NXDN™

Next Generation Digital LMR Technology.

NXDN™ Introduction

NXDN™ History

2003: Icom Incorporated and JVCKENWOOD Corporation made a technology alliance to develop NXDN™

2005: NXDN™ protocol development was announced at IWCE 2005

2006: First NXDN™ products released to the market

2008: The NXDN™ Forum was established with an initial eight members

2009: The NXDN™ website was opened (http://www.nxdn-forum.com/)

2010: The NXDN™ Forum expanded to 16 members

2010: An informal collaboration with the dPMR™ Association announced

2011: "Type-D" NXDN™ trunking protocol added to the standards suite

2011: Five new members join the Forum and membership increases to 21

2011: AES and DES encryption standards added to the standards suite

2012: Nine new member companies join the Forum

2012: The NXDN™ Forum website was renewed

2012: The NXDN™ standards suite was opened to the public domain

2016: 7 additional new members join

2017: NXDN™ standard added to ITU-M2014 Mobile Radio report

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What is NXDN™?

NXDN™

An Introduction

- An open technical standard consisting of
  - 6.25 kHz / 12.5 kHz narrowband CAI protocols
  - “Type-C” and “Type-D” trunking protocols
  - Encryption (DES / AES) standards
  - Interoperability and Conformance test procedures
- Narrowband digital protocol / 6.25kHz FDMA technology
  - Low complexity, low cost and spectrum efficient
  - A digital alternative for analog FDMA systems
- Encourages a Multi-vendor environment
  - Radio products from multiple manufacturers
  - Test equipment, silicon chips, applications, protocol stacks

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What is NXDN™?

NXDN™

NXDN™

- **Conventional Peer to Peer**
  (12.5kHz/6.25kHz FDMA)
  - **Conventional via Repeater**
    (12.5kHz/6.25kHz FDMA)
- **Type-C NXDN™ Trunking**
  (Control Channel type trunking)
  Single site trunking
  Multi-site trunking
  (12.5kHz/6.25kHz FDMA)
- **Type-D NXDN™ Trunking**
  (No Control Channel type trunking)
  Single site trunking
  Multi-site trunking
  (6.25kHz FDMA)

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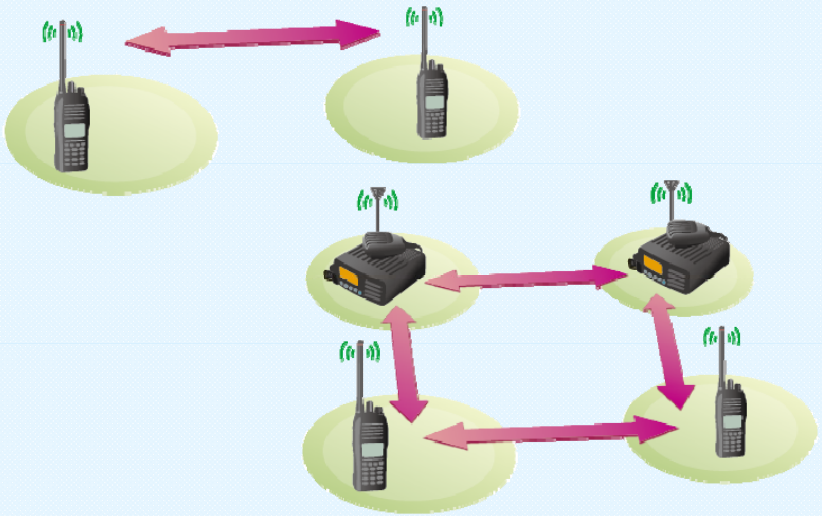
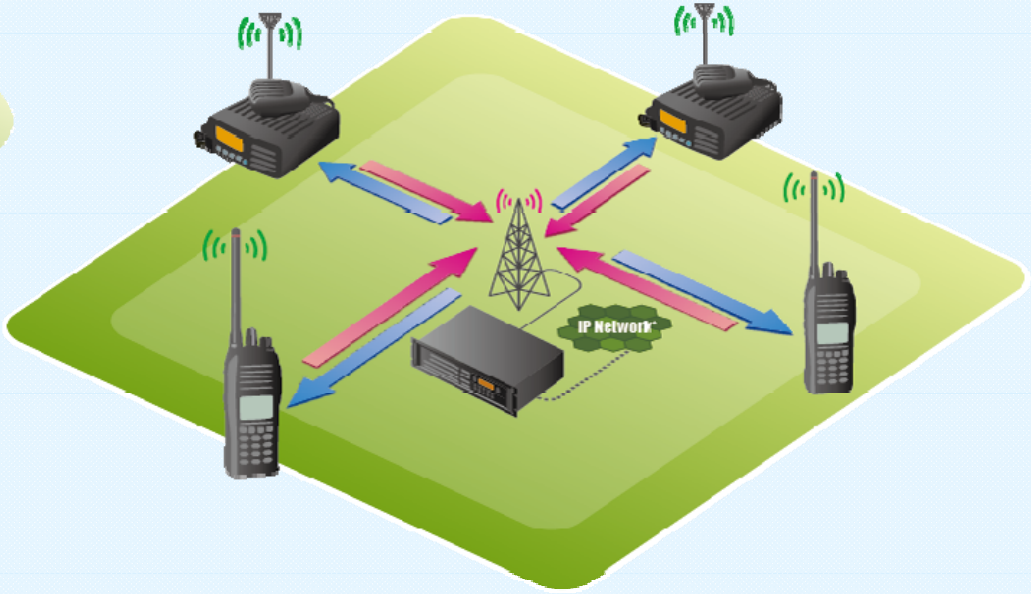
What is NXDN™?

