

An aerial night photograph of a city, likely San Francisco, showing a complex highway interchange and a cable-stayed bridge in the foreground. The city lights are visible in the background, creating a dense urban landscape.

OASIS

ORGANIZATION OF AFFILIATED SECURE INTEROPERABLE RF SUBSYSTEMS

2018 Annual Report

OASIS

ORGANIZATION OF AFFILIATED SECURE INTEROPERABLE RF SUBSYSTEMS

To: The Honorable Chris Abele, Milwaukee County Executive
The Honorable Mayors, Village Presidents and Executives
of OASIS Subscriber Organizations

Date: July 30, 2018

In accordance with Section 6.05 of Exhibit F of the Intergovernmental Agreement Permitting Access to Milwaukee County's Public Safety Radio Subsystem, and on behalf of the Governance Board of the Milwaukee County OASIS Public Safety Radio Subsystem, we respectfully submit this 2018 OASIS Annual Report.

By submission of this Annual Report, we hereby acknowledge:

- We have at this time no recommendations for changes to the operational and technical design of the subsystem;
- We have at this time no recommendations for changes to the funding model or operational standards needed to meet the costs for subsystem operations and maintenance; and
- We have reviewed and we recommend the 2019 Operational Budget for the subsystem, as presented in Figure 11, which also details the Capital Improvement Fund commencement in 2018.

We remain available to provide additional information regarding the state of the operations, finance, governance and overall plans of the Milwaukee County subsystem of OASIS.

Yours sincerely,


Andy Pederson, Chair


Christine Westrich, Vice Chair

Contents

BACKGROUND	4
– Figure 1: OASIS System	
– Figure 2: OASIS Users	
MILESTONES	7
– Figure 3: Performance Objectives of OEM’s Radio Services	
GOVERNANCE	9
• The Shared Core Memorandum of Understanding	
• The Municipal Use Intergovernmental Agreement	
• Governance Board of Directors	
• Technical & Operations Committees	
• 911 Special Committee	
– Figure 4: Governance Board Membership	
– Figure 5: Technical Committee Membership	
– Figure 6: Operations Committee Membership	
– Figure 7: 911 Special Committee Membership	
FINANCES	13
• Capital Build-Out Budget	
• Usage, Fees & Operational Costs	
• Capital Improvement Fund	
– Figure 8: Capital Build-Out Budget	
– Figure 9: Active User Radios	
– Figure 10: Municipal User Fees	
– Figure 11: OEM Radio Services Division 2019 Budget	
– Figure 12: Capital Improvement Fund	
THE WAY FORWARD	18
• The Next Phase	
• FirstNet	
• Next Generation 9-1-1	
– Figure 13: Agency Migration Status	
GLOSSARY OF TERMS & ENDNOTES	22
ACKNOWLEDGEMENTS	23
APPENDICES	24
– Appendix A: June Failsoft After-Action Report	
– Appendix B: July Failsoft After-Action Report	
– Appendix C: Radio Fee Analysis - Municipalities & Agencies	
– Appendix D: Radio Fee Analysis - North Shore Municipalities & Agencies	

Background

OASIS is a P25 digital, simulcast, trunked, 800MHz public safety radio system covering both Waukesha and Milwaukee Counties. The locations of the 10 OASIS transmitter sites are shown in Figure 1.

Each county has deployed radio towers and infrastructure equipment (e.g., transmitters, dispatch consoles) within their boundaries. The link between these “subsystems” is through the Shared Core at Waukesha County Radio Services (WCRS), which interconnects, controls and manages both subsystems to create OASIS.

This design for OASIS provides the following improvements over the prior independent systems:

- Improved radio coverage, system reliability, security and capacity (fewer busy signals);
- Cost-savings due to joint ownership of the Shared Core;
- Replacement of costly leased telephone lines with a site-to-site digital microwave network;
- Multiple hardware and vendor options for user radios, due to standard signaling of APCO P25; and
- Interoperability through the Shared Core:
 - Direct communications between users of varied agencies and counties; and
 - External network connections to the OpenSky (City of Milwaukee) and WISCOM (State of Wisconsin) radio systems.

Although OASIS uses digital signaling, its over-the-air transmissions can be susceptible to reception by citizen-owned scanners for rebroadcast over the internet. For the security of sensitive communications, some agencies (e.g., SWAT) will utilize OASIS’s encrypted communications capabilities.

OASIS’s Milwaukee County subsystem serves the 70 agencies shown in Figure 2.

Mutual aid use continues to be extended to select non-governmental organizations that provide support to emergency-response efforts, and it is also extended to public safety agencies in neighboring counties to enable them to communicate when necessary with agencies in Milwaukee County.

OASIS’s deployment includes expansion features to allow for future additional users in Milwaukee and Waukesha counties and interconnections to future radio subsystems in neighboring counties, should they wish to directly interface to the Shared Core.

