschnitt definiert sind.

##### 3.1.1

##### **abstrakte Syntax**

en: abstract syntax

die Festlegung von Daten der Anwendungsschicht oder von *Anwendungsprotokoll-Steuerinformationen* durch Anwendung von Notationsregeln, die von der zu ihrer Darstellung verwendeten Kodierungstechnik unabhängig sind (ISO 8822)

##### 3.1.2

##### **Anwendung**

en: application

eine Menge von Informationsverarbeitungsanforderungen eines *Benutzers* (ISO 8649)

##### 3.1.3

##### **Anwendungsentität**

en: application-entity

die OSI betreffenden Aspekte eines *Anwendungsprozesses* (ISO 7498)

##### 3.1.4

##### **Anwendungsprozess**

en: application-process

ein Element innerhalb eines *realen offenen Systems*, das die Informationsverarbeitung für eine bestimmte *Anwendung* durchführt (ISO 7498)

##### 3.1.5

##### **Anwendungsprotokoll-Steuerinformationen**

en: application-protocol-control-information

Informationen, die mit Hilfe von Darstellungsdiensten zwischen *Anwendungsentitäten* ausgetauscht werden, um deren gemeinsame Operation zu koordinieren (ISO 9545)

**3.1.6****Anwendungsprotokoll-Dateneinheit**

en: application-protocol-data-unit

eine in einem Anwendungsprotokoll festgelegte Dateneinheit, die aus *Anwendungsprotokoll-Steuerinformationen* und eventuell Anwendungsbenutzerdaten besteht (ISO 9545)

**3.1.7****Anwendungsdienstelement**

en: application-service-element

der Teil einer *Anwendungsentität*, der eine OSI-Umgebungsfähigkeit bereitstellt, gegebenenfalls unter Verwendung zugrunde liegender Dienste (ISO 7498)

**3.1.8****konkrete Syntax**

en: concrete syntax

diejenigen Aspekte der bei der formalen Festlegung von Daten angewendeten Regeln, die eine spezifische Darstellung dieser Daten verkörpern (ISO 7498)

**3.1.09****Bestätigung (primitiv)**

en: confirm (primitive)

eine Darstellung einer Interaktion, bei der ein *Dienstanbieter* an einem bestimmten *Dienstzugangspunkt* anzeigt, dass er eine Prozedur abgeschlossen hat, die an diesem *Dienstzugangspunkt* zuvor durch eine durch ein *Anforderungsprimitiv* dargestellte Interaktion aufgerufen wurde (ISO TR 8509)

**3.1.10****Anzeige (primitiv)**

en: indication (primitive)

eine Darstellung einer Interaktion, bei der ein *Dienstanbieter* entweder

- a) anzeigt, dass er auf eigene Veranlassung hin eine Prozedur aufgerufen hat oder
- b) anzeigt, dass eine Prozedur vom *Dienstbenutzer* am gleichrangigen *Dienstzugangspunkt* aufgerufen wurde (ISO TR 8509)

**3.1.11****Peer-Entitäten**

en: peer-entities

*Entitäten* innerhalb derselben Schicht (ISO 7498)

**3.1.12****reales offenes System**

en: real open system

ein *reales System*, das bei seiner Kommunikation mit anderen *realen Systemen* die Anforderungen von OSI-Normen einhält (ISO 7498)

**3.1.13****reales System**

en: real system

ein Satz von einem oder mehreren Rechnern, der dazugehörigen Software, Peripheriegeräten, Endgeräten, menschlichen Bedienern, physikalischen Prozessen, Informationsübertragungsmitteln usw., der ein autonomes Ganzes bildet, das in der Lage ist, Informationsverarbeitung und/oder Informationstransfer durchzuführen (ISO 7498)

**3.1.14****Anforderung(primitiv)**

en: request (primitive)

eine Darstellung einer Interaktion, bei der ein *Dienstbenutzer* eine Prozedur aufruft (ISO TR 8509)

**3.1.15****Antwort(primitiv)**

en: response (primitive)

eine Darstellung einer Interaktion, bei der ein *Dienstbenutzer* anzeigt, dass er eine Prozedur abgeschlossen hat, die zuvor durch eine durch ein *Anzeigeprimitiv* dargestellte Interaktion aufgerufen wurde (ISO TR 8509)

**3.1.16****(N)-Dienstzugangspunkt**

en: (N)-service-access-point

der Punkt, an dem (N)-Dienste von einer (N)-*Entität* für eine (N+1)-*Entität* bereitgestellt werden (ISO 7498)

**3.1.17****(N)-Dienstdateneinheit**

en: (N)-service-data-unit

eine Menge von (N)-Schnittstellendaten, deren Identität vom einen Ende einer (N)-Verbindung bis zum anderen gewahrt bleibt (ISO 7498)

**3.1.18****Dienstbenutzer**

en: service-user

eine *Entität* in einem einzelnen offenen System, die über *Dienstzugangspunkte* einen Dienst benutzt (ISO TR 8509)

**3.1.19****Dienstprimitiv; Primitiv**

en: service-primitive; primitive

eine abstrakte, implementierungsunabhängige Darstellung einer Interaktion zwischen dem *Dienstbenutzer* und dem *Dienstanbieter* (ISO TR 8509)

**3.1.20****Dienstanbieter**

en: service-provider

ein Abstraktum der Gesamtheit der Entitäten, die gleichrangigen *Dienstbenutzern* einen Dienst bereitstellen (ISO TR 8509)

**3.1.21****Transfersyntax**

en: transfer syntax

die bei der Übertragung von Daten zwischen offenen Systemen verwendete *konkrete Syntax* (ISO 7498)

**3.1.22****Benutzerelement**

en: user element

die Darstellung des Teils eines *Anwendungsprozesses*, der die zur Erreichung der Kommunikationsziele dieses *Anwendungsprozesses* notwendigen *Anwendungsdienstelemente* nutzt (ISO 7498)

**3.2 Für die vorliegende Norm definierte Begriffe****3.2.1****Zugriffskontrolle**

en: access control

ein Verfahren zur Regelung oder Einschränkung des Zugriffs auf *Netzwerkressourcen*

**3.2.2****Alarm**

en: alarm

1. eine hörbare und/oder sichtbare Meldung, die einen Bediener auf einen nicht normalen Zustand, der eine Korrekturmaßnahme erfordern kann, aufmerksam macht
2. ein von einem Gerät oder Controller erkannter nicht normaler Zustand, wobei das Gerät bzw. der Controller eine speziell für diesen Zustand ausgelegte Regel oder Logik implementiert

**3.2.3****Algorithmic Change Reporting**

en: algorithmic change reporting

das Erkennen und Berichten eines Alarms oder Ereignisses auf der Grundlage eines in einem Event-Enrollment-Objekt festgelegten Algorithmus. Siehe auch *Intrinsic Reporting* unter 3.2.27

**3.2.4****Authentifizierung**

en: authentication

Vorgang zur Verifizierung der Identität

**3.2.5****Authentifizierungs-Faktor**

en: authentication factor

ein Datenelement der Anmeldeinformationen, das verwendet wird um die Identität des Anmeldenden zu verifizieren

**3.2.6****Autorisierung (Netzwerksicherheit)**

en: authorization (network security)

Kontrolle des Zugangs zu Netzwerkressourcen basierend auf Identitätsprüfung und Zugriffsregeln

**3.2.7****Autorisierung (physische Zugangskontrolle)**

en: authorization (physical access control)

Prozess zur Bestimmung, ob es für den Anwender zulässig ist einen geschützten Bereich über einen Zugangskontrollierten Punkt zu betreten

**3.2.8****BACnet-Gerät**

en: BACnet device

jedes reale oder virtuelle Gerät, das eine digitale Kommunikation unter Anwendung des BACnet-Protokolls unterstützt

**3.2.9****BACnet-Benutzer**

en: BACnet-user

der Teil eines *Anwendungsprozesses*, der durch das *BACnet-Benutzerelement* repräsentiert wird

**3.2.10****Bridge**

en: bridge

eine Einrichtung, die zwei oder mehr *Segmente* auf der physikalischen Schicht und der Daten Verbindungsschicht miteinander verbindet. Diese Einrichtung kann auf der Grundlage von MAC-Schicht-Adressen auch Nachrichten filtern

**3.2.11****Broadcast**

en: broadcast

eine als einzelne Einheit gesendete Nachricht, die sich an mehr als ein Gerät richten kann

**3.2.12****Zustandsänderung**

en: change of state

ein Ereignis, das dann auftritt, wenn sich ein gemessener oder berechneter Boolescher Wert oder ein diskreter numerischer bzw. Zählwert ändert

**3.2.13****Wertänderung**

en: change of value

ein Ereignis, das dann auftritt, wenn sich ein Messwert oder ein berechneter Analogwert um einen definierten Wert ändert

**3.2.14****Client**

en: client

ein System oder eine Einrichtung, das/die eine andere Einrichtung für einen bestimmten Zweck über eine *Dienstanforderungsinstanz* einsetzt. Ein Client fordert einen Dienst bei einem *Server* an

**3.2.15****Kontext**

en: context

ein Satz von Daten oder Informationen, der eine bestimmte Kommunikationsumgebung zu einem bestimmten Zeitpunkt vollständig beschreibt

**3.2.16****Controller**

en: controller

eine Einrichtung zur Regelung bzw. zum Management eines Systems oder einer Komponente

**3.2.17****Anmeldeinformationen (physische Zugangskontrolle)**

en: credentials (physical access control)

Kombination aus Authentifizierungs-Faktoren und Zugangsrechten

**3.2.18****Vertraulichkeit von Daten**

en: data confidentiality

die Eigenschaft, dass Informationen unbefugten Personen, Entitäten oder Prozessen nicht zur Verfügung gestellt oder offengelegt werden

**3.2.19****Datenintegrität**

en: data integrity

die Eigenschaft, dass Daten nicht auf nicht autorisierte Weise verändert oder zerstört wurden

**3.2.20****Authentifizierung der Datenherkunft**

en: data origin authentication

Bestätigung, dass die Quelle der empfangenen Daten tatsächlich den Angaben entspricht

**3.2.21****Datumsmuster**

en: date pattern

Datum, das eine oder mehrere nicht spezifische Oktette oder spezielle Datumswerte enthalten kann

**3.2.22****direkt verbundenes Netzwerk**

en: directly connected network

ein Netzwerk, das von einem Router aus zugänglich ist, ohne dass Nachrichten über einen Zwischenrouter weitergeleitet werden müssen. Zu einem direkt verbundenen Netzwerk besteht eine PTP-Verbindung, wenn die PTP-Verbindung gerade aktiv ist und kein Zwischenrouter verwendet wird

**3.2.23****Download**

Herunterladen

en: download

eine bestimmte Art der Dateiübertragung, die sich auf die Übertragung eines ausführbaren Programms oder einer Datenbank auf ein abgesetztes Gerät bezieht, auf dem die Datei ausgeführt werden kann

**3.2.24****verschlüsselte Nachricht**

en: encrypted message

Nachricht, die in einen Security Header eingehüllt, signiert, und verschlüsselt ist

**3.2.25****Entität**

Gebilde

en: entity

ein eigenständiger, sich unterscheidender Gegenstand der Betrachtung. Ein identifizierbares Element, das mittels einer Sammlung oder eines Satzes von Eigenschaften beschrieben wird

**3.2.26****Fehlererkennung**

en: error detection

eine Prozedur, die dazu verwendet wird, das Vorhandensein von Fehlern in einer Kommunikation zu identifizieren

**3.2.27****Fehlerbehebung**

en: error recovery

eine Prozedur, die als Reaktion auf einen erkannten Fehler aufgerufen wird und ein Fortsetzen des Informationsaustausches erlaubt

**3.2.28****Gateway**

Netzübertragungseinheit

en: gateway

Einrichtung zur Verbindung zweier oder mehrerer nicht gleicher *Netzwerke*, um den Informationsaustausch zwischen diesen Netzwerken zu ermöglichen

**3.2.29****global**

en: global

alle Geräte oder Knoten auf einem *Inter-Netzwerk* betreffend

**3.2.30****globales Broadcast**

en: global broadcast

eine an alle Geräte oder *Knoten* auf allen Netzwerken in einem BACnet-*Internet* adressierte Nachricht

**3.2.31****Halbrouter**

en: half router

ein Gerät oder ein *Knoten*, der als ein Partner an einer PTP-Verbindung teilnehmen kann. Die beiden Halbrouter-Partner, die zusammen eine aktive PTP-Verbindung bilden, ergeben einen einzelnen *Router*

**3.2.32****unfähiges Gerät**

en: incapable device

Gerät, das von Natur aus unfähig ist oder konfiguriert wurde unfähig zu erscheinen sichere BACnet Nachrichten zu produzieren oder zu verarbeiten

**3.2.33****Initialisierung**

en: initialization

der Vorgang des Herbeiführens eines bekannten Zustands, üblicherweise nach einer Stromanschaltung. Die Initialisierung kann eine Wiedereingabe der logischen oder physikalischen Adresse eines Knotens erfordern

**3.2.34****Inter-Netzwerk**

Verbindungsnetzwerk

en: internetwork

eine Verbindung von zwei oder mehreren *Netzwerken* über *Router*. In einem BACnet-*Inter-Netzwerk* gibt es zwischen zwei beliebigen Knoten genau einen Nachrichtenweg.