Conventional peer to peer operation





Conventional via Repeater operation

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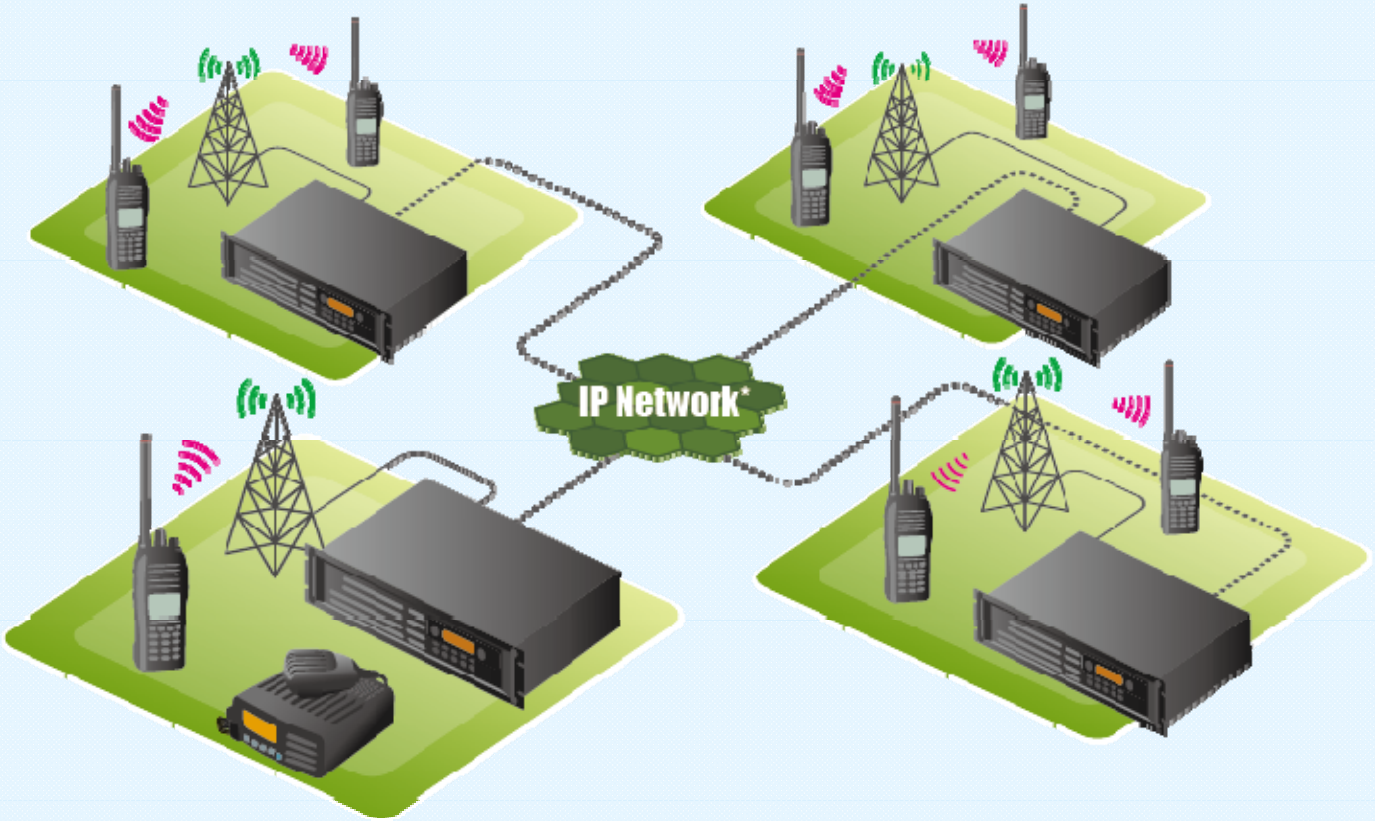
What is NXDN™?

NXDN™

IP Connectivity

Conventional IP linked wide area communications



Note: IP network specification is manufacturer specific.