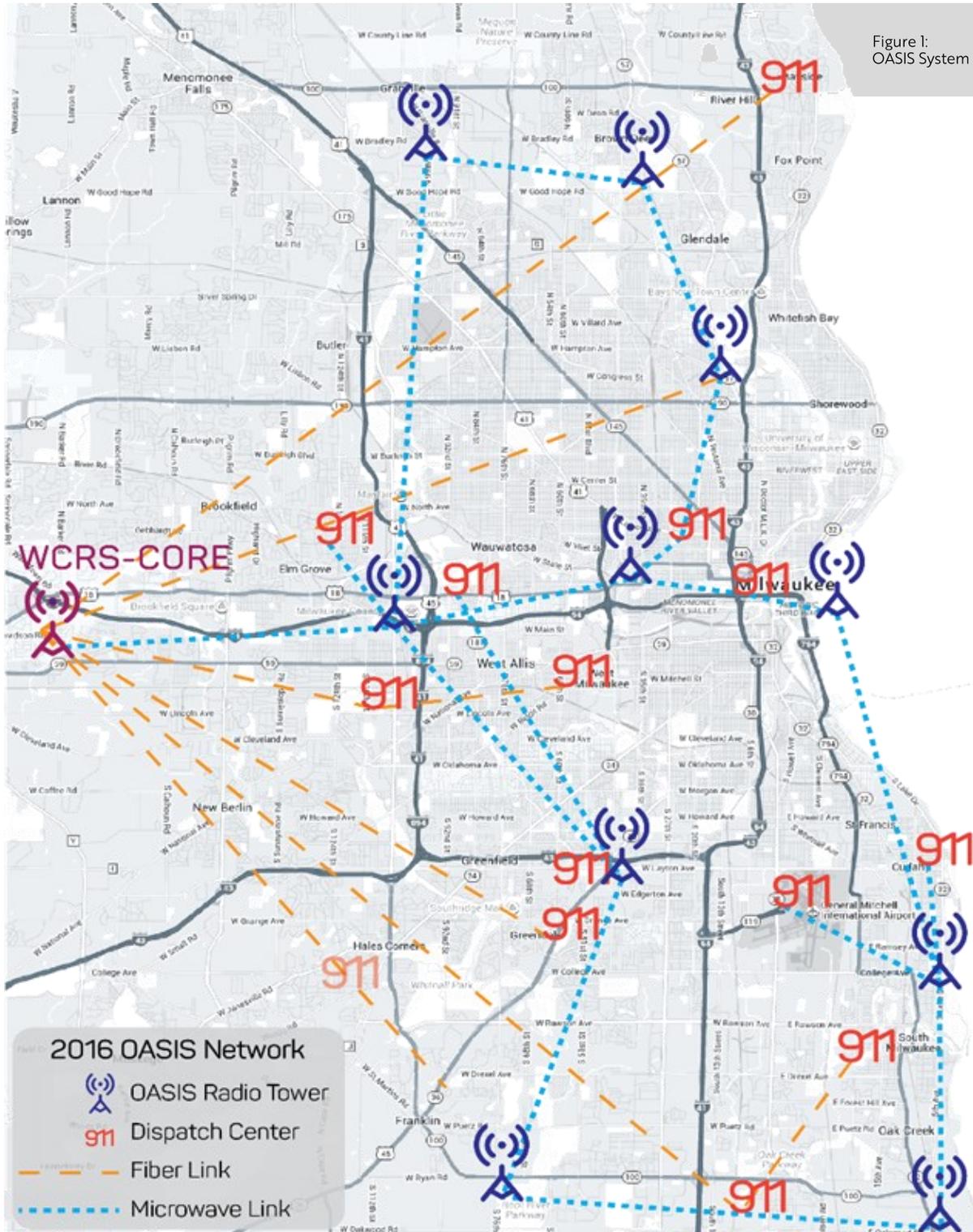


Figure 1:
OASIS System

Figure 2:
OASIS Users

MUNICIPALITIES

Bayside 911 Center
North Shore Fire/Rescue
Bayside Police Department
Brown Deer Police Department
Fox Point Police Department
Glendale Police Department
River Hills Police Department
Shorewood Police Department
Whitefish Bay Police Department
North Shore Public Health Dept.
Brown Deer Dept. of Public Works

Cudahy 911 Center
Cudahy Fire Department
Cudahy Police Department
Cudahy Public Health Dept.

Franklin 911 Center
Franklin Fire Department
Franklin Police Department
Franklin Public Health Dept.

Greendale 911 Center
Greendale Fire Department
Greendale Police Department
Hales Corners Fire Department
Hales Corners Police Department
Hales Corners Public Health Dept.
Hales Corners Dept. of Public Works

Greenfield 911 Center
Greenfield Fire Department
Greenfield Police Department
Greenfield Public Health Dept.

Oak Creek 911 Center
Oak Creek Fire Department
Oak Creek Police Department
Oak Creek Public Health Dept.
St. Francis Fire Department
St. Francis Police Department
St. Francis Public Health Dept.

South Milwaukee 911 Center
South Milwaukee Fire Department
South Milwaukee Police Department
South Milwaukee Public Health Dept.

Wauwatosa 911 Center
Wauwatosa Fire Department
Wauwatosa Police Department
Wauwatosa Dept. of Public Works

West Allis 911 Center
West Allis Fire Department
West Allis Police Department
West Allis Public Health Dept.
West Allis Dept. of Public Works

West Milwaukee 911 Center
West Milwaukee Police Department
West Milwaukee Dept. of Public Works

MILWAUKEE COUNTY DEPARTMENTS

Behavioral Health Division
Children's Court Center
Facilities Management
Highway Department
House of Correction
Information Management
Services Division
Office of the County Executive
Office of the District Attorney
Office of Emergency Management
Office of the Medical Examiner
Parks Department
Sheriff's Office
Transit System

MUTUAL AID USERS

American Red Cross
ARES/RACES
Brown County HIDTA
FireBell

INDEPENDENT COMMISSIONS

Milwaukee Area Domestic Animal
Control Commission

SPONSORED USERS

Mayfair Mall Security (Wauwatosa)
North Central HIDTA (West Allis)
US Department of Veterans Affairs
(West Milwaukee)

Milestones

JUNE 2017 - AUGUST 2017 OEM and Motorola responded to and resolved two major service disruptions to the analog radio system related to the MTC-3600 analog system controllers.

As a significant outcome, Motorola offered to provide rapid digital reprogramming for County and Municipal radios free of charge in an effort to mitigate the risk of future analog system service reductions. (For a detailed accounting of the incidents, response and resolution, see Appendix A: June Failsoft AAR and Appendix B: July Failsoft AAR.)

AUGUST 2017 Remaining Functional Acceptance Test Plans (FATP) completed.

SEPTEMBER 2017 The System Acceptance Milestone was achieved, marking substantial completion of the P25 digital system build-out and commencing of the one-year warranty phase.

The Customer Support Plan (CSP), which defines the processes and procedures for support of the radio system during the warranty period, was finalized and put into effect.

NOVEMBER 2017 The team identified a major issue: the XTS/XTL radios in use by municipal police and fire departments lacked a key feature, called InterWACN Roaming, required to allow the programming of other radio system's talkgroup (e.g., OpenSky talkgroups) directly into users radios.

The solution to this issue was complicated by the fact that Motorola had discontinued to production and sale of this feature to customers.

Milwaukee County OEM worked collaboratively with Motorola and was able to negotiate a solution to provide the 1,200 of the discontinued InterWACN Roaming upgrade kits to municipal police and fire departments at no cost (a total value of \$138,000).

OEM and Motorola delivered full-day APX P25 Digital Radio Train-the-Trainer sessions to 29 fire service and 62 law enforcement representatives. The training

- NOVEMBER 2017, cont'd** included an overview of the digital radio system, differences between analog and digital operations, review of digital system standards developed by the Technical and Operations Committee, discipline-specific operational guidelines, scenario-based training and APX radio operations and features. Each participant received a resources kit specific to each discipline to support their delivery of the training to their respective agency.
- DECEMBER 2017** The Final System Acceptance Milestone was achieved, marking the completion of the P25 digital system build-out and closure of Contract for Service No. 1332.
- JANUARY 2018** WISCOM ISSI connection completed, making WISCOM talkgroups available on user radios in the field and wireline dispatch centers.
- APRIL 2018** OASIS Governance Board voted unanimously to create 911 Special Committee to support the development, buildout and adoption of FirstNet and NG911 in Milwaukee County.

Figure 3:
Performance Objectives
of OEM's Radio Services

PERFORMANCE OBJECTIVES	2015 actual	2016 actual	2017 actual	2018 ytd*	2019 target
Limit downtime to under 5.26 minutes per 365 days	5.00 min	0.00 min	0.00 min	0.00 min	<5.26 min
Limit service reductions to 4 or fewer per 365 days	-	1	7	1	4
Accommodate call-requests without busy	99.982%	99.981%	99.924%	99.913%	>99.933%
Connect OASIS to WISCOM and OpenSky systems	-	-	Connected to WISCOM	-	Connected to OpenSky
Complete communications plans for special events	-	-	100%	100%	100%
Implement preventive maintenance plan	-	-	-	Develop plan	Service 633 of 1,888 radios

* 2018 data as of June 30

Governance

THE SHARED CORE MEMORANDUM OF UNDERSTANDING

With ownership and capital expense divide equally between Milwaukee and Waukesha Counties, the Shared Core is the foundation of the robust interoperability improvements realized by OASIS. A Shared Core Memorandum of Understanding (MOU) between the counties was fully executed on May 17, 2018, with clear definitions of the roles of ownership, operations, maintenance and the process to make any significant modifications, including expansion or upgrade.

WCRS provides routine upkeep on the Shared Core, with Motorola delivering more extensive maintenance, initially as part of the one-year warranty period and then through an annual maintenance agreement paid by Milwaukee County.