**3.2.35****Intrinsic Reporting**

en: intrinsic reporting

das Erkennen und Berichten eines Alarms oder Ereignisses auf der Grundlage eines als Teil der *Objektyp*-Spezifikation definierten Algorithmus. Dabei findet keine externe Verweisung auf ein „Event Enrollment“ statt. Siehe auch *Algorithmic Change Reporting* unter 3.2.3

**3.2.36****invertiertes Netzwerk**

en: inverted network

BACnet Inter-Netzwerk, bei dem zwei oder mehr Netzwerke durch ein Netzwerk verbunden sind, dessen NPDU kleiner als die des beitretenden Netzwerkes ist

**3.2.37****Schlüssel**

en: key

Symbolsequenz zur Regelung der Chiffrierung und Dechiffrierung

**3.2.38****lokal**

en: local

Geräte auf demselben *Netzwerk* wie das betrachtete Gerät betreffend

**3.2.39****lokales Broadcast**

en: local broadcast

eine Nachricht, die an alle Geräte oder *Knoten* adressiert ist, die sich auf demselben *Netzwerk* wie die Nachrichtenquelle befinden

**3.2.40****Medium**

en: medium

die physikalische Übertragungsentität. Typische Medien sind verdrehte Doppelader-Leitungen, Fiberoptik-Kabel und Koaxialkabel

**3.2.41****Medienzugriffskontrolle**

en: medium access control

ein Vorgang zur Wahrung der Ordnung und zur Gewährung des Zugriffs auf das Kommunikations*medium***3.2.42****Netzwerk**

en: network

ein Satz von einem oder mehreren durch *Bridges* verbundenen *Segmenten* mit derselben Netzwerkadresse**3.2.43****Netzwerkressource**

en: network resource

jede physikalische oder logische *Entität*, auf die über ein Kommunikations*medium* zugegriffen werden kann**3.2.44****Knoten**

en: node

eine mit dem Kommunikations*medium* verbundene adressierbare Einrichtung**3.2.45****Objekt**

en: object

eine spezifische Instanz eines *Objektyps*. Während ein *Objektyp* durch eine eindeutige *Object\_Type*-Eigenschaft bezeichnet ist, ist ein Objekt durch seine *Object\_Identifizier*-Eigenschaft bezeichnet**3.2.46****Objektprofil**

en: object profile

ein Objektprofil ist ein Mittel zum Definieren von Objekten über die in Abschnitt 12 definierten Objekte hinaus. Ein Profil definiert den Satz von Eigenschaften, Verhalten und/oder Anforderungen, der für ein proprietäres Objekt oder proprietäre Erweiterungen eines Normobjekts gilt

**3.2.47****Objektyp**

Objektart

en: object type

eine generische Datenklassifizierung, definiert durch einen Satz *Eigenschaften***3.2.48****Bediener-Authentifizierung**

en: operator authentication

die Bestätigung der Identität des sich an einer Einrichtung anmeldenden Bedieners

**3.2.49****Authentifizierung der Peer-Entität**

en: peer entity authentication

die Bestätigung der Identität einer assoziierten Peer-Entität

**3.2.50****physische Zugangskontrolle (PACS)**

en: physical access control (PACS)

elektronisches System, das durch Authentifizierung und Autorisierung an Zugangskontrollpunkten die Fähigkeit von Personen und Fahrzeugen einen geschützten Bereich zu betreten kontrolliert

**3.2.51****physikalisches Segment**

en: physical segment

ein einzelnes zusammenhängendes *Medium*, an das BACnet-*Knoten* angebunden sind

**3.2.52****physisch unsicher**

en: physically insecure  
nicht physisch sicher

**3.2.53****physisch sicher**

en: physically secure  
Gerät oder Netzwerk, das vor physischem Zugang nicht autorisierter Individuen geschützt ist

**3.2.54****einfaches Netzwerk**

en: plain network  
Netzwerk, das keinen signierten oder verschlüsselten Datenverkehr benötigt

**3.2.55****einfache Nachricht**

en: plain message  
Nachricht, die nicht durch einen BACnet Security Wrapper geschützt ist

**3.2.56****druckbares Zeichen**

en: printable character  
ein Zeichen, das im Gegensatz zu einem Gerätesteuerzeichen ein druckbares Symbol darstellt. Dazu gehören unter anderem Groß- und Kleinbuchstaben, Satzzeichen und mathematische Symbole. Der genaue Satz hängt von dem verwendeten Zeichensatz ab. In ANSI X3.4 sind die druckbaren Zeichen durch einzelne Oktetts im Bereich von X'20' bis X'7E' dargestellt

**3.2.57****Eigenschaft**

en: property  
ein spezielles Charakteristikum eines *Objektyps*

**3.2.58****proprietär**

herstellerspezifisch  
en: proprietary  
im BACnet-Kontext jede Erweiterung oder Ergänzung der in dieser Norm festgelegten *Objektypen*, *Eigenschaften*, *PrivateTransfer-Diensten* oder *Aufzählungen*

**3.2.59****empfangender BACnet-Benutzer**

en: receiving BACnet-user  
der *BACnet-Benutzer*, der ein *Anzeige-* oder *Bestätigungs-*Dienstprimitiv empfängt

**3.2.60****abgesetzt**

Fern-  
en: remote  
Geräte oder *Knoten* betreffend, die sich auf einem anderen Netzwerk als das referenzierte Gerät befinden

**3.2.61****Fern-Broadcast**

en: remote broadcast  
eine Nachricht, die an alle Geräte oder *Knoten* adressiert ist, die sich auf einem anderen *Netzwerk* als die Nachrichtenquelle befinden

**3.2.62****Repeater**

Verstärker

en: repeater

eine Einrichtung, die zwei oder mehr *physikalische Segmente* auf der physikalischen Schicht verbindet

**3.2.63****anfordernder BACnet-Benutzer**

en: requesting BACnet-user

der *BACnet-Benutzer*, der in einem bestätigten Dienst die Rolle eines *Clients* übernimmt

**3.2.64****antwortender BACnet-Benutzer**

en: responding BACnet-user

der *BACnet-Benutzer*, der in einem bestätigten Dienst die Rolle eines *Servers* übernimmt

**3.2.65****Funktionsgruppenbasierte Zugangskontrolle (RBAC)**

en: role-based access control

Zugangsrechte, die spezifischen Funktionsgruppen zugewiesen sind. Der Nutzer erhält die Zugangsrechte über die ihm zugewiesene Funktionsgruppe.

**3.2.66****Router**

Wegwahleinheit

en: router

ein Gerät zur Verbindung eines oder mehrere *Netzwerke* auf der Vermittlungsschicht

**3.2.67****sicheres Netzwerk**

en: secure network

Netzwerk, in dem sämtlicher Datenverkehr signiert oder verschlüsselt sein muss

**3.2.68****Sicherheit**

Schutz

en: security

eine von einer Vielzahl von Vorgehensweisen zur Sicherstellung der Überwachung des Informationsaustausches, um einer Offenlegung gegenüber unbefugten Personen vorzubeugen. Sicherheitsmaßnahmen sollen die Offenlegung sensibler Informationen auch gegenüber jenen verhindern, die einen gültigen Zugriff auf das Kommunikations*netzwerk* haben. Sicherheit unterscheidet sich von Zugriffskontrolle, wenngleich auch durch die Einschränkung des physischen Zugriffs auf das Kommunikationsmedium selbst ein gewisses Maß an Sicherheit erreicht werden kann

**3.2.69****Segment**

en: segment

ein Segment besteht aus einem oder mehreren miteinander über Repeater verbundenen *physikalischen Segment(en)*

**3.2.70****sendender BACnet-Benutzer**

en: sending BACnet-user

der *BACnet-Benutzer*, der ein *Anforderungs-* oder *Antwort-*Dienstprimitiv ausgibt

**3.2.71****Server**

en: server

ein System oder eine Einrichtung bzw. ein Gerät, das (die) für einen bestimmten Zweck auf eine Dienstanforderungsinstanz antwortet. Der Server stellt einen Dienst für einen *Client* bereit

**3.2.72****signierte Nachricht**

en: signed message

Nachricht, die in einen Security Header eingehüllt, signiert, und nicht verschlüsselt ist

**3.2.73****spezieller Datumswert**

en: special date value

Datumswert, der einem speziellen Wert wie z. B. "gerade Monate", "letzter Tag des Monats" usw. entspricht. Diese speziellen Datumswerte werden in Unterkomponenten (Oktetten) eines Datumswertes verwendet.

**3.2.74****spezifisches Datum**

en: specific date

vollständig spezifiziertes Datum. Zum Beispiel, Januar 24, 1991, Wochentag = Donnerstag. Ein spezifisches Datum darf keine nicht spezifischen Oktette oder spezielle Datumswerte enthalten.

**3.2.75****spezifische Datumszeit**

en: specific datetime

BACnetDateTime Konstrukt zusammengesetzt aus einem spezifischen Datum und einer spezifischen Zeit.

**3.2.76****spezifische Zeit**

en: specific time

Vollständig spezifizierte Zeit. Zum Beispiel, 17:35:45,17 (= 5:35:45,17 P. M.). Eine spezifische Zeit darf keine nicht spezifischen Oktette enthalten

**3.2.77****Standard-Objektyp**

en: standard object type

durch diese Norm definierter Objektyp, bei dem der numerische Wert im für ASHRAE reservierten Bereich liegt

**3.2.78****Standard-Eigenschaft**

en: standard property

eine erforderliche oder optionale Eigenschaft eines Standard-Objektyps, bei der der numerische Wert der Eigenschaftskennung im für ASHRAE reservierten Bereich liegt und die Eigenschaft in der Objektyp-Eigenschafts Tabelle in Abschnitt 12 aufgeführt ist.