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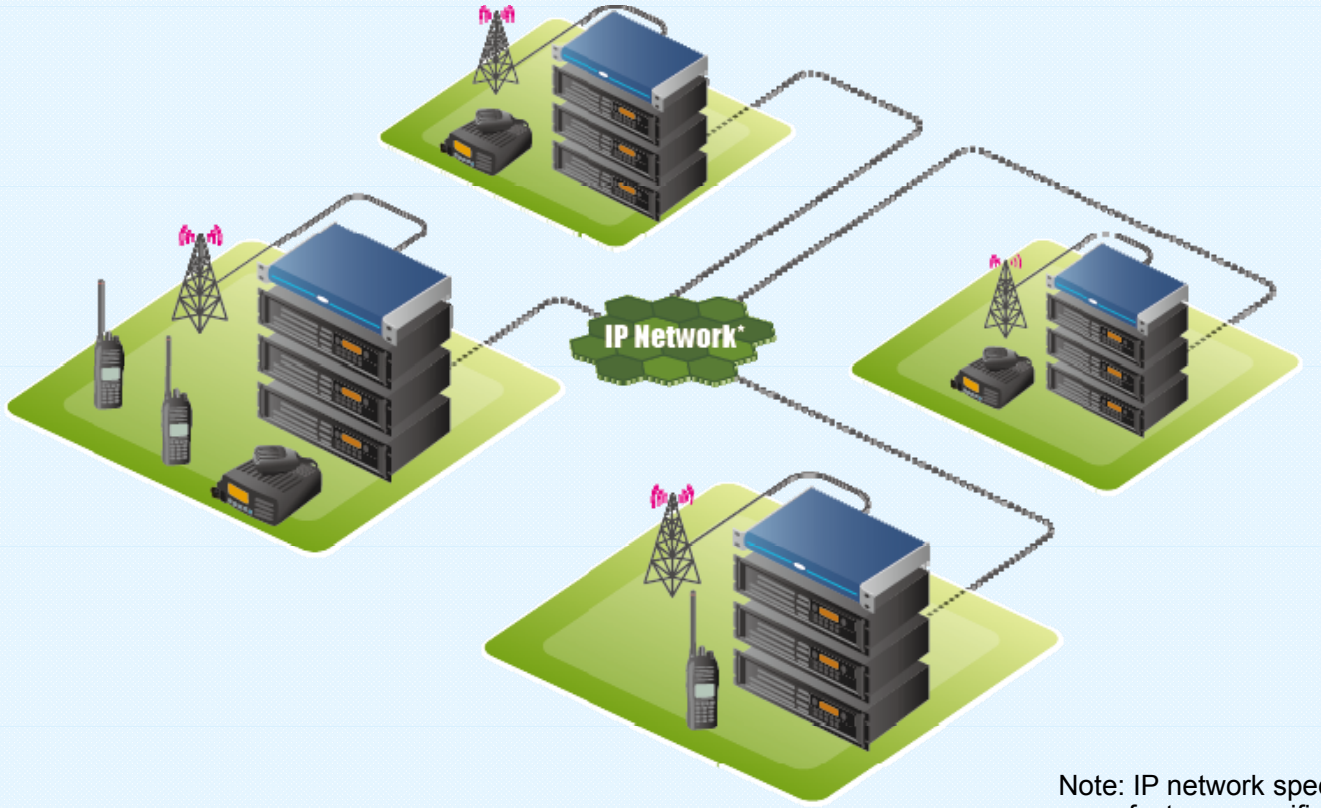
What is NXDN™?

Type-C/Type-D Trunking

Full single and/or multi-site wide area trunking networks
Type-C: Control channel based trunking
Type-D: Distributed logic based trunking



Note: IP network specification is manufacturer specific.

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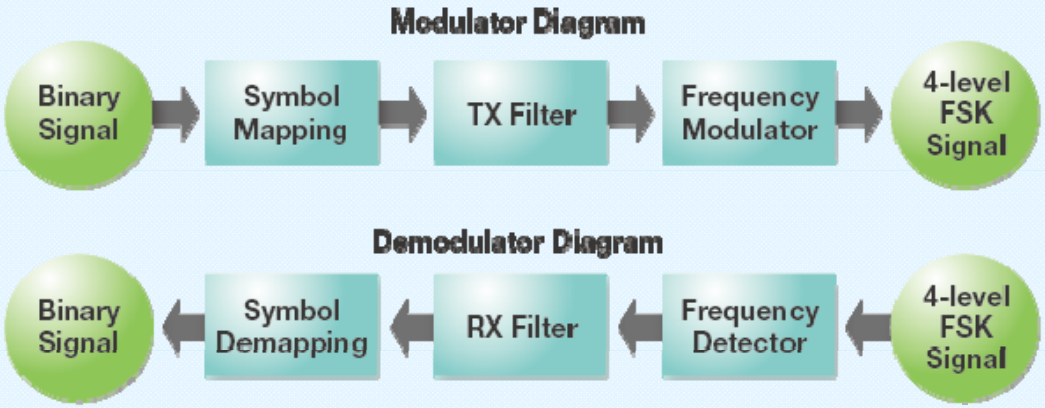
The Basic Technology