THE MUNICIPAL USE INTERGOVERNMENTAL AGREEMENT

The partnering document within the County of Milwaukee is the OASIS Intergovernmental Agreement (IGA) which defines responsibilities of the County as a system operator and those responsibilities of the user agencies as subscribers. The level of service is dictated as well as the graduated schedule for usage fees paid by subscriber agencies, shown in Figure 4.

The municipal agency usage fees, discussed in depth in the Finances section on page 13, are combined with fees from revenue-generating Milwaukee County departments and tax levy to fully fund the operations and maintenance of OASIS.

OEM and Milwaukee County's Office of Performance Strategy & Budget track departmental radio inventories which in turn dictate the per-radio charge for County departments. The projected 2019 charges equate to \$55.20 per radio per month.

Per radio, per month	Usage Fee	Capital Improvement Fee	Total Fees
2015	\$ 2.00	\$ 0.00	\$ 2.00
2016	5.00	0.00	5.00
2017	9.00	0.00	9.00
2018	12.00	2.00	14.00
2019	14.00	3.00	17.00
2020	14.00	4.00	18.00
2021	14.00	5.00	19.00
2022-	14.00	5.00	19.00

Figure 4: Municipal User Fees

Note: Beginning in 2015, Milwaukee County departments were charged a \$55.83 fee per radio, per month, subject to annual review and revision by Milwaukee County's Office of Performance Strategy & Budget. PSB revised the figure to \$55.67 in 2018 and \$55.20 for 2019.

GOVERNANCE BOARD OF DIRECTORS

The OASIS Governance Board, created through the implementation of the IGA, is comprised of seven members representing municipal agencies and

Figure 5:
Governance Board
Membership

Andy Pederson, Chair
Village Manager
Village of Bayside

Christine Westrich, Vice Chair
Director
Milwaukee County
Office of Emergency Management

Eric Cera, Secretary
Police Chief
Hales Corners Police Department

Hon. Erik Brooks, Director
Mayor
City of South Milwaukee

Kathleen David, Director
Deputy Director, Operations
& Maintenance
Milwaukee County
Gen. Mitchell International Airport

Daniel Laurila, Director
Budget Coordinator, Operations
Milwaukee County Office of
Performance Strategy & Budget

Mason Pooler, Director
Fire Chief
West Allis Fire Department

Milwaukee County. Per its bylaws, duties of the OASIS Governance Board include:

- Sole control of the segregated Capital Improvement Fund (IGA 4.1, 4.4);
- Allocation of these monies to procure contracted services to identify system requirements for P25 system replacement; commencing no later than 2028;
- Annual report to include recommendation on OEM OASIS operating budget to the County Executive and a 5-year Capital Improvement Plan;
- Approval of new users, non-public safety users and associated user fees;
- Establishment and implementation of technical and operational standards and procedures regarding the ongoing use and operations of the Subsystem;
- Prohibited actions include: implementation of OASIS; policies or

standards which expressly contradict the Waukesha County MOU or the IGA; negotiation with contractor/vendors regarding purchase; and the levying of taxes, incurring of debt, issuing of bonds and/or taking legal action.

Since June 1, 2017, the Governance Board:

- Provided guidance and oversight for the final acceptance milestone and P25 digital user migration;
- Approved update to Standard 004: Talkgroup Names, Unit IDs, Failsoft and Aliases and implemented Standard 006: Activation of 8Call & 8Tac Repeaters and Standard 007: Console LANs;
- Created 911 Special Committee;
- Approved as Mutual Aid users Drug Enforcement Agency (DEA) and US Marshals Service, working with HIDTA in Brown County;
- Published a 2017 annual report.

- Voted to amend by-laws to move the required delivery date to July 1 for the annual report, recommended operating budget and five-year capital improvement plan, and secured the County Executive’s approval for same, to align with the County’s budgeting cycle; and
- Welcomed two new Directors: Daniel Laurila on October 16, 2017, appointed to replace Steven Kreklow who left County employment on September 28, 2017; and Mason Pooler on April 24, 2018, appointed to replace Robert Ugaste, who retired from Wauwatosa Fire Department on December 15, 2017.

TECHNICAL & OPERATIONS COMMITTEES

The standing Technical and Operational Committees, referred together as “Tech/Ops”, provide critical input, and in the past year:

- Updated the “system fallback” plan that defines how user groups can continue radio operations in the case of system outage;
- Revised OASIS Standard 004 and sent drafts of Standards 006 and 007 to Governance Board for approval;
- Participated in the development of materials and resource kits for the APX P25 Digital Radio Train-the-Trainer sessions;
- Provide input and guidance in managing system capacity on the analog and digital systems during the user migration; and
- Welcomed Jay Fernandez on October 16, 2017, as a new member appointed to replace Wes Guajardo, who passed away on May 14, 2017.

OEM actively participates in the Governance Board and Tech/Ops to communicate system readiness, user agency deliverables, and for collaborative planning and execution of the migration to OASIS digital radio.

In accordance with Wis. s.s. Chapter 19, Open Records and Open Meetings Provisions, meetings of the Governance Board and Tech/Ops are open to the public and non-voting members.

BC Jim Mayer, Chair
North Shore Fire/Rescue

Lt. Andy Jensen, Vice Chair
St. Francis Fire Dept.

Rich Foscato, Secretary
Bayside 9-1-1 Dispatch

Capt. Sean Licht, Member
Greenfield Police Department

PO Jim Turk, Member
Whitefish Bay Police Department

Erik Viel, Member
Director, Radio Services Division
Milwaukee County OEM

Figure 6:
Technical Committee
Membership

AC Jay Scharfenberg, Chair
West Allis Fire Department

Michelle Dahlen, Vice Chair
Wauwatosa IT/911 Center

Erik Viel, Secretary
Director, Radio Services Division
Milwaukee County OEM

Lt. Chris Botsch, Member
West Allis Police Department

Jay Fernandez, Member
City of Cudahy IT Department

Julie Schneider, Member
Milwaukee County Transit Services

Jason Bauknecht, Member
Oak Creek 911 Center

Figure 7:
Operational Committee
Membership

911 SPECIAL COMMITTEE

Recognizing the synergies between mission-critical radio and the services FirstNet and NG911 will bring to the first responder community—as well as,

and more importantly, mirroring the structural framework of the Wisconsin Interoperability Council (IC)—the OASIS Governance Board voted in April 2018 to create a 911 Special Committee to support the development, buildout and adoption of both FirstNet and NG911 in Milwaukee County.

Each nominating organization is in the process of selecting their representatives with the goal of having the Committee staffed and ready to conduct business by late summer 2018.

Figure 8:
911 Special Committee
Membership

Dispatch Center Manager
Appointee of the Milwaukee County
Association of Fire Chiefs (MCAFC)

Dispatch Center Manager
Appointee of the Milwaukee County
Law Enforcement Executives
Association (MCLEEA)

Dispatch Center Manager
Appointee of the Chief of the
Milwaukee Police Department

IT System Manager
Appointee of the Milwaukee County
Association of Fire Chiefs (MCAFC)

IT System Manager
Appointee of the Milwaukee County
Law Enforcement Executives
Association (MCLEEA)

IT System Manager
Appointee of the Milwaukee County
Executive, from the Information
Management Services Division
(IMSD)

Fiscal/Budgetary Representative
Appointee of the Milwaukee County
Executive, from the Office of
Performance Strategy & Budget

Finances

CAPITAL BUILD-OUT BUDGET

Formally known as “Project WO614 Build Out Ten Sites to Digital” in the Milwaukee County capital budget, the build-out and implementation of the OASIS subsystem and Shared Core is funded through bonds and cash from 2010 through 2018.