**3.2.79****Synchronisierung**

en: synchronization

eine Möglichkeit für Prozesse, bestimmte Stellen in einer Übertragung oder einem Austausch zu definieren und zu identifizieren, die genutzt werden können, um eine Kommunikationssitzung in einen vordefinierten Zustand zurückzusetzen

**3.2.80****Zeitmuster**

en: time pattern

Zeit, die ein oder mehrere nicht spezifizierte Oktette enthalten kann

**3.2.81****Zeitstempel**

en: timestamp

einem Ereignis oder einer Handlung zugeordneter Eintrag über Datum und Uhrzeit

**3.2.82****vertrauenswürdig**

en: trusted

Begriff der für Geräte oder Netzwerke angewendet wird, deren Nachrichten für authentisch gehalten werden, entweder durch die Verwendung von sicheren Nachrichten oder basierend auf der physischen Sicherheit des Gerätes oder Netzwerkes

**3.2.83****Zeiteinheit**

unit\_time

en: unit\_time

die Länge der Zeit, die erforderlich ist, um ein Oktett mit einem Startbit und einem einzigen Stoppbit zu senden. Zehn Bitintervalle

**3.2.84****nicht spezifiziertes Datum**

en: unspecified date

Datum, das ausschließlich aus nicht spezifizierten Oktetten besteht (Wert von X'FF' = D'255')

**3.2.85****nicht spezifizierte Datumszeit**

en: unspecified datetime

BACnetDateTime Konstrukt zusammengesetzt aus einem nicht spezifizierten Datum und einer nicht spezifizierten Zeit

**3.2.86****nicht spezifiziertes Oktett**

en: unspecified octet

Oktett, das im Zusammenhang mit Datum, Zeit oder BACnetWeekNDay Werten verwendet wird und den Wert X'FF' = D'255' beinhaltet

**3.2.87****nicht spezifizierte Zeit**

en: unspecified time

Zeit, die ausschließlich aus nicht spezifizierten Oktetten besteht (Wert von X'FF' = D'255')

**3.2.88****Upload**

Hochladen

en: upload

der Prozess, ein Abbild eines ausführbaren Programms oder eine Datenbank von einer abgesetzten Einrichtung so zu übertragen, dass ein anschließender Download erfolgen kann

**3.3 Abkürzungen in der vorliegenden Norm**

| Abkürzung<br>(englisch) | Bedeutung (englisch)         | Bedeutung (deutsch)          |
|-------------------------|------------------------------|------------------------------|
| <b>A</b>                | application layer            | Anwendungsschicht (Präfix)   |
| <b>ABA</b>              | American Bankers Association | American Bankers Association |
| <b>AE</b>               | application entity           | Anwendungsentität            |

| Abkürzung<br>(englisch) | Bedeutung (englisch)                                           | Bedeutung (deutsch)                                                                                                            |
|-------------------------|----------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| <b>ANSI</b>             | American National Standards Institute                          | American National Standards Institute                                                                                          |
| <b>APCI</b>             | application protocol control information                       | Anwendungsprotokoll-Steuerinformationen                                                                                        |
| <b>APDU</b>             | application layer protocol data unit                           | Protokolldateneinheit der Anwendungsschicht                                                                                    |
| <b>API</b>              | application program interface                                  | Anwendungsprogramm-Schnittstelle                                                                                               |
| <b>ARCNET</b>           | attached resource computer network                             | Attached Resource Computer Network                                                                                             |
| <b>ASE</b>              | application service element                                    | Anwendungsdienstelement                                                                                                        |
| <b>ASN.1</b>            | Abstract Syntax Notation One                                   | Notation Eins für Abstrakte Syntax (ISO 8824)                                                                                  |
| <b>B' '</b>             |                                                                | gibt an, dass zwischen den Anführungszeichen eine Binärschreibweise verwendet wird                                             |
| <b>BAC</b>              | building automation and control                                | Gebäudeautomation (GA)                                                                                                         |
| <b>BBMD</b>             | BACnet/IP broadcast management device                          | Einrichtung für das BACnet/IP-Broadcast-Management                                                                             |
| <b>BDT</b>              | broadcast distribution table                                   | Broadcast-Verteilungstabelle                                                                                                   |
| <b>B/IP</b>             | BACnet/IP                                                      | BACnet/IP                                                                                                                      |
| <b>B/IP-M</b>           | BACnet/IP multicast                                            | BACnet/IP-Multicast                                                                                                            |
| <b>BVLC</b>             | BACnet virtual link control                                    | virtuelle Verbindungsteuerung von BACnet                                                                                       |
| <b>BVLCI</b>            | BACnet virtual link control information                        | Steuerinformationen der virtuellen Verbindung von BACnet                                                                       |
| <b>BVLL</b>             | BACnet virtual link layer                                      | virtuelle Verbindungsschicht von BACnet                                                                                        |
| <b>C</b>                | conditional                                                    | bedingt                                                                                                                        |
| <b>C(=)</b>             | conditional                                                    | bedingt (Der Parameter entspricht semantisch dem Parameter in dem Dienstprimitiv unmittelbar zu seiner Linken in der Tabelle.) |
| <b>CNF</b>              | confirm primitive                                              | Bestätigungsprimitiv                                                                                                           |
| <b>COV</b>              | change of value                                                | Wertänderung                                                                                                                   |
| <b>CRC</b>              | cyclic redundancy check                                        | zyklische Redundanzprüfung                                                                                                     |
| <b>D' '</b>             |                                                                | gibt an, dass zwischen den Anführungszeichen eine Dezimalschreibweise verwendet wird                                           |
| <b>DA</b>               | local destination MAC layer address                            | MAC-Schicht-Adresse des lokalen Ziels                                                                                          |
| <b>DADR</b>             | ultimate destination MAC layer address                         | MAC-Schicht-Adresse des endgültigen Ziels                                                                                      |
| <b>DER</b>              | Data Encryption Standard                                       | Data Encryption Standard (FIPS 46-1)                                                                                           |
| <b>DES</b>              | Data Encryption Standard (FIPS 46-1)                           | Datenverschlüsselungsstandard (FIPS 46-1)                                                                                      |
| <b>DESFire</b>          | Data Encryption Standard Fast, Innovative, Reliable and Secure | Datenverschlüsselungsstandard Schnell, Innovativ, Zuverlässig und Sicher                                                       |
| <b>DID</b>              | ARCNET destination MAC address                                 | MAC-Adresse des ARCNET-Ziels                                                                                                   |
| <b>DLEN</b>             | 1-octet length of ultimate destination MAC layer address       | 1-Oktett-Länge der MAC-Schicht-Adresse des endgültigen Ziels                                                                   |
| <b>DNET</b>             | 2-octet length of ultimate destination MAC layer address       | 2-Oktett-Länge der MAC-Schicht-Adresse des endgültigen Ziels                                                                   |

| Abkürzung<br>(englisch) | Bedeutung (englisch)                              | Bedeutung (deutsch)                                                                                                                                        |
|-------------------------|---------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>DSAP</b>             | LLC destination service access point              | Dienstzugangspunkt des LLC-Ziels                                                                                                                           |
| <b>EIB</b>              | European Installation Bus                         | Europäischer Installationsbus                                                                                                                              |
| <b>EIBA</b>             | European Installation Bus Association             | European Installation Bus Association                                                                                                                      |
| <b>EXEC</b>             |                                                   | fähig, eine Dienstanforderung auszuführen (execute)                                                                                                        |
| <b>FDT</b>              | foreign device table                              | Fremdgerätetabelle                                                                                                                                         |
| <b>ICI</b>              | interface control information                     | Schnittstellensteuerinformation                                                                                                                            |
| <b>IL</b>               | ARCNET information length field                   | ARCNET-Feld Informationslänge                                                                                                                              |
| <b>IND</b>              | indication primitive                              | Anzeigeprimitiv                                                                                                                                            |
| <b>INF</b>              | „Infinity“                                        | „Unendlich“, ein eindeutiges Binärmuster, das positiv unendlich darstellt (siehe ANSI/IEEE 754-1985)                                                       |
| <b>-INF</b>             | „Negative infinity“                               | „Negativ unendlich“, ein eindeutiges Binärmuster, das negativ unendlich darstellt (siehe ANSI/IEEE 754-1985)                                               |
| <b>IEEE</b>             | Institute of Electrical and Electronics Engineers | Institute of Electrical and Electronics Engineers                                                                                                          |
| <b>INIT</b>             |                                                   | fähig, eine Dienstanforderung einzuleiten (initiate)                                                                                                       |
| <b>IP</b>               | Internet Protocol                                 | Internet-Protokoll (RFC 791)                                                                                                                               |
| <b>ISO</b>              | International Organization for Standardization    | Internationale Organisation für Normung                                                                                                                    |
| <b>KNX</b>              | Konnex System Specification                       | Konnex-System-Spezifikation: EIB ist das Kernprotokoll des Konnex-Standards. Die Konnex-System-Spezifikation spiegelt den derzeitigen Stand für EIB wider. |
| <b>L</b>                | data link                                         | Datenverbindung (Präfix)                                                                                                                                   |
| <b>LAN</b>              | Local Area Network                                | Local Area Network                                                                                                                                         |
| <b>LLC</b>              | logical link control                              | logische Verbindungssteuerung                                                                                                                              |
| <b>LPCI</b>             | link protocol control information                 | Verbindungsprotokoll-Steuerinformation                                                                                                                     |
| <b>LPDU</b>             | link protocol data unit                           | Verbindungsprotokoll-Dateneinheit                                                                                                                          |
| <b>LRC</b>              | Longitudinal Redundancy Check                     | Longitudinale Redundanzprüfung                                                                                                                             |
| <b>LSAP</b>             | link service access point                         | Verbindungsdienstzugriffspunkt ((X'82' für BACnet)                                                                                                         |
| <b>LSDU</b>             | link service data unit                            | Verbindungsdienstdateneinheit                                                                                                                              |
| <b>M</b>                | mandatory                                         | verpflichtend                                                                                                                                              |
| <b>M(=)</b>             | mandatory                                         | verpflichtend (Der Parameter entspricht semantisch dem Parameter in dem Dienstprimitiv unmittelbar zu seiner Linken in der Tabelle.)                       |
| <b>MA</b>               | medium access (prefix)                            | Medienzugriff (Präfix)                                                                                                                                     |

| Abkürzung<br>(englisch) | Bedeutung (englisch)                          | Bedeutung (deutsch)                                                                                     |
|-------------------------|-----------------------------------------------|---------------------------------------------------------------------------------------------------------|
| <b>MAC</b>              | medium access control                         | Medienzugriffskontrolle                                                                                 |
| <b>MPCI</b>             | MAC protocol control information              | MAC-Protokollsteuerinformation                                                                          |
| <b>MPDU</b>             | MAC layer protocol data unit                  | MAC-Schicht-Protokolldateneinheit                                                                       |
| <b>MSDU</b>             | MAC service data unit                         | MAC-Dienstdateneinheit                                                                                  |
| <b>MS/TP</b>            | master-slave/token-passing                    | Master-Slave/Token-Passing                                                                              |
| <b>N</b>                | network layer (prefix)                        | Vermittlungsschicht (Präfix)                                                                            |
| <b>NaN</b>              | „Not a Number“                                | „Keine Zahl“, ein eindeutiges Binärmuster, das eine ungültige Zahl darstellt (siehe ANSI/IEEE 754-1985) |
| <b>NAT</b>              | Network Address Translation – RFC 2663        | Network Address Translation – RFC 2663                                                                  |
| <b>NP</b>               | network priority                              | Netzwerkpriorität                                                                                       |
| <b>NPCI</b>             | network protocol control information          | Netzwerkprotokoll-Steuerinformationen                                                                   |
| <b>NPDU</b>             | network layer protocol data unit              | Vermittlungsschicht-Protokolldateneinheit                                                               |
| <b>NRZ</b>              | non-return to zero                            | Non-Return-To-Zero                                                                                      |
| <b>NSAP</b>             | network service access point                  | Netzwerkdienstzugriffspunkt                                                                             |
| <b>NSDU</b>             | network service data unit                     | Netzwerkdienstdateneinheit                                                                              |
| <b>O</b>                |                                               | gibt an, dass die Unterstützung einer Eigenschaft optional ist                                          |
| <b>OSI</b>              | open systems interconnection                  | Kommunikation offener Systeme                                                                           |
| <b>P</b>                | physical layer (prefix)                       | physikalische Schicht (Präfix)                                                                          |
| <b>PAC</b>              | ARCNET data packet header octet               | Oktett des ARCNET-Datenpaket-Headers                                                                    |
| <b>PCI</b>              | protocol control information                  | Protokollsteuerinformation                                                                              |
| <b>PDU</b>              | protocol data unit                            | Protokolldateneinheit                                                                                   |
| <b>PICS</b>             | protocol implementation conformance statement | Konformitätserklärung zur Protokollimplementierung                                                      |
| <b>PK</b>               | Private Key                                   | privater Schlüssel                                                                                      |
| <b>PPCI</b>             | physical layer protocol control information   | Protokollsteuerinformationen der physikalischen Schicht                                                 |
| <b>PPDU</b>             | physical protocol data unit                   | physikalische Protokolldateneinheit                                                                     |
| <b>PPP</b>              | Point-To-Point protocol                       | Punkt-zu-Punkt-Protokoll (RFC 1661)                                                                     |
| <b>PSDU</b>             | physical service data unit                    | physikalische Dienstdateneinheit                                                                        |
| <b>PTP</b>              | point-to-point                                | Punkt-zu-Punkt                                                                                          |
| <b>R</b>                |                                               | gibt an, dass eine Eigenschaft unterstützt werden und lesbar (readable) sein muss                       |
| <b>REQ</b>              | request primitive                             | Anforderungsprimitiv                                                                                    |
| <b>RFC</b>              | request for comment                           | Request for Comment                                                                                     |
| <b>RSP</b>              | response primitive                            | Antwortprimitiv                                                                                         |