NXDN™

– **General specifications:**

Access Method	:	FDMA
Modulation	:	4-level FSK
Vocoder	:	AMBE+2™
Channel Spacing	:	6.25kHz / 12.5kHz
Transmission Rate	:	4800 bps / 9600 bps
Codec Rate	:	3600 bps / 7200 bps
Conventional	:	Yes
Trunking	:	Yes Type-C and Type-D
Digital Scrambling	:	Yes (15-bit, 32,000 keys)
Encryption	:	Yes (AES, DES)



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What is good about NXDN™?

Advantages

- The use of FDMA technology provides a “low complex, low cost” development platform
  - Basic design technology maintained from analog FM
  - Low complexity does *not* mean simple capability. NXDN™ can be scalable from 1 repeater to a multi-site system
- Two-way radio fundamentals “built-in”
  - Peer to peer standard (No “reinvention of the wheel”)
  - No reduction in coverage vs analog FM
  - Technical advantages in analog apply equally to digital
- A like for like natural transition from analog to digital
  - System design fundamentals do not change

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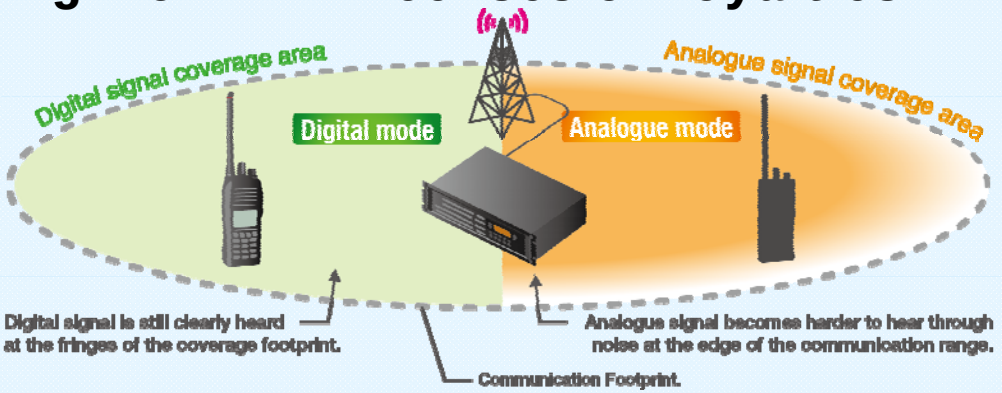
What is good about NXDN™?

NXDN™

Advantages

- **Leading vocoder utilized**
  - AMBE+2™ is the standard vocoder for NXDN™
  - Excellent noise suppression for clearer communications
- **NXDN™ *is* spectrum efficient**
  - True 6.25kHz channels, no “equivalent” caveats needed
  - Will be a viable technology when 12.5kHz spectrum is full
  - Future proofed investment for the near and mid-term
- **IPR Licenses and Royalties not required**
  - No added costs resulting from IPR licenses or royalties



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NXDN™ Features

Note 1: List below is a general guide of available features
Note 2: Implementation of features may differ between manufacturers

Function, Feature, Application		Conventional	Type-C Trunking	Type-D Trunking	Notes
System Configuration					
	Peer to Peer (DMO)	X			
	Repeater Relay	X			
	Trunking: Single site		X	X	
	Trunking: Multi-site		X	X	
	Trunking: Multi-system		X	X	
	Wide Area IP Networking	X	X	X	
Equipment/System Components					
	Hand portables	X	X	X	
	Mobile Radios	X	X	X	
	Repeaters	X	X	X	
	Trunking Controllers		X	X	
	Remote Control (E.g. via PC)	X	X	X	
	VoIP Devices		X	X	
	Analog over IP Devices	X		X	3rd party

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NXDN™ Features

Note 1: List below is a general guide of available features
Note 2: Implementation of features may differ between manufacturers

Function, Feature, Application		Conventional	Type-C Trunking	Type-D Trunking	Notes
Call Types					
	Individual Call	X	X	X	
	Group Call	X	X	X	
	Broadcast Call	X	X	X	
	All Call	X	X	X	
	Emergency Call	X	X	X	
	Telephone Interconnect	X	X	X	
Data Call Types					
	Status Message	X	X	X	
	Text Message	X	X	X	
	Short Data Message	X	X	X	
	Data with Voice	X	X	X	
	GPS Positioning Data	X	X	X	
	Transparent Data Mode	X	X	X	