The project was originally appropriated \$17,490,699 over the nine-year period, but three revisions increased the total Capital Project Budget (Figure 9) to \$17,880,002:

- A \$308,692 cash fund transfer was added in 2015 to cover equipment found not bond-eligible;
- A \$52,320.00 cash fund transfer was added in 2016 to provide for coverage enhancements in County buildings; and
- A \$28,291.00 appropriation was made in 2017 to cover interest accrued on the financing bonds.

A \$1,080,801.00 balance remains to cover the final close-out items, including flash upgrades, encryption and programming of County subscriber radios, professional services, in-building coverage enhancements, radio site clean-up, ISSI channel expansion and any remaining contingencies.

USAGE, FEES AND OPERATIONAL COSTS

OASIS currently supports 4,479 digital radios programed, 1,829 in municipal agencies and 2,650 in Milwaukee County departments and other users, shown in detail in Figure 10. Usage fees and capital improvement contributions are charged to municipalities and County departments on a per-radio, per-month basis, shown in Figure 4 on page 9.

Total operational costs for the Milwaukee County subsystem in 2019 are budgeted at \$1,598,478, with \$374,136 (23.4%) in revenues drawn from municipal radio fees, \$760,486 (47.6%) in charges to revenue-generating County departments, and \$463,856 (29.0%) balance from direct property tax levy support.

While usage fee revenue is collected at the different levels from municipalities and County departments, it is applied evenly to all categories of OASIS’s operational costs. The detailed operating budget for OEM Radio Services Division is provided in Figure 11, including staff, radio site leases held on privately-owned property, utility costs for the sites, Shared Core hosting services to WCRS and on-going technical support from

Figure 9:
Capital Build-Out
Budget

CATEGORY	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
Infrastructure: Contract for Service #1332 with Motorola	\$ 0.00	\$ 0.00	\$ 0.00	\$459,944.95	\$ 2,115,746.78	\$ 4,139,504.58	\$ 0.00	\$ 2,483,702.75	\$ 0.00	\$ 9,198,899.06
Shared Core: 50% of total Shared Core operations	0.00	0.00	0.00	0.00	0.00	86,468.17	207,121.43	108,587.93	0.00	402,177.53
Subscriber Radios: Mobiles and Portables for Milwaukee County Departments	0.00	0.00	0.00	1,417,011.55	2,600,602.88	136,266.25	83,651.70	368,786.63	624,077.02	5,230,396.03
Contingency: Change orders with Motorola, other unplanned expenses	0.00	0.00	0.00	0.00	43,635.40	343,799.49	284,420.00	388,513.61	382,490.21	1,442,858.71
Internal Charges: Other Milwaukee County Departments	0.00	0.00	0.00	0.00	19,901.76	13,124.79	254.16	127.08	0.00	33,407.79
Professional Services: Consultants, external contractors	0.00	0.00	20,540.80	24,759.15	32,480.94	284,860.88	299,939.58	215,383.68	90,361.80	1,259,326.83
Interest: debt service	2,041.00	95,634.67	76,520.00	26,671.39	32,766.00	48,692.00	2,320.00	28,291.00	0.00	312,936.06
TOTALS	\$ 2,041.00	\$ 95,634.67	\$ 97,060.80	\$ 1,928,387.04	\$ 5,136,133.76	\$ 5,052,716.16	\$ 877,706.87	\$ 3,593,392.68	\$ 1,096,929.03	\$ 17,880,002.01

CATEGORY	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
Appropriation	\$ 1,761,000.00	\$ 0.00	\$ 0.00	\$ 1,842,168.00	\$ 7,126,100.00	\$ 2,009,183.00	\$ 1,559,183.00	\$ 28,291.00	\$ 0.00	\$ 14,325,925.00
Funds Transfer	193,065.00	0.00	0.00	0.00	3,000,000.00	308,692.00	52,320.00	0.00	0.00	3,554,077.00
TOTALS	\$ 1,954,065.00	\$ 0.00	\$ 0.00	\$ 1,842,168.00	\$ 10,126,100.00	\$ 2,317,875.00	\$ 1,611,503.00	\$ 28,291.00	\$ 0.00	\$ 17,880,002.00

OEM’s operation of OASIS for these contributing user groups is measured by three key performance indicators—limiting downtime, limiting service reductions and accommodating call-requests without busies. Objectives and outcomes are detailed in Figure 3 on page 8.

At the request of the Governance Board, OEM researched an alternative fee structure based on push-to-talks (PTTs). PTTs are an indication of true system usage, or voice traffic, generated by each user group on the existing system, with Municipal users averaging 9,127,302 PTTs annually and County users averaging 7,843,323. This analysis is included in Appendices C and D.



Figure 11:
OEM Radio Services Division
2019 Operating Budget

2019 OPERATING BUDGET

TOTAL REVENUE	\$ 1,598,478.43
Charges to Revenue Departments	760,486.21
Municipal Radio Charges	374,136.00
Direct Property Tax Levy	463,856.22

TOTAL EXPENDITURES	\$ 1,598,478.43
Personnel Services	241,813.00
Commodities / Services	1,356,575.43
Crosscharges	90.00

EXPENDITURE DETAIL

Personnel Services	\$ 241,813.00
Salaries/Wages	216,974.00
Overtime	0.00
Social Security Taxes	16,598.00
Adjusted Social Security Taxes	0.00
Other Post-Employment Benefits Liability	7,947.00
Compensated Absences	294.00
Employee Healthcare	0.00
Employee Pension	0.00
Legacy Healthcare	0.00
Legacy Pension	0.00

Commodities / Services	\$ 1,356,575.43
Membership Dues	300.00
Electricity	50,000.00
Natural Gas	750.00
Telephone and Outside Vendors	52,000.00
Fire Protection	2,000.00
Building & Space Rental	249,025.79
Repair & Maintenance: Buildings & Structures	12,000.00
Repair & Maintenance: Grounds	4,000.00
Repair & Maintenance: Machinery, Tools, Equipment	974,800.00
Repair & Maintenance: Radio Transmitters	7,500.00
Fleet Vehicle	0.00
Fuel	599.64
Auto Allowance	500.00
Conference Expenses	2,000.00
Hardware & Other Material	500.00
Office Supplies	300.00
Minor Office Equipment	300.00

Commodities / Services	\$ 90.00
Technical Support & Infrastructure	0.00
Repair & Maintenance: Computer Equipment	0.00
Applications Charges - Network	0.00
HRIS Allocation	0.00
IMSD Central Purchases	0.00
House of Correction Graphics	90.00

CAPITAL IMPROVEMENT FUND

Collection of the Capital Improvement Fund fees began in 2018 with a first-year projected amount of \$53,952. Based on the current fee structure and radio count, the 12-year Capital Improvement Fund balance projection is \$1,701,324.00 for the betterment and/or replacement of OASIS, as dictated by the OASIS Governance Board.