| Abkürzung<br>(englisch) | Bedeutung (englisch)                                | Bedeutung (deutsch)                                                                                                                   |
|-------------------------|-----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| <b>S</b>                | selection                                           | Auswahl                                                                                                                               |
| <b>S(=)</b>             | selection                                           | Auswahl (Der Parameter entspricht semantisch dem Parameter in dem Dienstprimitiv unmittelbar zu seiner Linken in der Tabelle.)        |
| <b>SA</b>               | local network source MAC layer address              | MAC-Schicht-Adresse der lokalen Netzwerkquelle                                                                                        |
| <b>SAP</b>              | service access point                                | Dienstzugangspunkt                                                                                                                    |
| <b>SC</b>               | ARCNET system code                                  | ARCNET-Systemcode (X'CD' für BACnet)                                                                                                  |
| <b>SDU</b>              | service data unit                                   | Dienstdateneinheit                                                                                                                    |
| <b>SIA</b>              | Security Industry Association                       | Security Industry Association                                                                                                         |
| <b>SID</b>              | ARCNET source MAC address                           | MAC-Adresse der ARCNET-Quelle                                                                                                         |
| <b>SK</b>               | Session Key                                         | Sitzungsschlüssel                                                                                                                     |
| <b>SLEN</b>             | 1-octet length of original source MAC layer address | 1-Oktett-Länge der MAC-Schicht-Adresse der ursprünglichen Quelle                                                                      |
| <b>SLIP</b>             | Serial Line Internet Protocol                       | Serial Line Internet Protocol (RFC 1055)                                                                                              |
| <b>SNET</b>             | 2-octet original source network number              | 2-Oktett-Netzwerknummer der ursprünglichen Quelle                                                                                     |
| <b>SPC</b>              | Standard Project Committee                          | ASHRAE-Ausschuss für Normungsvorhaben                                                                                                 |
| <b>SSAP</b>             | LLC source service access point (X'82' for BACnet)  | LLC-Quellen-Dienstzugangspunkt (X'82' für BACnet)                                                                                     |
| <b>TSM</b>              | transaction state machine                           | Transaktionszustandsmaschine                                                                                                          |
| <b>U</b>                | user option                                         | Benutzeroption                                                                                                                        |
| <b>U(=)</b>             | user option                                         | Benutzeroption (Der Parameter entspricht semantisch dem Parameter in dem Dienstprimitiv unmittelbar zu seiner Linken in der Tabelle.) |
| <b>UART</b>             | universal asynchronous receiver/transmitter         | Universeller Asynchron-Empfänger/-Sender                                                                                              |
| <b>UDP</b>              | User Datagram Protocol                              | User Datagram Protocol (RFC 768)                                                                                                      |
| <b>UTC</b>              | Universal Time Coordinated                          | Koordinierte Weltzeit                                                                                                                 |
| <b>VT</b>               | virtual terminal                                    | virtuelles Terminal                                                                                                                   |
| <b>W</b>                |                                                     | gibt an, dass eine Eigenschaft unterstützt werden und lesbar und schreibbar (writable) sein muss                                      |
| <b>X'</b>               |                                                     | gibt an, dass zwischen den Anführungszeichen eine Hexadezimalschreibweise verwendet wird                                              |
| <b>XID</b>              | eXchange IDentification                             | Exchange Identification (ISO 8802-2)                                                                                                  |

## **Nationaler Anhang NC** (informativ)

### **Literaturhinweise**

DIN ISO/IEC 9545, *Informationstechnik — Kommunikation Offener Systeme — Struktur der Anwendungsschicht*

March 2012

ICS 35.240.99; 91.040.01

Will supersede EN ISO 16484-5:2010

English Version

Building automation and control systems —  
Part 5: Data communication protocol  
(ISO/FDIS 16484-5:2012)

Systèmes d'automatisation et de gestion technique du  
bâtiment —  
Partie 5: Protocole de communication de données  
(ISO/FDIS 16484-5:2012)

Systeme der Gebäudeautomation —  
Teil 5: Datenkommunikationsprotokoll  
(ISO/FDIS 16484-5:2012)

This draft European Standard is submitted to CEN members for unique acceptance procedure. It has been drawn up by the Technical Committee CEN/TC 247.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

This draft European Standard was established by CEN in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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COMITÉ EUROPÉEN DE NORMALISATION  
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: Avenue Marnix 17, B-1000 Brussels

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## Foreword

This document (FprEN ISO 16484-5:2012) has been prepared by Technical Committee ISO/TC 205 "Building environment design" in collaboration with Technical Committee CEN/TC 247 "Building Automation, Controls and Building Management" the secretariat of which is held by SNV.

This document is currently submitted to the Unique Acceptance Procedure.

This document will supersede EN ISO 16484-5:2010.

### Endorsement notice

The text of ISO/FDIS 16484-5:2012 has been approved by CEN as a FprEN ISO 16484-5:2012 without any modification.

## 1 Scope

This part of ISO 16484 defines data communication services and protocols for computer equipment used for monitoring and control of heating, ventilation, air-conditioning and refrigeration (HVAC&R) and other building systems. It defines, in addition, an abstract, object-oriented representation of information communicated between such equipment, thereby facilitating the application and use of digital control technology in buildings. The scope and field of application are furthermore detailed in Clause 2 of the enclosed ANSI/ASHRAE publication.

## 2 Requirements

Requirements are the technical recommendations made in the following publication (reproduced on the following pages), which is adopted as an International Standard:

ANSI/ASHRAE 135-2010, *A Data Communication Protocol for Building Automation and Control Networks*

The text on the back of the title page of the ANSI/ASHRAE standard and the policy statement on the last page are not relevant for the purposes of international standardization.

The following International Standards are cited in the text:

ISO/IEC 7498 (all parts), *Information technology — Open Systems Interconnection — Basic Reference Model*

ISO/TR 8509, *Information processing systems — Open Systems Interconnection — Service conventions*

ISO/IEC 8649, *Information technology — Open Systems Interconnection — Service definition for the Association Control Service Element*

ISO/IEC 8802-2, *Information technology — Telecommunications and information exchange between systems — Local and metropolitan area networks — Specific requirements — Part 2: Logical link control*

ISO/IEC 8802-3, *Information technology — Telecommunications and information exchange between systems — Local and metropolitan area networks — Specific requirements — Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications*

ISO/IEC 8822, *Information technology — Open Systems Interconnection — Presentation service definition*

ISO/IEC 8824 (all parts), *Information technology — Abstract Syntax Notation One (ASN.1)*

ISO/IEC 8825 (all parts), *Information technology — ASN.1 encoding rules*

ISO/IEC 8859-1, *Information technology — 8-bit single-byte coded graphic character sets — Part 1: Latin alphabet No. 1*

ISO/IEC 9545, *Information technology — Open Systems Interconnection — Application Layer structure*

ISO/IEC 10646, *Information technology — Universal Coded Character Set (UCS)*

## 3 Revision of ANSI/ASHRAE 135

It has been agreed with the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) that Technical Committee ISO/TC 205 will be consulted in the event of any revision or amendment of ANSI/ASHRAE 135. To this end, ANSI will act as a liaison body between ASHRAE and ISO.



**ANSI/ASHRAE Standard 135-2010**  
(Supersedes ANSI/ASHRAE Standard 135-2008)  
Includes ANSI/ASHRAE addenda listed in the History of Revisions

# ASHRAE STANDARD



## A Data Communication Protocol for Building Automation and Control Networks

See the History of Revisions at the end of this standard for approval dates by the ASHRAE Standards Committee, the ASHRAE Board of Directors, and the American National Standards Institute.

This standard is under continuous maintenance by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the standard. The change submittal form, instructions, and deadlines may be obtained in electronic form from the ASHRAE Web site ([www.ashrae.org](http://www.ashrae.org)) or in paper form from the Manager of Standards. The latest edition of an ASHRAE Standard may be purchased from ASHRAE Customer Service, 1791 Tullie Circle, NE, Atlanta, GA 30329-2305. E-mail: [orders@ashrae.org](mailto:orders@ashrae.org). Fax: 404-321-5478. Telephone: 404-636-8400 (worldwide), or toll free 1-800-527-4723 (for orders in US and Canada). For reprint permission, go to [www.ashrae.org/permissions](http://www.ashrae.org/permissions).

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## FOREWORD

*BACnet, the ASHRAE building automation and control networking protocol, has been designed specifically to meet the communication needs of building automation and control systems for applications such as heating, ventilating, and air-conditioning control, lighting control, access control, and fire detection systems. The BACnet protocol provides mechanisms by which computerized equipment of arbitrary function may exchange information, regardless of the particular building service it performs. As a result, the BACnet protocol may be used by head-end computers, general-purpose direct digital controllers, and application specific or unitary controllers with equal effect.*

*The motivation for this Standard was the widespread desire of building owners and operators for "interoperability," the ability to integrate equipment from different vendors into a coherent automation and control system - and to do so competitively. To accomplish this, the Standard Project Committee (SPC) solicited and received input from dozens of interested firms and individuals; reviewed all relevant national and international data communications standards, whether de facto or the result of committee activity; and spent countless hours in debate and discussion of the pros and cons of each element of the protocol.*

*What has emerged from the committee deliberations is a network protocol model with these principal characteristics:*

*(a) All network devices (except MS/TP slaves) are peers, but certain peers may have greater privileges and responsibilities than others.*

*(b) Each network device is modeled as a collection of network-accessible, named entities called "objects." Each object is characterized by a set of attributes or "properties." While this Standard prescribes the most widely applicable object types and their properties, implementors are free to create additional object types if desired. Because the object model can be easily extended, it provides a way for BACnet to evolve in a backward compatible manner as the technology and building needs change.*

*(c) Communication is accomplished by reading and writing the properties of particular objects and by the mutually acceptable execution of other protocol "services." While this Standard prescribes a comprehensive set of services, mechanisms are also provided for implementors to create additional services if desired.*

*(d) Because of this Standard's adherence to the ISO concept of a "layered" communication architecture, the same messages may be exchanged using various network access methods and physical media. This means that BACnet networks may be configured to meet a range of speed and throughput requirements with commensurately varying cost. Multiple BACnet networks can be interconnected within the same system forming an internetwork of arbitrarily large size. This flexibility also provides a way for BACnet to embrace new networking technologies as they are developed.*

*BACnet was designed to gracefully improve and evolve as both computer technology and demands of building automation systems change. Upon its original publication in 1995, a Standing Standards Project Committee was formed to deliberate enhancements to the protocol under ASHRAE rules for "continuous maintenance." Much has happened since the BACnet standard was first promulgated. BACnet has been translated into Chinese, Japanese, and Korean, and embraced across the globe. BACnet devices have been designed, built and deployed on all seven continents. Suggestions for enhancements and improvements have been continually received, deliberated, and, ultimately, subjected to the same consensus process that produced the original standard. This publication is the result of those deliberations and brings together all of the corrections, refinements, and improvements that have been adopted.*

*Among the features that have been added to BACnet are: increased capabilities to interconnect systems across wide area networks using internet protocols, new objects and services to support fire detection and other life safety applications, capabilities to backup and restore devices, standard ways to collect trend data, new tools to make specifying BACnet systems easier, a mechanism for making interoperable extensions to the standard visible, and many others. The successful addition of these features demonstrates that the concept of a protocol deliberately crafted to permit extension of its capabilities over time as technology and needs change is viable and sound.*

*All communication protocols are, in the end, a collection of arbitrary solutions to the problems of information exchange and all are subject to change as time and technology advance. BACnet is no exception. Still, it is the hope of those who have contributed their time, energies, and talents to this work that BACnet will help to fulfill, in the area of building automation and control, the promise of the information age for the public good!*

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## 1 PURPOSE

The purpose of this standard is to define data communication services and protocols for computer equipment used for monitoring and control of HVAC&R and other building systems and to define, in addition, an abstract, object-oriented representation of information communicated between such equipment, thereby facilitating the application and use of digital control technology in buildings.