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NXDN™ Features

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Function, Feature, Application		Conventional	Type-C Trunking	Type-D Trunking	Notes
Other Features					
	Late Entry	X	X	X	
	Digital /Analogue Mix Mode	X	X	X	
	Call Queing		X	X*	* CH Busy wait
	PTT ID	X	X	X	
	Alphanumeric CH Naming	X	X	X	
	Digital Scrambler	X	X	X	
	Encryption	X	X	X	
	ESN Validation	X	X	X	
	Ambience Listening	X	X	X	
	Man Down	X	X	X	
	Lone Worker	X	X	X	
	Time Out Timer	X	X	X	
	Call Channel Protection	X	X	X	RAN code
	Radio Stun	X	X	X	
	Radio Kill	X	X	X	
	Radio Revive	X	X	X	
	Paging	X	X	X	

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NXDN™ Features

Note 1: List below is a general guide of available features
Note 2: Implementation of features may differ between manufacturers

Function, Feature, Application	Conventional	Type-C Trunking	Type-D Trunking	Notes
Applications (Enquire with manufacturers for details)				
System Diagnostics	X	X	X	
Trunking Management		X	X	
Data Peripheral Interface			X	
Local PC based Solution	X	X	X	
Fleet Management Systems	X	X	X	
Call Dispatcher	X	X	X	
Call Logging	X	X	X	
Voice Recorder	X	X	X	
Reporting	X	X	X	
Remote VoIP based Console	X	X	X	
Remote Control Systems	X	X	X	

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NXDN™ Features

Note 1: List below is a general guide of available features
Note 2: Implementation of features may differ between manufacturers

Function, Feature, Application	Conventional	Type-C Trunking	Type-D Trunking	Notes
Outdoor GPS based Localization	X	X	X	
Indoor Beacon based Localization	X		X	
Indoor RFID based Localization	X		X	
Using Online Maps (Google)	X		X	
Using Raster/Vector Maps	X		X	
Guard Control/Personal Security	X		X	
Alarm Notification/Management	X	X	X	
Switch/Gateway solutions	X	X	X	PSTN/SIP
Developer Kits for customizing	X	X	X	
Services				
Test Sets	X	X	X	
Protocol Stacks for Development	X	X	X	
Baseband chips for Development	X	X	X	