Comparatively, the current system cost for OASIS is \$11,923,249.97 (total project cost including 50% of the Shared Core), excluding the costs of Milwaukee County radios and dispatch consoles. The delta between the cost to deploy the Milwaukee County subsystem and the amount collected in the Capital Improvement Fund by 2030 is shown in Figure 12.

While it is not known what technology will be available to replace OASIS in 2030 (nor its cost), there exists a vast disparity between the costs to implement OASIS and the amounts invested in the Capital Improvement Fund. The Governance Board is keenly aware of this disparity and will continue to monitor the Capital Improvement Fund's balance and plan for its most effective use. At this time, there are no recommended improvements or scheduled expenses related to the Fund.

2030 Capital Improvement Fund Will Fall Short on New System Costs

Figure 12: Capital Improvement Fund

OASIS Project Cost

\$ 11,923,250 (2011-2018 actual)



- 2011
- 2012
- 2013
- 2014
- 2015
- 2016
- 2017
- 2018

OASIS Capital Improvement Fund

\$ 1,576,716 (2019-2030, projected)



- 2019
- 2020
- 2021
- 2022
- 2023
- 2024
- 2025
- 2026
- 2027
- 2028
- 2029
- 2030

The Way Forward

THE NEXT PHASE

CUTOVER OF REMAINING 911 CENTERS

Work is ongoing to convert equipment to new, digital-capable dispatch consoles at Bayside and Greenfield 911 Centers and interconnect to the Shared Core.

TRANSITION TO POST-WARRANTY PERIOD

Milwaukee County expects to purchase Motorola monitoring and support services for OASIS once the one-year warranty period expires.

INTERCONNECTING OASIS TO OPENSKY

Work is underway with City of Milwaukee radio services, Harris and Motorola to configure an ISSI interconnection between the OASIS and OpenSky. Test talkgroups have been configured and traffic has been successfully passed between the two systems. Networking modifications are required to address some issues and ensure all required features are working before functional testing can be conducted. An MOU between the City and County governing the operation of the ISSI gateway is in draft, with plans to complete and activate the interconnection in the Fall of 2018.

DECOMMISSIONING THE ANALOG SYSTEM

As user radios are transitioned from the existing analog system to OASIS, so will the 800MHz radio channels be transferred from use to OASIS. Once all user radios are transitioned, the existing analog radio system will be turned off and its equipment will be removed from radio sites for storage or disposal.

TRANSITIONING USER GROUP RADIOS

The analog-to-digital bridging capability of the Shared Core allows for the convenient scheduling of reprogramming handheld and vehicle-mounted radios over the several months required to transition large departments (e.g., the Sheriff's Office and Transit Systems, each of which operates nearly 700 radios). For more detail on the number of radios migrated to date, see Figure 9; to review the remaining agencies needing migration, see Figure 13.

Pending
Mirrored
On OASIS

AGENCY MIGRATION, as of 06/25/2018

Figure 13:
Agency Migration Status

MUNICIPALITIES

	x	Bayside Police Department
	x	Brown Deer Police Department
x		Brown Deer Dept. of Public Works
	x	Cudahy Fire Department
	x	Cudahy Police Department
x		Cudahy Public Health Dept.
	x	Fox Point Police Department
	x	Franklin Fire Department
x		Franklin Police Department
x		Franklin Public Health Dept.
	x	Glendale Police Department
	x	Greendale Fire Department
	x	Greendale Police Department
	x	Greenfield Fire Department
x		Greenfield Police Department
x		Greenfield Public Health Dept.
	x	Hales Corners Fire Department
	x	Hales Corners Police Department
x		Hales Corners Public Health Dept.
	x	Hales Corners Dept. of Public Works
	x	North Shore Fire/Rescue
x		North Shore Public Health Dept.
	x	Oak Creek Fire Department
	x	Oak Creek Police Department
x		Oak Creek Public Health Dept.
	x	River Hills Police Department
	x	St. Francis Fire Department
	x	St. Francis Police Department
x		St. Francis Public Health Dept.
	x	Shorewood Police Department
	x	South Milwaukee Fire Department
x		South Milwaukee Police Department
x		South Milwaukee Public Health Dept.
	x	Wauwatosa Fire Department
	x	Wauwatosa Police Department
x		Wauwatosa Dept. of Public Works
	x	West Allis Fire Department
x		West Allis Police Department
x		West Allis Public Health Dept.
x		West Allis Dept. of Public Works
	x	West Milwaukee Police Department
x		West Milwaukee Dept. of Public Works
	x	Whitefish Bay Police Department

Pending	Mirrored	On OASIS	AGENCY MIGRATION, cont'd
			MILWAUKEE COUNTY DEPARTMENTS
		x	Behavioral Health Division
x			Children's Court Center
	x		Criminal Justice Facility
		x	Facilities Management
			Gen. Mitchell International Airport
x			<i>Operations</i>
x			<i>Fire Department</i>
		x	Highway Department
x			House of Correction
x			Information Management Services Division
x			Office of the County Executive
	x		Office of the District Attorney
			Office of Emergency Management
x			<i>Emergency Management</i>
x			<i>Emergency Medical Services</i>
x			Office of the Medical Examiner
		x	Parks Department
			Sheriff's Office
	x		<i>Airport</i>
	x		<i>Criminal Investigations Division</i>
	x		<i>Community Policing</i>
	x		<i>Courts, Institutions, LEADS, Civil Process</i>
	x		<i>Patrol</i>
	x		<i>Training Academy</i>
			Transit System
		x	<i>Operations</i>
		x	<i>Security</i>
			MUTUAL AID USERS
x			American Red Cross
x			ARES/RACES
x			Brown County HIDTA
x			FireBell
			SPONSORED USERS
		x	Mayfair Mall Security
		x	North Central HIDTA
x			US Department of Veterans Affairs
			INDEPENDENT COMMISSIONS
x			Milwaukee Area Domestic Animal Control Commission

FIRSTNET

Commissioned in 2012 by the U.S. Department of Commerce, the Nationwide Public Safety Broadband Network, or “FirstNet”, is the independent federal authority to provide emergency responders with a nationwide, high-speed, broadband network dedicated to public safety.



FirstNet™

In December 2017, Gov. Scott Walker announced his decision to opt in to FirstNet and AT&T’s plan to deliver a public safety broadband network for the State, setting aside Band 14 of the public safety spectrum and paving the way for FirstNet and AT&T to create a contracting vehicle for local municipalities to procure and utilize FirstNet for their respective public safety agencies.

As of June 2018, the State’s Department of Administration procurement division is in active contract negotiations with AT&T to finalize the terms of the statewide contract. In the meantime, OEM has applied for an addendum to the NASPO Value Point contract to make FirstNet services available to Milwaukee County’s public safety agencies. OEM plans to begin migrating first responders to FirstNet during the summer of 2018.

NEXT GENERATION 9-1-1

Next Generation 9-1-1 (NG911) is an Internet-based system that allows digital information (e.g., voice, photos, videos, text messages) to flow seamlessly from the public, through the 911 network, and on to emergency responders.

Deployment requires system enhancements and improvements including redundancy, resiliency, large-file data sharing and the ability to transfer of 911 operations during a crisis.



In addition, a new Emergency Services IP-based Network (ESInet) will function as the core of NG911, connecting to 911 Centers and allow for the seamless transfer of data received from 911 calls to the field. ESInet will operate on the i3 Standard, developed by the National Emergency Number Association (NENA).