## 2 SCOPE

**2.1** This protocol provides a comprehensive set of messages for conveying encoded binary, analog, and alphanumeric data between devices including, but not limited to:

- (a) hardware binary input and output values,
- (b) hardware analog input and output values,
- (c) software binary and analog values,
- (d) text string values,
- (e) schedule information,
- (f) alarm and event information,
- (g) files, and
- (h) control logic.

**2.2** This protocol models each building automation and control computer as a collection of data structures called "objects," the properties of which represent various aspects of the hardware, software, and operation of the device. These objects provide a means of identifying and accessing information without requiring knowledge of the details of the device's internal design or configuration.

## 3 DEFINITIONS

### 3.1 Terms Adopted from International Standards

The following terms used in this standard are defined by international standards or draft standards for open system interconnection (OSI). The definitions are repeated here and a reference to the appropriate standard is provided. Clause 25 contains the titles of all national and international standards referenced in this clause and elsewhere in this standard. Words or phrases in *italics* refer to terms defined elsewhere in this clause.

**abstract syntax:** the specification of application layer data or *application-protocol-control-information* by using notation rules which are independent of the encoding technique used to represent them (ISO 8822).

**application:** a set of a USER's information processing requirements (ISO 8649).

**application-entity:** the aspects of an *application-process* pertinent to OSI (ISO 7498).

**application-process:** an element within a *real open system* which performs the information processing for a particular *application* (ISO 7498).

**application-protocol-control-information:** information exchanged between *application-entities*, using presentation services, to coordinate their joint operation (ISO 9545).

**application-protocol-data-unit:** a unit of data specified in an application protocol and consisting of *application-protocol-control-information* and possibly application-user-data (ISO 9545).

**application-service-element:** that part of an *application-entity* which provides an OSI environment capability, using underlying services when appropriate (ISO 7498).

**concrete syntax:** those aspects of the rules used in the formal specification of data which embody a specific representation of that data (ISO 7498).

**confirm (primitive):** a representation of an interaction in which a *service-provider* indicates, at a particular *service-access-point*, completion of some procedure previously invoked, at that *service-access-point*, by an interaction represented by a *request* primitive (ISO TR 8509).

**indication (primitive):** a representation of an interaction in which a *service-provider* either  
(a) indicates that it has, on its own initiative, invoked some procedure; or  
(b) indicates that a procedure has been invoked by the *service-user* at the peer *service-access-point* (ISO TR 8509).

**peer-entities:** *entities* within the same layer (ISO 7498).

**real open system:** a *real system* which complies with the requirements of OSI standards in its communication with other *real systems* (ISO 7498).

**real system:** a set of one or more computers, the associated software, peripherals, terminals, human operators, physical processes, information transfer means, etc., that forms an autonomous whole capable of performing information processing and/or information transfer (ISO 7498).

**request (primitive):** a representation of an interaction in which a *service-user* invokes some procedure (ISO TR 8509).

**response (primitive):** a representation of an interaction in which a *service-user* indicates that it has completed some procedure previously invoked by an interaction represented by an *indication* primitive (ISO TR 8509).

**(N)-service-access-point:** the point at which (N)-services are provided by an (N)-*entity* to an (N+1)-*entity* (ISO 7498).

**(N)-service-data-unit:** an amount of (N)-interface-data whose identity is preserved from one end of an (N)-connection to the other (ISO 7498).

**service-user:** an *entity* in a single open system that makes use of a service through *service-access-points* (ISO TR 8509).

**service-primitive; primitive:** an abstract, implementation-independent representation of an interaction between the *service-user* and the *service-provider* (ISO TR 8509).

**service-provider:** an abstract of the totality of those entities which provide a service to peer *service-users* (ISO TR 8509).

**transfer-syntax:** that *concrete syntax* used in the transfer of data between open systems (ISO 7498).

**user element:** the representation of that part of an *application-process* which uses those *application-service-elements* needed to accomplish the communications objectives of that *application-process* (ISO 7498).

### 3.2 Terms Defined for this Standard

**access control:** a method for regulating or restricting access to *network resources*.

**access rights (physical access control):** the access privileges granted to a credential.

**access user (physical access control):** the person or asset holding one or more credentials.

**alarm: 1.** An annunciation, either audible or visual or both, that alerts an operator to an off-normal condition that may require corrective action. **2.** An abnormal condition detected by a device or controller that implements a rule or logic specifically designed to look for that condition.

**algorithmic change reporting:** the detection and reporting of an alarm or event, based on an algorithm specified in an Event Enrollment object. See *intrinsic reporting*.

**authentication:** the act of verifying identity

**authentication factor:** a data element of the credential which is used to verify a credential's identity.

**authorization (network security):** the control of access to network resources based on known identity and access rules.

**authorization (physical access control):** the process of determining whether the access user is permitted to enter a protected zone through an access controlled point.

**BACnet device:** any device, real or virtual, that supports digital communication using the BACnet protocol.

**BACnet-user:** that portion of an *application-process* that is represented by the BACnet *user element*.

**bridge:** a device that connects two or more *segments* at the physical and data link layers. This device may also perform message filtering based upon MAC layer addresses.

**broadcast:** a message sent as a single unit, which may apply to more than one device.

**change of state:** an event that occurs when a measured or calculated Boolean or discrete enumerated value changes.

**change of value:** an event that occurs when a measured or calculated analog value changes by a predefined amount.

**client:** a system or device that makes use of another device for some particular purpose via a service *request* instance. A client requests service from a *server*.

**context:** a set of data or information that completely describes a particular communication environment at a particular point in time.

**controller:** a device for regulation or management of a system or component.

**credential (physical access control):** the combination of authentication factors and access rights.

**data confidentiality:** the property that information is not made available or disclosed to unauthorized individuals, entities, or processes.

**data integrity:** the property that data has not been altered or destroyed in an unauthorized manner.

**data origin authentication:** the corroboration that the source of data received is as claimed.

**date pattern:** a date that may contain one or more unspecified octets or special date values.

**directly connected network:** a network that is accessible from a router without messages being relayed through an intervening router. A PTP connection is to a directly connected network if the PTP connection is currently active and no intervening router is used.

**download:** a particular type of file transfer that refers to the transfer of an executable program or database to a remote device where it may be executed.

**encrypted message:** a message that is wrapped in a security header, signed, and encrypted.

**entity:** something that has a separate and distinct existence. An identifiable item that is described by a set or collection of properties.

**error detection:** a procedure used to identify the presence of errors in a communication.

**error recovery:** a procedure invoked in response to a detected error that permits the information exchange to continue.

**gateway:** a device that connects two or more dissimilar *networks*, permitting information exchange between them.

**global:** pertaining to all devices or nodes on a communication *internetwork*.

**global broadcast:** a message addressed to all devices or *nodes* on all *networks* in a BACnet *internet*.

**half router:** a device or *node* that can participate as one partner in a PTP connection. The two half-router partners that form an active PTP connection together make up a single *router*.

**incapable device:** a device that is inherently incapable, or has been configured to be appear to be incapable, of producing or consuming secure BACnet messages. All incapable devices are plain devices.

**initialization:** the process of establishing a known state, usually from a power up condition. Initialization may require re-establishment of a node's logical or physical address.

**internetwork:** a set of two or more *networks* interconnected by *routers*. In a BACnet *internetwork*, there exists exactly one message path between any two nodes.

**intrinsic reporting:** the detection and reporting of an alarm or event, based on an algorithm defined as part of the *object type* specification. No external reference to an Event Enrollment is involved. See *algorithmic change reporting*.

**inverted network:** a BACnet internetwork where two or more networks are connected by a network with an NPDU size smaller than the networks it joins.

**key:** a sequence of symbols that controls the operations of encipherment and decipherment.

**local:** pertaining to devices on the same *network* as the referenced device.

**local broadcast:** a message addressed to all devices or *nodes* on the same *network* as the originator.

**medium:** the physical transmission *entity*. Typical media are twisted-pair wire, fiber optic cable, and coaxial cable.

**medium access control:** a process used to maintain order and provide access to the communication *medium*.

**network:** a set of one or more *segments* interconnected by *bridges* that have the same network address.

**network resource:** any physical or logical *entity* that may be accessed via a communication *medium*.

**node:** an addressable device connected to the communication *medium*.

**object:** a specific instance of an *object type*. While an object type is identified by a unique Object\_Type property, an object is identified by its Object\_Identifier property.

**object profile:** an object profile is a means of defining objects beyond those defined in Clause 12. A profile defines the set of properties, behavior, and/or requirements for a proprietary object, or for proprietary extensions to a standard object.

**object type:** a generic classification of data that is defined by a set of *properties*.

**operator authentication:** the corroboration that the operator logging on to a device is as claimed.

**peer entity authentication:** the corroboration that a peer entity in an association is the one claimed.

**physical access control (PACS):** an electronic system that controls the ability of people or vehicles to enter a protected area, by means of authentication and authorization at access control points.

**physical segment:** a single contiguous *medium* to which BACnet nodes are attached.

**physically insecure:** not physically secure.

**physically secure:** a device or network that is protected from physical access by unauthorized individuals.

**plain device:** a device that does not normally produce or consume secure BACnet messages. All incapable devices are plain devices. However, a plain device that is not an incapable device is capable of producing or consuming secure BACnet messages when communicating with another device that requires it.

**plain network:** a network that does not require signed or encrypted traffic.

**plain message:** a message that is not secured by a BACnet security wrapper.

**printable character:** a character that represents a printable symbol as opposed to a device control character. Printable characters include, but are not limited to, upper- and lowercase letters, punctuation marks, and mathematical symbols. The exact set depends upon the character set being used.

**property:** a particular characteristic of an *object type*.

**proprietary:** within the context of BACnet, any extension of or addition to *object types*, *properties*, PrivateTransfer services, or enumerations specified in this standard.

**receiving BACnet-user:** the *BACnet-user* that receives an *indication* or *confirm* service primitive.

**remote:** pertaining to devices or *nodes* on a different *network* than the referenced device.

**remote broadcast:** a message addressed to all devices or *nodes* on a different *network* than the originator.

**repeater:** a device that connects two or more *physical segments* at the physical layer.

**requesting BACnet-user:** the *BACnet-user* that assumes the role of a *client* in a confirmed service.

**responding BACnet-user:** the *BACnet-user* that assumes the role of a *server* in a confirmed service.

**role-based access control (RBAC):** access privileges that are assigned to specific roles. Access users acquire privileges through their assigned role.

**router:** a device that connects two or more *networks* at the network layer.

**secure network:** a network on which all traffic is required to be signed or encrypted.

**security:** any of a variety of procedures used to ensure that information exchange is guarded to prevent disclosure to unauthorized individuals. Security measures are intended to prevent disclosure of sensitive information even to those who have valid access to the communication *network*. Security is distinct from access control, although some security can be provided by limiting physical access to the communication medium itself.

**segment:** a segment consists of one or more *physical segments* interconnected by repeaters.

**sending BACnet-user:** the *BACnet-user* that issues a *request* or *response* service primitive.

**server:** a system or device that responds to a service *request* instance for some particular purpose. The server provides service to a *client*.

**signed message:** a message that is wrapped in a security header, signed, and not encrypted.

**special date value:** a date value that is one of the special values such as "even months", "last day of month", etc. These special date values are used in subcomponents (octets) of a value of type Date.

**specific date:** a fully specified date. For example, January 24, 1991, Day of week = Thursday. A specific date shall contain no unspecified octets or Special Date Values.