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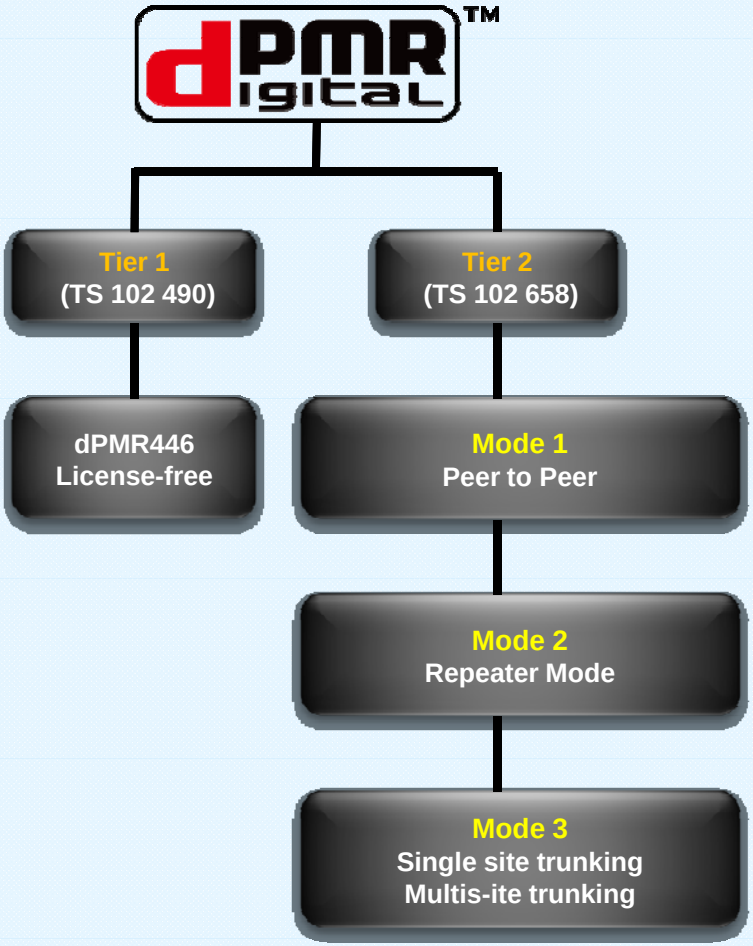
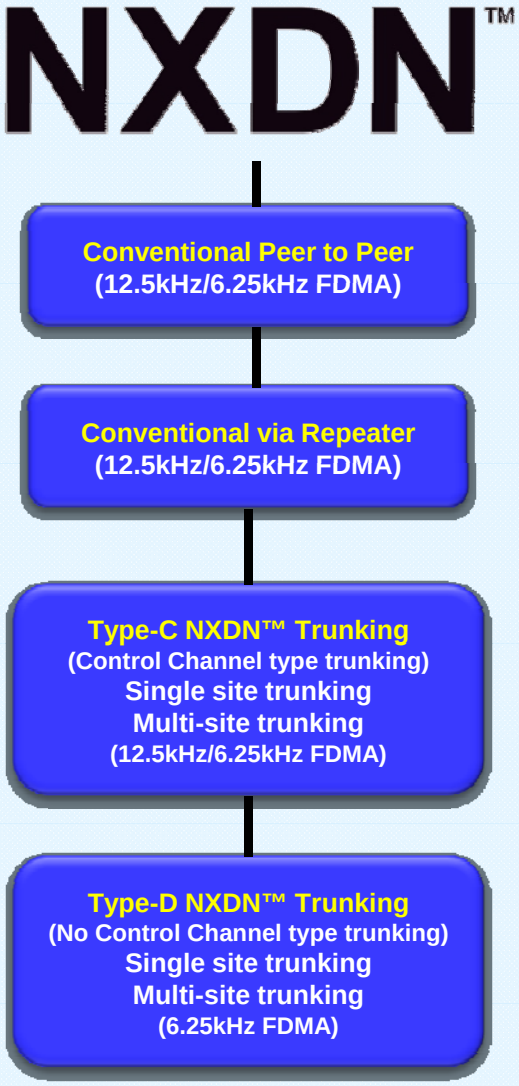
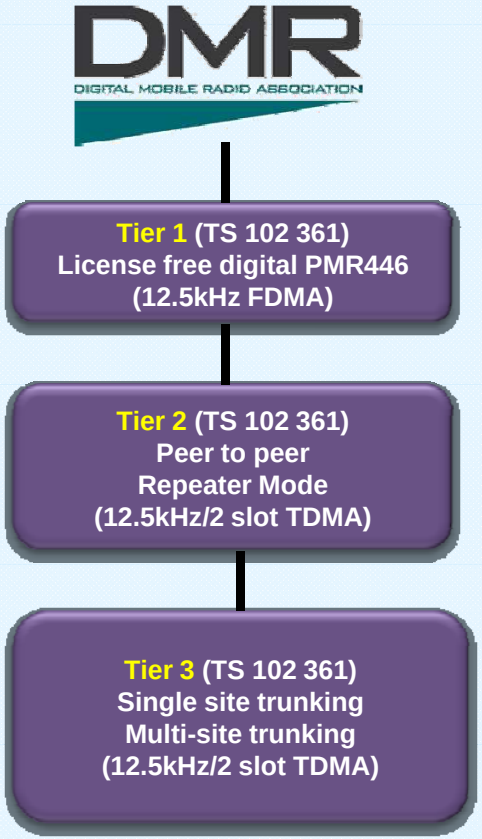
NXDN™ and other technologies







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The NXDN™ Forum

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The NXDN™ Forum

- **Founded in 2008**
  - **Started with eight members**
- **Currently 31 member companies (As of March 2016)**
  - **Support a broad range of core competences in the industry**
- **Established to follow up NXDN™ standards work**
  - **Maintenance and addition of the standards suite**
- **Mandated the standard vocoder (AMBE+2™)**
- **Promote NXDN™ and a Multi-vendor environment**
- **Create and support interoperability testing regime**
- **Obtain/register trademarks for NXDN™**