In May 2018, the Wisconsin Office of Emergency Communication (OEC) and Department of Administration procurement staff developed a request for information (RFI) for a statewide ESInet system, issued on June 22, 2018.

Glossary of Terms

800 MHz	The portion of the radio spectrum licensed by the FCC to local agencies for public safety radio systems
alias	The text name assigned to a user radio, displayed at dispatch consoles when that radio transmits
APCO	Association of Public-Safety Communications Officials
ARES/RACES	A corps of trained amateur radio operator volunteers organized to assist in public service and emergency communications
FirstNet	Nationwide Public Safety Broadband Network, the independent federal authority to provide emergency responders with a dedicated nationwide, high-speed, broadband network
HIDTA	High-Intensity Drug Trafficking Area, a drug-prohibition enforcement program run by the United States Office of National Drug Control Policy (ONDCP)
ISSI	Inter RF Subsystem Interface, which enables RF subsystems built by different manufacturers to be connected into wide area networks so that users on different networks can talk with each other
mirroring	Converting the analog programming into an identical digital version as the intermediate step in the full transition from analog to digital
NENA	National Emergency Number Association
NG911	Next Generation 9-1-1, the Internet-based system that allows digital information to flow seamlessly from the public, through the 911 network, and on to emergency responders
OpenSky	Digital radio system used by the City of Milwaukee's fire and police departments
P25	Project 25, a federal initiative managed by APCO to upgrade public safety radio systems from analog to digital
PSAP	Public Safety Answering Point, a 911 Center
simulcast	A radio system in which a signal is transmitted over multiple radio towers simultaneously, providing wide area coverage and improved in-building coverage
trunked	A system in which users communicate on dynamically assigned talkgroups from a pool of available channels, rather than discrete frequencies
WCRS	Waukesha County Radio Services, which hosts the Shared Core at 2120 Davidson Rd.; Waukesha, WI 53186
WISCOM	Wisconsin Interoperable System for Communications, a shared system that first responders in communities across the state will use to communicate during a major disaster or large-scale incident

Acknowledgements

SPECIAL THANKS

From May 2012 through March 2018, Steve Surwillo, principal with CDX Wireless, Inc., was a key leader on the OASIS P25 digital radio project. As a consultant, Steve was tasked by Milwaukee and Waukesha Counties with coordinating a joint needs assessment, drafting the request for proposal and facilitating the RFP response evaluation and interviews. After Motorola was awarded the contract, Steve transitioned to a project manager role for Milwaukee County OEM. Though his contributions over the years are too numerous to detail, his thoroughness, attention to detail, and technical expertise contributed greatly to the successful implementation of the OASIS radio system.

IN REMEMBRANCE

The Technical and Operations Committees lost two members who were passionate advocates and cherished colleagues. Their contributions resonate to this day, and they are sincerely missed.



As EMS Captain on the Hales Corners Fire Department and a former OEM-EMS Communicator, Wes Guajardo brought extensive field experience to the OASIS Operations Committee in July 2015. Capt. Guajardo was an active and influential member of the Milwaukee County public safety radio community until his passing on May 14, 2017.



Greg Reske, electronics mechanic for General Mitchell International Airport, was a founding member of the OASIS Technical Committee, where he freely shared a lifetime of technical knowledge gained by managing GMIA's radio fleet. Greg was generous with his time and talents, frequently hosting Committee meetings at the airport's Sijan Conference Center. He passed away on March 19, 2018.

APPENDIX A
JUNE FAILSOFT AFTER-ACTION REPORT

After-Action Report (AAR)
for the
Milwaukee County
Analog Public Safety
Radio System
Failsoft Event
of June 03-05, 2017



Prepared by
Milwaukee County
Office of Emergency Management
Radio Services Division

June 28, 2017

1 **Executive Summary**

ISSUE: From June 03, 2017 to June 05, 2017, the radio system that serves the public safety and public
2 service departments of Milwaukee County and 17 of the 19 municipalities within the County
3 suffered a failure event that prevented it from operating at full functionality. This After Action
4 Report (AAR) describes what happened, possible causes, and the actions being taken to diagnose this failure
5 and prevent future occurrences.
6

BACKGROUND: Milwaukee County currently operates an aging analog public safety radio system and is
7 in the process of deploying a replacement, digital public safety radio system known as
8 OASIS (Organization of Affiliated Secure and Interposable Radio Frequency Systems). As
9 of the date of the failure event, all but one user agency were operating on the analog radio system, awaiting
10 reprogramming of the user-agency radios (handheld and car-mounted radios used by police, fire, public
11 works, and other departments) so that they could begin operation on OASIS. Both systems have centralized
12 control computers (controllers) to manage the system resources that process call requests from field user
13 radios and assign them radio channels for their conversations. Each system has main and standby controllers.
14 Should both controllers fail, the system will enter a condition known as "failsoft" (in which user radios operate
15 in a party-line fashion on channels that carry multiple user groups without coordinated assignment of
16 channels for exclusive conversations). The failures described in this After Action Report is limited to the
17 controllers of the analog radio system which affected only that system (and not OASIS).
18

EVENTS: **From September 01, 2016 to June 02, 2017:** New controllers are installed to replace those
19 that have existed since the analog system was deployed in the 1990s. They are tested and
20 brought on-line as part of the startup of OASIS on March 15, 2017. Between that time and June
21 02, 2017, each controller has a brief (5 minutes) but separate failure resulting in analog system failsoft but
22 recovery is relatively quick while the controllers transfer functionality from main to standby.
23

24 **From 8:30am to 11:00am, June 03, 2017:** During a storm that produced lightning throughout Milwaukee
25 County, failures occur within both controllers of the analog radio system. They attempt to transfer
26 functionality between each other but since their failures are simultaneous, they are unable to complete a
27 main-to-standby switchover. The analog radio system enters failsoft mode. Field users recognize this
28 through displays on their radios, backup radio systems are activated, and Milwaukee County representatives
29 inform their dispatch centers via email and phone.

30 **From 11:00am to 7:30pm, June 03 2017:** Resources from Motorola (manufacturer of the analog radio system
31 and OASIS) and Milwaukee County work to restore service to the failed controllers by attempting to
32 reconfigure them and by using spare parts obtained that day from a nearby Motorola facility. Eventually,
33 service is partially restored to one controller such that the system operates with 7 of its 13 channels
34 (producing more-than-typical system-busy signals to users' call requests but in normal/non-failsoft mode).

35 **From 7:30pm, June 03 to 3:30pm, June 05, 2017:** Spare parts from other locations are expedited for delivery
36 to Milwaukee County and, upon their arrival, Motorola and Milwaukee County staff use them to fully restore
37 service to one controller so that it fully supports all channels of the analog radio system in normal/non-
38 failsoft mode.

39 **From 3:30pm, June 05 to 3:00pm June 6, 2017:** Motorola uses other available spare parts to fully restore
40 service to the second controller, creating the main/standby pair.

After-Action Report for June, 2017 Failsoft Event of Milwaukee County Countywide Analog Radio System

POSSIBLE

CAUSES:

Motorola and Milwaukee County have not confirmed a root cause the controller failures, including those that preceded and those that constituted the failsoft that began on June 03, 2017. Two possible causes are being investigated. First, the storm of June 03, 2017 may have produced lightning that simultaneously damaged both controllers. (Other equipment from the analog radio system that is housed at a different site from the controllers was confirmed to have suffered lightning damage approximately 5 minutes before the controllers' failure and lightning remained prevalent in the area afterward). Second, the controllers may have had faulty components or configuration.