**specific datetime:** a BACnetDateTime construct composed of a specific date and a specific time.

**specific time:** a fully specified time. For example, 17:35:45.17 (= 5:35:45.17 P.M.). A specific time shall contain no unspecified octets.

**standard object type:** an object type defined by this standard where the numerical value is within the range reserved for ASHRAE.

**standard property:** a required or optional property of a standard object type where the numerical value of the property identifier is within the range reserved for ASHRAE and the property is listed in the object type's properties table in Clause 12.

**synchronization:** a facility that allows processes to define and identify specific places in a transmission or exchange that can be used to reset a communication session to a predefined state.

**time pattern:** a time that may contain one or more unspecified octets.

**timestamp:** the indication of the point in time recorded for and accompanying the record of an event or operation.

**trusted:** a term used to refer to devices or networks from which messages are believed to be authentic, either through the use of secure messages or based on the physical security of that device or network.

**unit\_time:** the length of time required to transmit one octet with a start bit and a single stop bit. Ten bit-times.

**unspecified date:** a date composed entirely of unspecified octets (A value of X'FF' = D'255').

**unspecified datetime:** a BACnetDateTime construct composed of an unspecified date and an unspecified time.

**unspecified octet:** an octet used in the context of date, time or BACnetWeekNDay values that contains the value X'FF' = D'255'.

**unspecified time:** a time composed entirely of unspecified octets (A value of X'FF' = D'255').

**upload:** the process of transferring an executable program image or a database from a remote device in such a manner as to allow subsequent download.

### 3.3 Abbreviations and Acronyms Used in this Standard

|               |                                                                |
|---------------|----------------------------------------------------------------|
| <b>A</b>      | application layer (prefix)                                     |
| <b>ABA</b>    | American Bankers Association                                   |
| <b>AE</b>     | application entity                                             |
| <b>ANSI</b>   | American National Standards Institute                          |
| <b>APCI</b>   | application protocol control information                       |
| <b>APDU</b>   | application layer protocol data unit                           |
| <b>API</b>    | application program interface                                  |
| <b>ARCNET</b> | attached resource computer network                             |
| <b>ASE</b>    | application service element                                    |
| <b>ASN.1</b>  | Abstract Syntax Notation One (ISO 8824)                        |
| <b>B' '</b>   | denotes that binary notation is used between the single quotes |
| <b>BAC</b>    | building automation and control                                |
| <b>BBMD</b>   | BACnet/IP broadcast management device                          |
| <b>BDT</b>    | broadcast distribution table                                   |
| <b>B/IP</b>   | BACnet/IP                                                      |
| <b>B/IP-M</b> | BACnet/IP multicast                                            |
| <b>BVLC</b>   | BACnet virtual link control                                    |

|                |                                                                                                                                                        |
|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>BVLCI</b>   | BACnet virtual link control information                                                                                                                |
| <b>BVLL</b>    | BACnet virtual link layer                                                                                                                              |
| <b>C</b>       | conditional                                                                                                                                            |
| <b>C(=)</b>    | conditional (The parameter is semantically equivalent to the parameter in the service primitive to its immediate left in the table.)                   |
| <b>CNF</b>     | confirm primitive                                                                                                                                      |
| <b>COV</b>     | change of value                                                                                                                                        |
| <b>CRC</b>     | cyclic redundancy check                                                                                                                                |
| <b>D' '</b>    | denotes that decimal notation is used between the single quotes                                                                                        |
| <b>DA</b>      | local destination MAC layer address                                                                                                                    |
| <b>DADR</b>    | ultimate destination MAC layer address                                                                                                                 |
| <b>DER</b>     | data expecting reply                                                                                                                                   |
| <b>DES</b>     | Data Encryption Standard (FIPS 46-1)                                                                                                                   |
| <b>DESFire</b> | Data Encryption Standard Fast, Innovative, Reliable and Secure                                                                                         |
| <b>DID</b>     | ARCNET destination MAC address                                                                                                                         |
| <b>DLEN</b>    | 1-octet length of ultimate destination MAC layer address                                                                                               |
| <b>DNET</b>    | 2-octet ultimate destination network number                                                                                                            |
| <b>DSAP</b>    | LLC destination service access point (X'82' for BACnet)                                                                                                |
| <b>EIB</b>     | European Installation Bus                                                                                                                              |
| <b>EIBA</b>    | European Installation Bus Association                                                                                                                  |
| <b>EXEC</b>    | capable of executing a service request                                                                                                                 |
| <b>FDT</b>     | foreign device table                                                                                                                                   |
| <b>ICI</b>     | interface control information                                                                                                                          |
| <b>IL</b>      | ARCNET information length field                                                                                                                        |
| <b>IND</b>     | indication primitive                                                                                                                                   |
| <b>INF</b>     | "Infinity", a unique binary pattern representing positive infinity (see ANSI/IEEE 754-1985)                                                            |
| <b>-INF</b>    | "Negative infinity", a unique binary pattern representing negative infinity (see ANSI/IEEE 754-1985)                                                   |
| <b>IEEE</b>    | Institute of Electrical and Electronics Engineers                                                                                                      |
| <b>INIT</b>    | capable of initiating a service request                                                                                                                |
| <b>IP</b>      | Internet Protocol - RFC 791                                                                                                                            |
| <b>ISO</b>     | International Organization for Standardization                                                                                                         |
| <b>KNX</b>     | The Konnex System Specification: EIB is the core protocol of the Konnex standard. The Konnex System Specification reflects the current status for EIB. |
| <b>L</b>       | data link (prefix)                                                                                                                                     |
| <b>LAN</b>     | local area network                                                                                                                                     |
| <b>LLC</b>     | logical link control (ISO 8802-2)                                                                                                                      |
| <b>LPCI</b>    | link protocol control information                                                                                                                      |
| <b>LPDU</b>    | link protocol data unit                                                                                                                                |
| <b>LRC</b>     | Longitudinal Redundancy Check                                                                                                                          |
| <b>LSAP</b>    | link service access point (X'82' for BACnet)                                                                                                           |
| <b>LSDU</b>    | link service data unit                                                                                                                                 |
| <b>M</b>       | mandatory                                                                                                                                              |
| <b>M(=)</b>    | mandatory (The parameter is semantically equivalent to the parameter in the service primitive to its immediate left in the table.)                     |
| <b>MA</b>      | medium access (prefix)                                                                                                                                 |
| <b>MAC</b>     | medium access control                                                                                                                                  |
| <b>MPCI</b>    | MAC protocol control information                                                                                                                       |
| <b>MPDU</b>    | MAC layer protocol data unit                                                                                                                           |
| <b>MSDU</b>    | MAC service data unit                                                                                                                                  |
| <b>MS/TP</b>   | master-slave/token-passing                                                                                                                             |
| <b>N</b>       | network layer (prefix)                                                                                                                                 |
| <b>NaN</b>     | "Not a Number", a unique binary pattern representing an invalid number (see ANSI/IEEE 754-1985)                                                        |
| <b>NAT</b>     | Network Address Translation - RFC 2663                                                                                                                 |
| <b>NP</b>      | network priority                                                                                                                                       |
| <b>NPCI</b>    | network protocol control information                                                                                                                   |
| <b>NPDU</b>    | network layer protocol data unit                                                                                                                       |

### 3. DEFINITIONS

|             |                                                                                                                                      |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------|
| <b>NRZ</b>  | non-return to zero                                                                                                                   |
| <b>NSAP</b> | network service access point                                                                                                         |
| <b>NSDU</b> | network service data unit                                                                                                            |
| <b>O</b>    | indicates that support of a property is optional                                                                                     |
| <b>OSI</b>  | open systems interconnection                                                                                                         |
| <b>P</b>    | physical layer (prefix)                                                                                                              |
| <b>PAC</b>  | ARCNET data packet header octet                                                                                                      |
| <b>PCI</b>  | protocol control information                                                                                                         |
| <b>PDU</b>  | protocol data unit                                                                                                                   |
| <b>PICS</b> | protocol implementation conformance statement                                                                                        |
| <b>PK</b>   | Private Key                                                                                                                          |
| <b>PPCI</b> | physical layer protocol control information                                                                                          |
| <b>PPDU</b> | physical protocol data unit                                                                                                          |
| <b>PPP</b>  | Point-To-Point protocol - RFC 1661                                                                                                   |
| <b>PSDU</b> | physical service data unit                                                                                                           |
| <b>PTP</b>  | point-to-point                                                                                                                       |
| <b>R</b>    | indicates that a property shall be supported and readable using BACnet services                                                      |
| <b>REQ</b>  | request primitive                                                                                                                    |
| <b>RFC</b>  | request for comment                                                                                                                  |
| <b>RSP</b>  | response primitive                                                                                                                   |
| <b>S</b>    | selection                                                                                                                            |
| <b>S(=)</b> | selection (The parameter is semantically equivalent to the parameter in the service primitive to its immediate left in the table.)   |
| <b>SA</b>   | local network source MAC layer address                                                                                               |
| <b>SAP</b>  | service access point                                                                                                                 |
| <b>SC</b>   | ARCNET system code (X'CD' for BACnet)                                                                                                |
| <b>SDU</b>  | service data unit                                                                                                                    |
| <b>SIA</b>  | Security Industry Association                                                                                                        |
| <b>SID</b>  | ARCNET source MAC address                                                                                                            |
| <b>SK</b>   | Session Key                                                                                                                          |
| <b>SLEN</b> | 1-octet length of original source MAC layer address                                                                                  |
| <b>SLIP</b> | Serial Line Internet Protocol -RFC 1055                                                                                              |
| <b>SNET</b> | 2-octet original source network number                                                                                               |
| <b>SPC</b>  | standard project committee                                                                                                           |
| <b>SSAP</b> | LLC source service access point (X'82' for BACnet)                                                                                   |
| <b>TSM</b>  | transaction state machine                                                                                                            |
| <b>U</b>    | user option                                                                                                                          |
| <b>U(=)</b> | user option (The parameter is semantically equivalent to the parameter in the service primitive to its immediate left in the table.) |
| <b>UART</b> | universal asynchronous receiver/transmitter                                                                                          |
| <b>UDP</b>  | User Datagram Protocol - RFC 768                                                                                                     |
| <b>UTC</b>  | Universal Time Coordinated                                                                                                           |
| <b>VT</b>   | virtual terminal                                                                                                                     |
| <b>W</b>    | indicates that a property shall be supported, readable, and writable using BACnet services                                           |
| <b>X'</b>   | denotes that hexadecimal notation is used between the single quotes                                                                  |
| <b>XID</b>  | eXchange IDentification (ISO 8802-2)                                                                                                 |

#### 4 BACnet PROTOCOL ARCHITECTURE

The Open System Interconnection (OSI) - Basic Reference Model (ISO 7498) is an international standard that defines a model for developing multi-vendor computer communication protocol standards. The OSI model addresses the general problem of computer-to-computer communication and breaks this very complex problem into seven smaller, more manageable sub-problems, each of which concerns itself with a specific communication function. Each of these sub-problems forms a "layer" in the protocol architecture.

The seven layers are arranged in a hierarchical fashion as shown in Figure 4-1. A given layer provides services to the layers above and relies on services provided to it by the layers below. Each layer can be thought of as a black box with carefully defined interfaces on the top and bottom. An application process connects to the OSI application layer and communicates with a second, remote application process. This communication appears to take place between the two processes as if they were connected directly through their application layer interfaces. Minimal knowledge or understanding of the other layers is required. In a similar manner, each layer of the protocol relies on lower layers to provide communication services and establishes a virtual peer-to-peer communication with its companion layer on the other system. The only real connection takes place at the physical layer.