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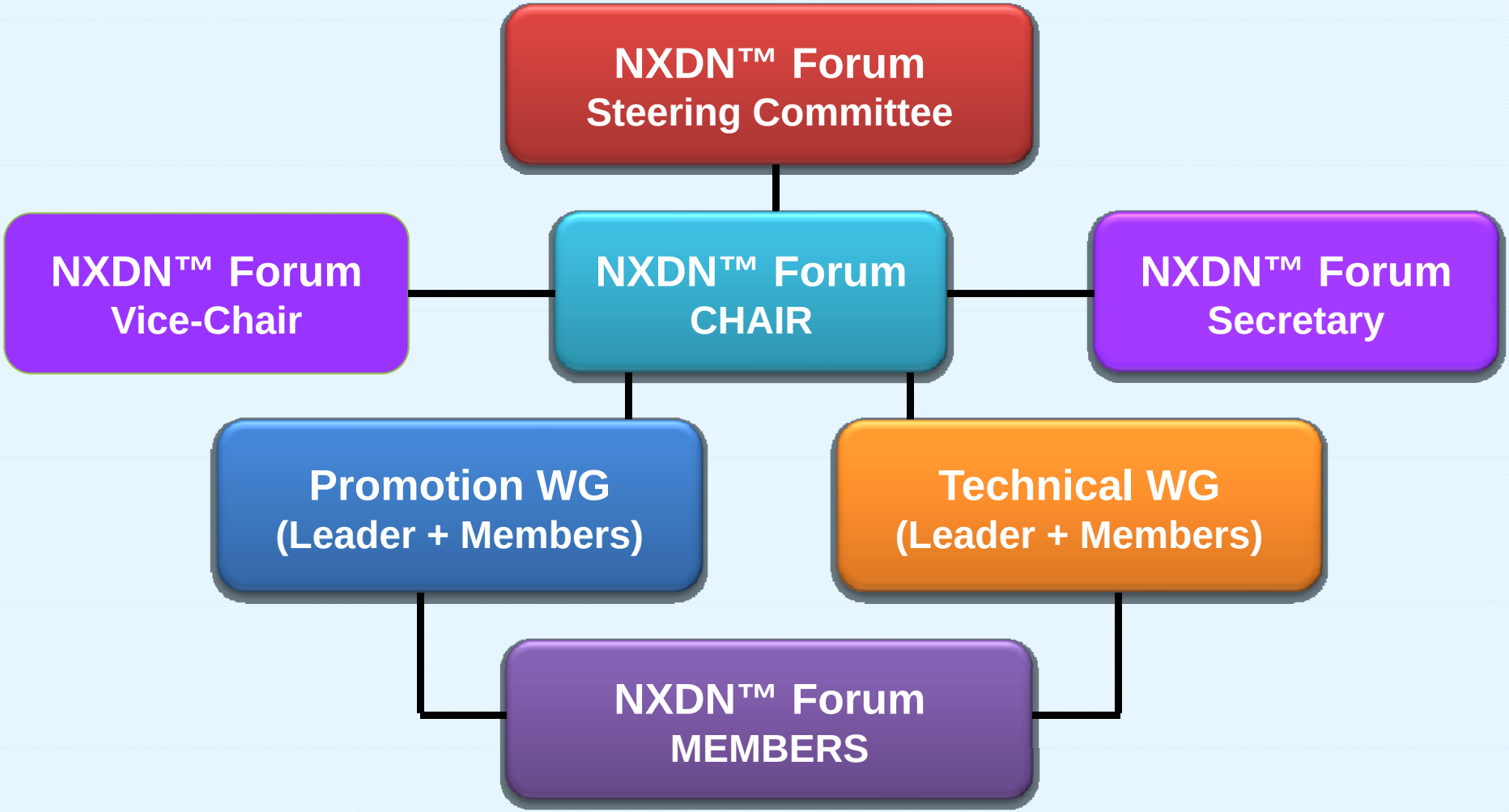
The NXDN™ Forum

Structure of the Forum



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Current Members

More details at:

http://www.nxdn-forum.com/our-members/who-are-members/

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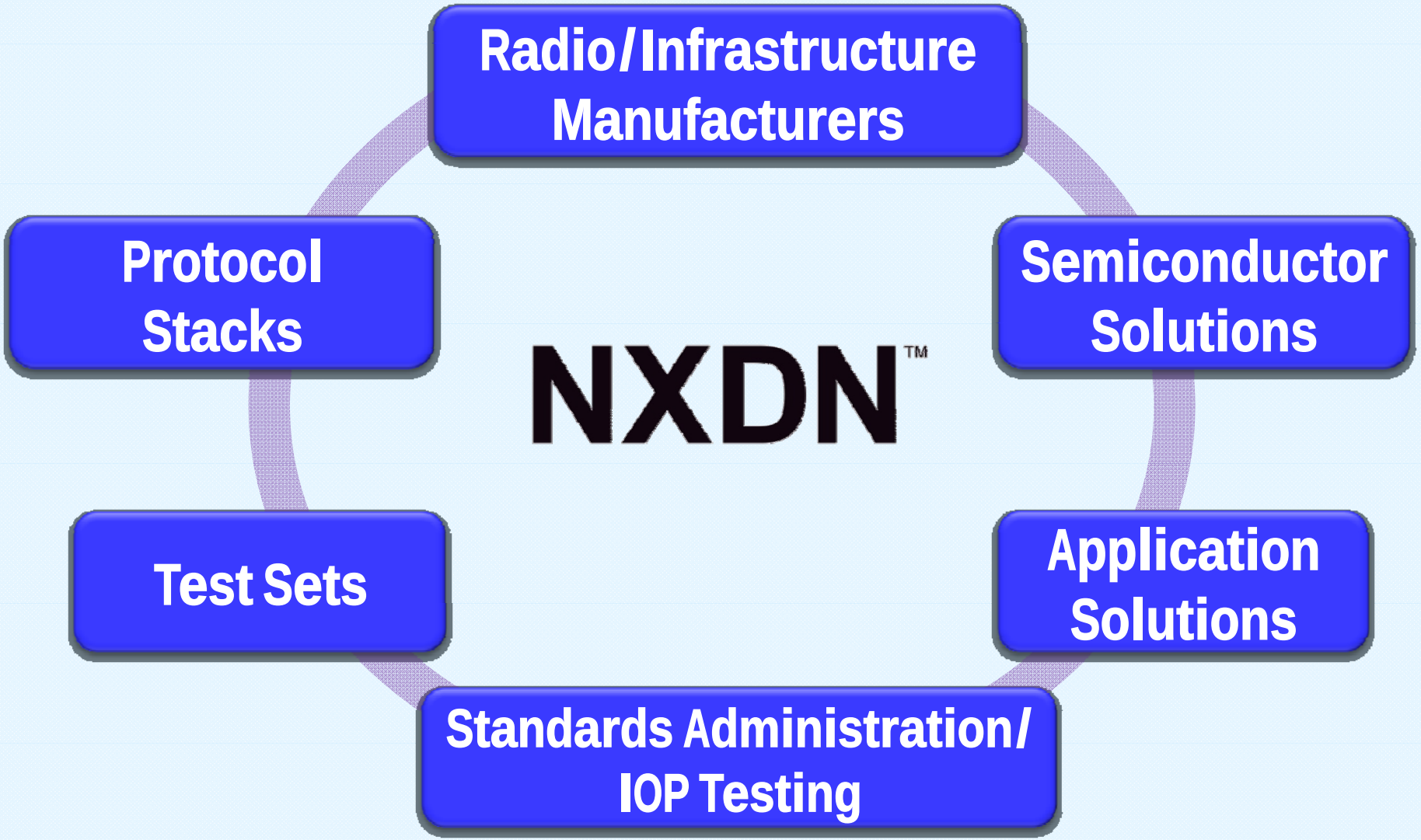
Member's Core Competences