ACTIONS:

Milwaukee County has developed the following list of action items (with due-dates and identified responsible individuals listed in Section 6) to identify the cause of this failure, to minimize the possibility of its reoccurrence, and to improve preparedness for all possible future radio system failures:

1. Analyze the components and configurations of the controllers to determine a cause of their failure
2. Address any deficiencies in the lightning protection deployed at all Milwaukee County radio sites
3. Review the spare parts inventory for the controllers of both the analog radio system and OASIS
4. Identify a backup radio system to be used by each user agency in case of failure modes
5. Complete a written procedure regarding the use of backup radio systems
6. Review the radio systems' settings for sending automated failure notices
7. Complete a written procedure regarding emails/phone-calls/texts/etc. about radio system issues
8. Confirm the points of contact within each user agency that are to receive such notifications
9. Evaluate any possible issues with the network used to interconnect controllers to radio sites
10. Complete all tests on OASIS, including those addressing failure modes
11. Agree to a plan and schedule for exercises to these use of backup radio systems
12. Train user agencies (especially field officers, firefighters, etc.) on ways to identify failure modes
13. Develop a schedule to program user agency radios to operate on OASIS (and cease use of analog)

All of these actions are to be completed by August 30, 2017. Any relevant information from their completion will be made available as supplements to this After Action Report.

1 Table of Contents

2 Executive Summary2

3 Table of Contents4

4 1 Scope and Purpose4

5 2 Technology Overview4

6 3 Chronology5

7 4 Impacts to User Agencies7

8 5 Investigations into Cause8

9 6 Survey Feedback from User Agencies9

10 7 Open Issues and Assignments 10

11 Appendix A – Email and Teletype (TTY) Communications Log 12

13 1 Scope and Purpose

14 This After-Action Report (AAR), prepared by the Milwaukee County Office of Emergency Management, Radio
 15 Services Division (OEM-RSD), describes the failsoft event that reduced functionality of the Milwaukee County
 16 **analog** (not OASIS P25 digital) public safety analog radio system on the days of June 03, 2017 to June 05, 2017.
 17 This AAR denotes the chronology that occurred before, during, and after the analog failsoft event, the impacts
 18 on user agencies, and the results of a user survey post event. Most importantly, follow-up actions with
 19 responsible individuals and timeframes are listed to improve countywide preparedness.

20 2 Technology Overview

21 The Milwaukee County analog public safety analog radio system (“analog radio system”) has been in
 22 operation since the 1990’s and it uses a redundant-pair of Prime Site Controllers (PSCs) to control and manage
 23 the entire collection of analog radio site equipment and user radios. The two PSCs are located at the
 24 Muirdale radio site and they interface to a radio transmitter site that is also located at Muirdale as well as
 25 eight other sites (two of which provide receive-only functionality) located across Milwaukee County. The
 26 connection between the PSCs and the eight other remote sites is via a digital microwave backhaul network.

27 The two PSC’s operate in main-standby fashion such that one is operational while the other remains in a
 28 standby mode to takeover operations should there be a failure of the first. If both the main and standby PSC
 29 experience simultaneous major-alarm failures, the system will be left without an operational PSC and this
 30 will result in a condition called failsoft, in which: a) the controllers generate alarms noting their failures, b)
 31 the functions related to call-processing cease, c) all available radio channels change their operations to
 32 support conventional-mode communications (operating like a “party line” channel), and d) an indication of
 33 the failsoft condition is presented on user radios and dispatch consoles.

34 The analog-system PSCs that encountered failures on June 03, 2017 were Motorola Solutions, Inc (“Motorola”)
 35 MTC36000 PSCs that had been installed into the analog radio system in 2016 as part of the deployment of
 36 the new Milwaukee County digital public safety radio system OASIS (Organization of Affiliated Secure
 37 Interoperable RF Subsystems). These MTC36000 PSCs were manufactured in 2014 and were among the last
 38 to be manufactured as Motorola had developed a newer model for OASIS and digital radio systems like it.

After-Action Report for June, 2017 Failsoft Event of Milwaukee County Countywide Analog Radio System

1 The MTC3600s were deployed because they support both the analog radio system and an interface to OASIS
2 for the sake of cross-system communications. They will, however, be decommissioned once all user radios
3 are transitioned to OASIS.

4 3 Chronology

5 Note: A full listing of all those communications (including emails sent by OEM-RSD to user agencies and by
6 teletypes sent by Milwaukee County 9-1-1 to dispatch center within Milwaukee County) are in Appendix A.

Timeframe	Event(s)
Q4, 2016 to Q1, 2017	The two new MTC3600 PSCs are installed and configured at Muidale. The configuration and operation of the two new MTC3600's are tested and then monitored in preparation for the wireline console-cutover of March 15, 2017.
March 15, 2017	As part of the wireline console cutover event of March 15, 2017, the two new PSC's are fully activated and connected to both the radio sites of the analog radios system and to the PSCs of OASIS. They are successfully tested during the cutover event, prior to returning users from backup systems to the analog radio system.
March 17, 2017	In the early morning of March 17, 2017, the analog radio system encountered a brief failsoft event, due to: i) the main MTC3600 PSC (referred to as "Controller A") encountered a major alarm and ii) at that time the mode of switching from main to standby PSC (referred to as "Controller B") had been configured for manual, not automatic. NOTE: Manual switchover of the MTC3600 PSCs was initially intentionally configured (because automatic switchover between their predecessors had been found to occur too often and for unnecessary reasons).
From March 17, 2017 to April 13, 2017	Representatives from Milwaukee County and Motorola work together to diagnose the failure of the "Controller A" MTC3600 PSC and to develop a plan to enable and test automatic switchover between the two PSCs. During this period, the "Controller B" MTC3600 PSC operates as the main controller.
April 13, 2017	The analog radio system is intentionally placed into failsoft for a period of approximately 60 minutes to configure and test the two MTC3600 PSCs for automatic switchover. The reconfiguration and tests are considered successful and the analog radio system is left using the "Controller B" MTC3600 PSC.
April 14, 2017 to June 02, 2017	Milwaukee County and Motorola discuss actions to diagnose and correct any issues with the "Controller A" MTC3600 PSC. Motorola orders a set of replacement modules/cards that comprise the MTC3600 PSC so that they may be installed in "Controller A" or be available as spares.
June 02, 2017	The analog radio system encountered a brief failsoft event (5 minutes in duration, from 0607 to 0612) when the "Controller B" MTC3600 PSC encounters a major-alarm failure and radio-system control is switched to the "Controller A" MTC3600 PSC.
Approx 0835 ¹ , June 03, 2017	A lightning strike occurs near the Engine 38 radio site resulting in that site's disconnection from the analog radio system.
Approx 0840, June 03, 2017	While lightning continues throughout Milwaukee County, the "Controller B" MTC3600 PSC reports major alarms and attempts to transfer control to the "Controller A" MTC3600

¹ Note: All times are listed as Central Daylight Time

After-Action Report for June, 2017 Failsoft Event of Milwaukee County Countywide Analog Radio System