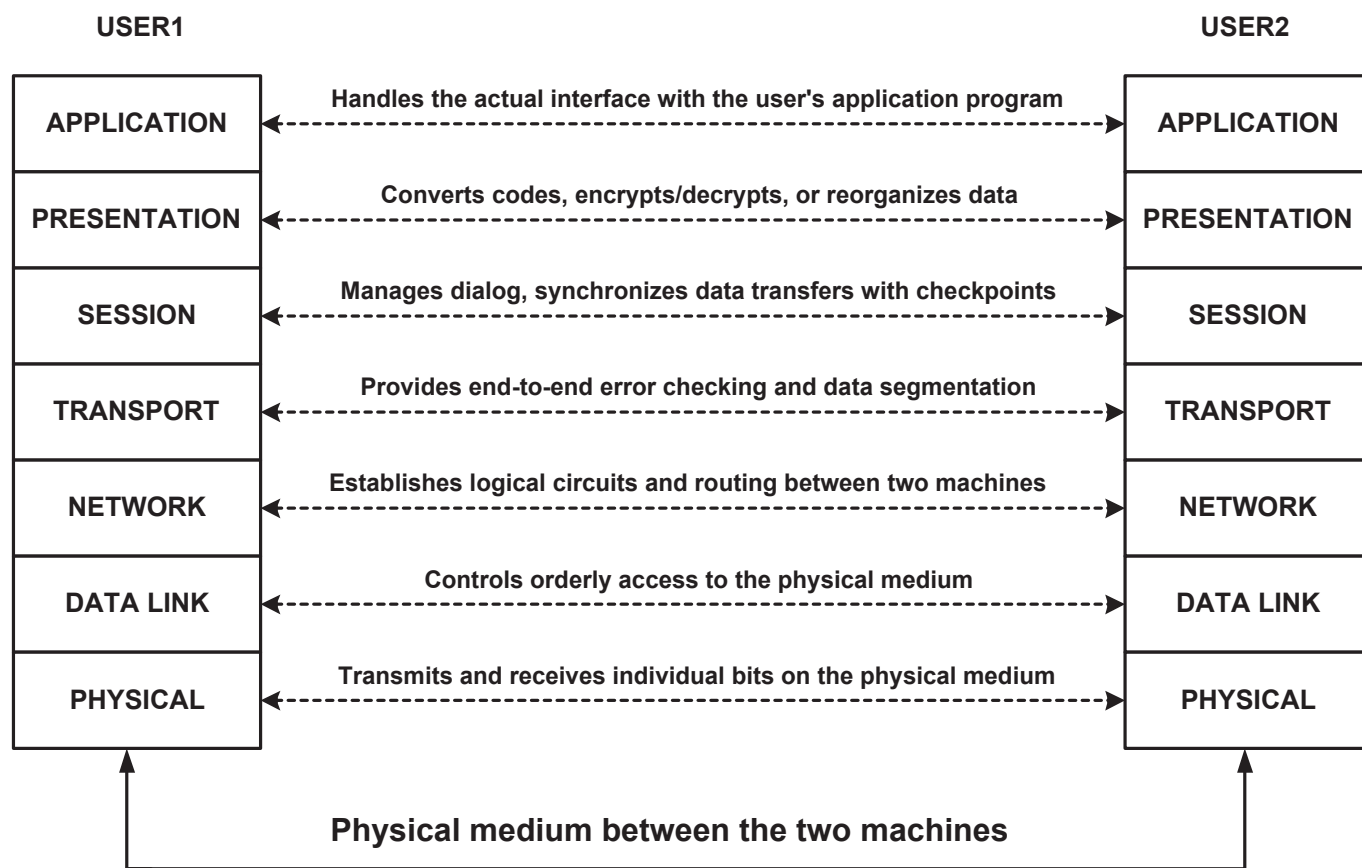


Figure 4-1. The ISO Open Systems Interconnection Basic Reference Model.

The OSI model addresses computer-to-computer communication from a very general perspective. It was designed to deal with the problems associated with computers in large, complex networks communicating with other computers in networks anywhere in the world. In this environment, computers can be separated by long distances and the messages might pass through several intermediate points, each of which may have to make routing decisions or perform some type of translation. Complex synchronization and error recovery schemes may also be needed.

The cost of implementing such a protocol today is prohibitively high for most building automation applications and is not generally required. Nevertheless, the OSI model is a good one to use for a building automation protocol if consideration is

given to including only the OSI functionality that is actually needed, thereby collapsing the seven-layer architecture. In a collapsed architecture, only selected layers of the OSI model are included. The other layers are effectively null, thus reducing message length and communication processing overhead. Such a collapsed architecture permits the building automation industry to take advantage of lower cost, mass-produced processor and local area network technologies such as have been developed for the process control and office automation industries. The use of readily available, widespread technologies, such as Ethernet,<sup>1</sup> ARCNET,<sup>2</sup> and LonTalk,<sup>3</sup> will lower the cost, increase performance, and open new doors to system integration.

#### 4.1 The BACnet Collapsed Architecture

BACnet is based on a four-layer collapsed architecture that corresponds to the physical, data link, network, and application layers of the OSI model as shown in Figure 4-2. The application layer and a simple network layer are defined in the BACnet standard. BACnet provides seven options that correspond to the OSI data link and physical layers. Option 1 is the logical link control (LLC) protocol defined by ISO 8802-2 Type 1, combined with the ISO 8802-3 medium access control (MAC) and physical layer protocol. ISO 8802-2 Type 1 provides unacknowledged connectionless service only. ISO 8802-3 is the international standard version of the well-known "Ethernet" protocol. Option 2 is the ISO 8802-2 Type 1 protocol combined with ARCNET (ATA 878.1). Option 3 is a Master-Slave/Token-Passing (MS/TP) protocol designed specifically for building automation and control devices as part of the BACnet standard. The MS/TP protocol provides an interface to the network layer that looks like the ISO 8802-2 Type 1 protocol and controls access to an EIA-485 physical layer. Option 4, the Point-To-Point protocol, provides mechanisms for hardwired or dial-up serial, asynchronous communication. Option 5 is the LonTalk protocol. Option 6, BACnet/IP, permits BACnet devices to use standard Internet Protocols (UDP and IP) as a virtual data link layer. Option 7, ZigBee, provides a wireless datalink. Collectively these options provide a master/slave MAC, deterministic token-passing MAC, high-speed contention MAC, dial-up access, star and bus topologies, and a choice of twisted-pair, coax, or fiber optic media, in addition to wireless connectivity. The details of these options are described in Clauses 7 through 11 Annex J, and Annex O.

A four-layer collapsed architecture was chosen after careful consideration of the particular features and requirements of BAC networks, including a constraint that protocol overhead needed to be as small as possible. The reasoning behind the selection of the physical, data link, network, and application layers for inclusion in the BACnet architecture is outlined in this subclause.

What layers are required for the proper operation of a BAC network? BAC networks are local area networks. This is true even though in some applications it is necessary to exchange information with devices in a building that is very far away. This long-distance communication is done through telephone networks. The routing, relaying, and guaranteed delivery issues are handled by the telephone system and can be considered external to the BAC network. BAC devices are static. They don't move from place to place and the functions that they are asked to perform do not change in the sense that a manufacturing device may make one kind of part today and some very different part tomorrow. These are among the features of BAC networks that can be used to evaluate the appropriateness of the layers in the OSI model.

| BACnet Layers                     |        |         |         |         |        |        | Equivalent OSI Layers |
|-----------------------------------|--------|---------|---------|---------|--------|--------|-----------------------|
| BACnet Application Layer          |        |         |         |         |        |        | Application           |
| BACnet Network Layer              |        |         |         |         |        |        | Network               |
| ISO 8802-2 (IEEE 802.2)<br>Type 1 |        | MS/TP   | PTP     | LonTalk | BVLL   | BZLL   | Data Link             |
| ISO 8802-3<br>(IEEE 802.3)        | ARCNET | EIA-485 | EIA-232 |         | UDP/IP | ZigBee | Physical              |

Figure 4-2. BACnet collapsed architecture.

<sup>1</sup> Ethernet is a registered trademark of Digital Equipment Corporation, Intel, and Xerox and is the basis for international standard ISO 8802-3.

<sup>2</sup> ARCNET is a registered trademark of Datapoint Corporation.

<sup>3</sup> LonTalk is a registered trademark of Echelon Corporation.

The physical layer provides a means of connecting the devices and transmitting the electronic signals that convey the data. Clearly the physical layer is needed in a BAC protocol.

The data link layer organizes the data into frames or packets, regulates access to the medium, provides addressing, and handles some error recovery and flow control. These are all functions that are required in a BAC protocol. The conclusion is that the data link layer is needed.

Functions provided by the network layer include translation of global addresses to local addresses, routing messages through one or more networks, accommodating differences in network types and in the maximum message size permitted by those networks, sequencing, flow control, error control, and multiplexing. BACnet is designed so that there is only one logical path between devices, thus eliminating the need for optimal path routing algorithms. A network is made up of one or more physical segments connected by repeaters or bridges but with a single local address space. In the case of a single network, most network layer functions are either unnecessary or duplicate data link layer functions. For some BACnet systems, however, the network layer is a necessity. This is the case when two or more networks in a BACnet internet use different MAC layer options. When this occurs, there is a need to recognize the difference between local and global addresses and to route messages to the appropriate networks. BACnet provides this limited network layer capability by defining a network layer header that contains the necessary addressing and control information.

The transport layer is responsible for guaranteeing end-to-end delivery of messages, segmentation, sequence control, flow control, and error recovery. Most of the functions of the transport layer are similar to functions in the data link layer, though different in scope. The scope of transport layer services is end-to-end whereas the scope of data link services is point-to-point across a single network. Since BACnet supports configurations with multiple networks, the protocol must provide the end-to-end services of the transport layer. Guaranteed end-to-end delivery and error recovery are provided in the BACnet application layer via message retry and timeout capabilities. Message segmentation and end-to-end flow control is required for buffer and processor resource management. This is because potentially large amounts of information may be returned for even simple BACnet requests. These functions are provided in the BACnet application layer. Last, sequence control is required in order to properly reassemble segmented messages. This is provided in the BACnet application layer within the segmentation procedure. Since BACnet is based on a connectionless communication model, the scope of the required services is limited enough to justify implementing these at a higher layer, thus saving the communication overhead of a separate transport layer.

The session layer is used to establish and manage long dialogues between communicating partners. Session layer functions include establishing synchronization checkpoints and resetting to previous checkpoints in the event of error conditions to avoid restarting an exchange from the beginning. Most communications in a BAC network are very brief. For example, reading or writing one or a few values, notifying a device about an alarm or event, or changing a setpoint. Occasionally longer exchanges take place, such as uploading or downloading a device. The few times when the services of this layer would be helpful do not justify the additional overhead that would be imposed on the vast majority of transactions, which are very brief and do not need them.

The presentation layer provides a way for communicating partners to negotiate the transfer syntax that will be used to conduct the communication. This transfer syntax is a translation from the abstract user view of data at the application layer to sequences of octets treated as data at the lower layers. If only one transfer syntax is permitted, then the presentation layer function reduces to an encoding scheme for representing the application data. BACnet defines such a fixed encoding scheme and includes it in the application layer, making an explicit presentation layer unnecessary.

The application layer of the protocol provides the communication services required by the applications to perform their functions, in this case monitoring and control of HVAC&R and other building systems. Clearly an application layer is needed in the protocol.