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NXDN™ in the Market

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NXDN™ in the Market

Market Segment / Tier	Vertical Markets
High-tier Public Safety / Professional	Emergency Services / Police / Military Professional Utilities (Airports etc.) / Government / Private Systems
Mid-high tier B&I / Light Commercial	Transportation / Local Govt. / Utilities / Large Industry (Manufacturing etc.) / Small-mid sized Systems / Security
Low-tier B&I / License-free	Construction / Security / Retail / Hotels / Restaurants / Warehouses / Theme Parks / Private Security / Rental

Technology

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NXDN™ in the Market

Examples of Actual NXDN™ Users

- Police and Public Safety entities
- Amusement parks and Casinos
- United States Class-1 railways
- Humanitarian agencies
- University and Industrial campuses
- Medical Centers and Rescue services
- Security entities and Sports facilities
- Transport entities and Airports
- City Councils and Local Government agencies
- Road maintenance and Highway Administrations
- Private System Operators and Utilities

Over *3 MILLION* NXDN™ Units in the field!

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Migration

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Migration

The Basic Migration Alternatives:

- **"Big Bang" Migration**
  - Throw away the existing system and completely start anew
  - Obvious cost and system down time risk considerations need to be analyzed
- **Infrastructure migration**
  - Initially replace older infrastructure with digital infrastructure
  - Allows an orderly switchover of the system with no down time
  - Can set up and monitor IP links and RF coverage for maximum smoothness of the eventual transition to digital mode
- **Infrastructure/Terminals mixed migration**
  - Replace sites and radios as required
  - Mixed analogue/digital mode terminals allow continuous communications with existing radios
  - Advantages in cost outlays and system planning requirements

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Migration

The NXDN™ Advantage:

- **FDMA offers a like for like migration**
  - Use of existing site equipment possible
  - RF propagation and coverage characteristics would be similar to analog FM
- **Cross protocol communications**
  - Some NXDN™ solutions offer the ability to have NXDN™ and MPT radios operate in the same system for example
  - Radio users can continue to use analog radios for a smoother gradual migration as needed
- **Natural system integrity**
  - Failsafe peer to peer if system fails
  - Only one channel lost if repeater fails

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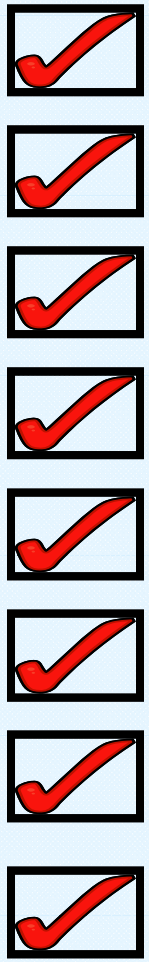
In Summary

NXDN™ is:

- An open standard
- A continuously evolving standard
- Supported by multiple leading industry players
- Supported via a dedicated industry group
- A multi-vendor selection of products/services
- Has a legitimate interoperability qualification system
- Spectrum efficient and viable solution beyond 12.5kHz channel spacing
- Used in the field with proven success



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