In summary:

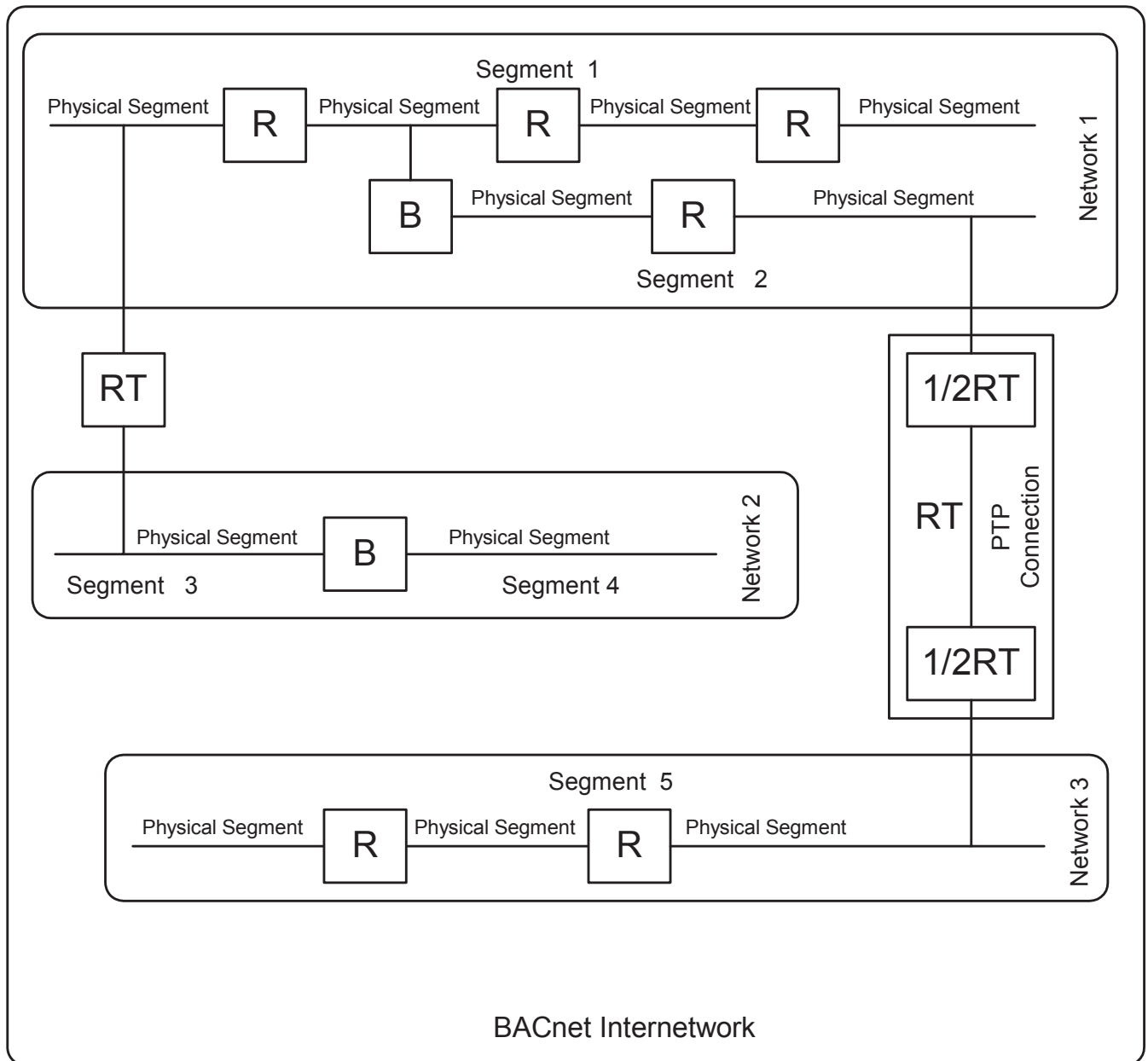
- (a) The resource and overhead costs for implementing a full OSI seven-layer architecture make it impractical for current building automation devices.
- (b) Following the OSI model offers advantages in terms of adopting existing computer networking technology. This can result in cost savings and make integration with other computer network systems easier.

- (c) The expectations and environment of building automation systems permit simplification of the OSI model by eliminating the functionality of some of the layers.
- (d) A collapsed architecture made up of the physical, data link, network, and application layers is the optimum solution for today's building automation systems.

#### 4.2 BACnet Network Topology

In the interest of application flexibility, BACnet does not prescribe a rigid network topology. Rather, BACnet devices are physically connected to one of four types of local area networks (LANs) or via dedicated or dial-up serial, asynchronous lines. These networks may then be further interconnected by BACnet routers as described in Clause 6.

In terms of LAN topology, each BACnet device is attached to an electrical medium or *physical segment*. A BACnet *segment* consists of one or more physical segments connected at the physical layer by *repeaters*. A BACnet *network* consists of one or more segments interconnected by *bridges*, devices that connect the segments at the physical and data link layers and may perform message filtering based upon MAC addresses; a network forms a single MAC address domain. Multiple networks, possibly employing different LAN technologies, may be interconnected by BACnet *routers* to form a BACnet *internetwork*. In a BACnet internetwork, there exists exactly one message path between any two nodes. These concepts are shown graphically in Figure 4-3.



B = Bridge  
R = Repeater  
RT = Router  
1/2RT = Half Router

**Figure 4-3.** A BACnet internetwork illustrating the concepts of Physical Segments, Repeaters, Segments, Bridges, Networks, Half Routers, and Routers.

#### 4. BACnet PROTOCOL ARCHITECTURE

##### 4.3 Security

The principal security threats to BACnet systems are people who, intentionally or by accident, modify a device's configuration or control parameters. Problems due to an errant computer are outside the realm of security considerations. One important place for security measures is the operator-machine interface. Since the operator-machine interface is not part of the communication protocol, vendors are free to include password protection, audit trails, or other controls to this interface as needed. In addition, write access to any properties that are not explicitly required to be "writable" by this standard may be restricted to modifications made only in virtual terminal mode or be prohibited entirely. This permits vendors to protect key properties with a security mechanism that is as sophisticated as they consider appropriate. BACnet also defines services that can be used to provide peer entity, data origin, and operator authentication. See Clause 24.

## 5 THE APPLICATION LAYER

### 5.1 The Application Layer Model

This clause presents a model of the BACnet application layer. The purpose of the model is to describe and illustrate the interaction between the application layer and application programs, the relationship between the application layer and lower layers in the protocol stack, and the peer-to-peer interactions with a remote application layer. This model is not an implementation specification.

An Application Process is that functionality within a system that performs the information processing required for a particular application. All parts of the Application Process outside the Application Layer, (i.e., those that do not concern the communication function) are outside the scope of BACnet. The part of the Application Process that is within the Application Layer is called the Application Entity. In other words, an Application Entity is that part of the Application Process related to the BACnet communication function. An application program interacts with the Application Entity through the Application Program Interface (API). This interface is not defined in BACnet, but it would probably be a function, procedure, or subroutine call in an actual implementation. These concepts are illustrated in Figure 5-1. The shaded region indicates the portion of the Application Process that is within the BACnet Application Layer.

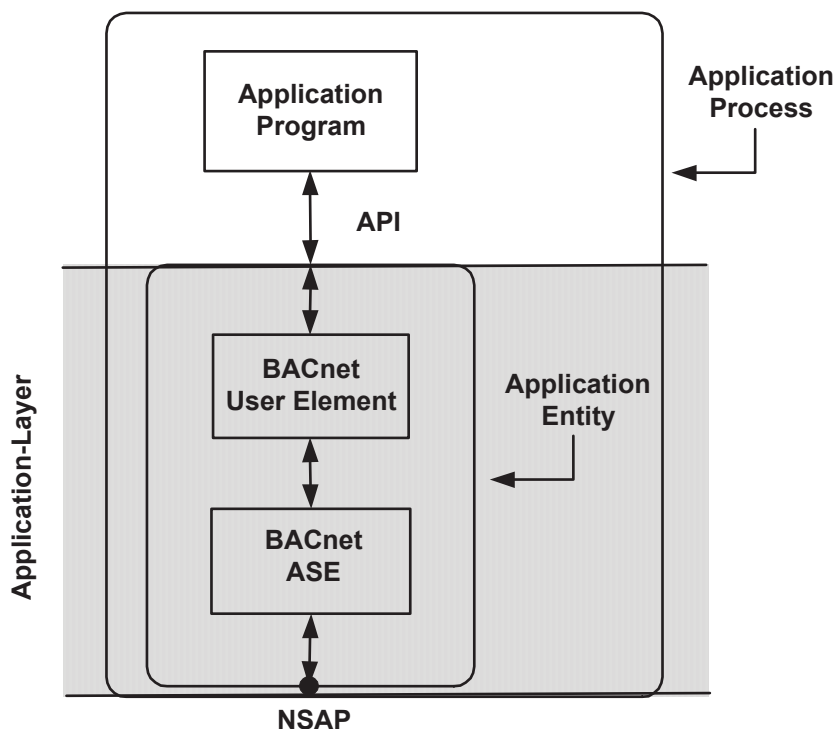


Figure 5-1. Model of a BACnet Application Process.

The Application Entity is itself made up of two parts: the BACnet User Element and the BACnet Application Service Element (ASE). The BACnet ASE represents the set of functions or application services specified in Clauses 13 through 17 and Clause 24. The BACnet User Element carries out several functions in addition to supporting the local API. It represents the implementation of the "service procedure" portion of each application service. It is responsible for maintaining information about the context of a transaction, including generating invoke IDs and remembering which invoke ID goes with which application service request (response) to (from) which device. It is also responsible for maintaining the time-out counters that are required for the retrying of a transmission. The BACnet User Element also presides over the mapping of a device's activities into BACnet objects.

Information exchanged between two peer application processes is represented in BACnet as an exchange of abstract service primitives, following the ISO conventions contained in the OSI technical report on service conventions, ISO TR 8509. These

primitives are used to convey service-specific parameters that are defined in Clauses 13 through 17 and Clause 24. Four service primitives are defined: request, indication, response, and confirm. The information contained in the primitives is conveyed using a variety of protocol data units (PDUs) defined in this standard. In order to make clear which BACnet PDU is being used, the notation will be as follows:

|                     |                        |                    |                   |
|---------------------|------------------------|--------------------|-------------------|
| CONF_SERV.request   | CONF_SERV.indication   | CONF_SERV.response | CONF_SERV.confirm |
| UNCONF_SERV.request | UNCONF_SERV.indication |                    |                   |
| SEGMENT_ACK.request | SEGMENT_ACK.indication |                    |                   |
| REJECT.request      | REJECT.indication      |                    |                   |
| ABORT.request       | ABORT.indication       |                    |                   |
|                     | SEC_ERR.indication     |                    |                   |

The designation CONF\_SERV indicates that BACnet confirmed service PDUs are being used. Similarly, the designations UNCONF\_SERV, SEGMENT\_ACK, ERROR, REJECT, and ABORT indicate that unconfirmed service PDUs, segment acknowledge PDUs, error PDUs, reject PDUs, and abort PDUs, respectively, are being used. The designation SEC\_ERR indicates that an error occurred in the BACnet security layer and is being indicated up to the BACnet application program. The format of a SEC\_ERR.indication is a local matter.

An application program that needs to communicate with a remote application process accesses the local BACnet User Element through the API. Some of the API parameters, such as the identity (address) of the device to which the service request is to be sent and protocol control information, is passed directly down to the network or data link layers. The remainder of the parameters make up an application service primitive that is passed from the BACnet User Element to the BACnet ASE. Conceptually, the application service primitive results in the generation of an APDU that becomes the data portion of a network service primitive, which is passed to the network layer through the Network Service Access Point (NSAP). Similarly this request passes down through the lower layers of the protocol stack in the local device. This process is illustrated in Figure 5-2. The message is then transmitted to the remote device, where it is passed up through the protocol stack in the remote device, eventually appearing as an indication primitive passed from the remote BACnet ASE to the remote BACnet User Element. The response from the remote device, if any, returns to the initiator of the service in a similar fashion (see Clause 5.5).

In addition to the service primitives and the service specific parameters, the application entity exchanges interface control information (ICI) parameters with the application program via the API. The content of the ICI is dependent upon the service primitive type. The ICI parameters received by the application entity provide the information that is passed on to the lower layers (as ICI across layer interfaces) to help them construct their PDUs. The ICI parameters that are provided by the application entity to the application programs contain information recovered by the lower layers from their respective PDUs.

The following ICI parameters are exchanged with the various service primitives across an API:

'destination\_address' (DA): the address of the device(s) intended to receive the service primitive. Its format (device name, network address, etc.) is a local matter. This address may also be a multicast, local broadcast or global broadcast type.

'source\_address' (SA): the address of the device from which the service primitive was received. Its format (device name, network address, etc.) is a local matter.

'network\_priority' (NP): a four-level network priority parameter described in 6.2.2.

'data\_expect\_reply' (DER): a Boolean parameter that indicates whether (TRUE) or not (FALSE) a reply service primitive is expected for the service being issued.

'security\_parameters' (SEC): The optional security parameters for the request to send, or from the received request. It indicates the level of security (Key Id, Plain/Signed/Encrypted, User Authentication data, End-To-End, etc) and its format is a local matter.