Timeframe	Event(s)
	PSC which reports its own major alarms and attempts to transfer control back to "Controller B". The analog radio system enters failsoft.
0840 to 1100, June 03, 2017	<p>0840 - Erik Viel, Director of Milwaukee County OEM-RSD, is notified of the failsoft event through a phone call from a representative of the General Mitchell International Airport (GMIA).</p> <p>0840-0920 – Mr. Viel, Rick Richford (Motorola’s Field Service Organization (FSO) Technician), and Clyde Gestl (Milwaukee County OEM-RSD Technician) meet at Muirdale to attempt to restore service. Mr. Richford is to access the system remotely to begin diagnosis and restoration efforts. Mr. Viel also contacts Kristen Wellhausen, Motorola’s System Engineer for the OASIS project, with a request that she provide assistance to Mr. Richford.</p> <p>1000 - Milwaukee County’s OASIS project’s Project Manager, Steve Surwillo, contacts Ron Mirka, Motorola’s OASIS Project Manager to inform him of failsoft and requests any/all available assistance in restoring service.</p>
1230 to 1535, June 03, 2017	<p>1230 – Motorola identifies availability of spare parts (cards internal to the MTC36000 PSC) in their 'Schaumburg (Illinois) Parts Depot'.</p> <p>1535 – The replacement card parts arrive at Muirdale via Milwaukee County OEM RSD technician, Dan Weber, and work begins to use them to restore service to one MTC3600 PSC.</p>
1245 to 1930 June 03, 2017	In parallel to activities listed directly above, the spare set of cards that were previously ordered by Motorola are FedEx’ed to Milwaukee County for delivery by Monday, June 05, 2017 while yet another set are readied for pickup the next day in Motorola’s "Elgin Service Center" (in Elgin, Illinois).
Approx 1940, June 03, 2017	The replacement card parts obtained from the Schaumburg Parts Depot are used to successfully restore partial service to the "Controller B" MTC3600 PSC. This controller is made operational but it is only able to support seven (7) of the analog radio system’s 13 channels. Mr. Viel notifies user groups of this development, informing them they can use the analog radio system but requesting they do so only for priority conversations and with transmissions of limited duration.
1940, June 03, 2017 to 1100 June 04, 2017	The analog radio system continues to operate in non-failsoft mode but with diminished capacity (7 of 13 channels) and without a backup controller.
1100 June 04, 2017	<p>Representatives from Milwaukee County and Motorola regroup to establish a plan to restore full capacity to Controller B and/or to restore Controller A:</p> <ul style="list-style-type: none"> • Mr. Richford will drive to Elgin to obtain the parts from the Elgin Service Center. • Mr. Gestl will collect the cards that are being FedEx’ed to Milwaukee County on Monday, June 05, 2017. • Motorola will procure a refurbished MTC3600 PSC that has been found at a radio equipment reseller in Colorado. It will be flown directly to Milwaukee County.
1100 to 2000 June 04, 2017	Mr. Richford attempts to use the new cards from Elgin to restore full service to "Controller B" however, that is unsuccessful and the system remains semi-operational with 7 of 13 channels active and without a backup controller. Users agencies are

After-Action Report for June, 2017 Failsoft Event of Milwaukee County Countywide Analog Radio System

Timeframe	Event(s)
	reminded to curtail non-essential radio conversations and some County departments are instructed to use alternate radio systems.
2000 June 04, 2017 to 1000 June 05, 2017	The "Colorado Controller" arrives and is taken to Muirdale where work begins to use it as a full-scale replacement to the failed "Controller A" MTC3600 PSC however that work is unsuccessful.
1000 to 1535 June 05, 2017	The additional set of cards arrives by FedEx in Milwaukee County and is taken by Mr. Gestl to Muirdale. Mr. Richford, Mr. Gestl, and Mr. Mathew (Motorola's System Technologist for OASIS), using all available parts, create a new functional controller as new "Controller A" and by 1535 it is successfully tested to provide non-failsoft operation to all 13 channels.
1600, June 05, 2017 to 0900, June 06, 2017	Between 1600, June 05, 2017 and 0900, June 06, 2017, the analog radio system continues to operate in non-failsoft mode and with full capacity (all 13 of 13 channels) but without a backup controller.
0900 to 1500, June 06, 2017	<p>Mr. Richford uses available replacement cards/parts to restore full service to "Controller B" and conducts several tests to ensure both Controllers are fully functional. All tests are successful. Also during this period, Mr. Gestl and Mr. Weber, perform repairs to the failed components at the Engine 38 radio site, replacing parts and cables that had been visibly scorched by lightning.</p> <p>By 1500, June 06, 2017, service to both MTC3600 PSCs had been fully restored, the system is operating at full functionality, and Engine 38 radio site had returned to full operations.</p>

4 Impacts to User Agencies

Once user agencies became aware of the failsoft condition (through indicator on their radio or dispatch console), they are to execute steps to notify their users and either: i) continue to communicate on the radio system in its failsoft state or ii) switch to an alternate, backup radio system. Each user agency is to have their own radio-system failsoft plan that identifies their failsoft system choice (continue in failsoft or switch to backup) and their procedure for notifying and, if necessary, switching individual users.

There are a number of alternate, backup radio systems available in in Milwaukee County, including:

- The 8TAC/8CALL network of conventional repeaters that are operated by the City of Milwaukee. These are normally off and can be activated by public safety agencies within Milwaukee County by contacting the City of Milwaukee Police Department's dispatch center. On June 03, 2017, a representative from the North Shore Fire Department activated the City's 8TAC/8CALL (with assistance from the City of Milwaukee Police Department's dispatch center) at approximately 0900. It was then used by the North Shore Fire Department and other agencies.
 - NOTE: A standard plan (referred to as Draft OASIS Standard 006) regarding the process for activating the 8TAC/8CALL network is currently under development, pending approval of the draft process to contact the City of Milwaukee.
- The Greenfield SmartNet radio system that is operated by the City of Greenfield for the primary purposes of: i) serving the Greenfield Public Works Department and ii) remaining available as a backup radio system for Greenfield's agencies as well as in instances of failsoft of the countywide

After-Action Report for June, 2017 Failsoft Event of Milwaukee County Countywide Analog Radio System

1 radio system. This system is normally operational and it was in an active-and-useable state on June
2 03, 2017. It was used by numerous agencies during this failsoft event, primarily those in the general
3 proximity of Greenfield.

- 4 • A legacy VHF radio channel plan known as the Zone/Siren system that consists of simplex/direct VHF
5 frequencies that are assigned to various regions within Milwaukee County. This was used by a few
6 user agencies during this failsoft event, primarily those in the southeastern portion of the County.
- 7 • The County Backup Repeater Network that is operated by Milwaukee County OEM-RSD and that is
8 comprised of distributed conventional repeaters that use frequencies from the analog radio system.
9 This system was active on June 03, 2017 and users from Criminal Justice Facility (CJF), House of
10 Corrections (HoC), and Sheriff's Courts detail were instructed to use these backup repeaters for some
11 or all of the failsoft event.

12 Additionally, the Milwaukee County Emergency Medical Services Division (OEM-EMS) was instructed to use
13 cell phones for coordination between paramedics and hospitals for transportation to emergency medicine
14 departments.

15 The activation of, transition to, and use of backup systems during the failsoft event of June 03, 2017 is noted
16 by some agencies in the results of an AAR survey (see Section 6 and Appendix B, below) as in need of
17 clarification, simplification, or other improvement. The adoption of OASIS Standard 006 will provide
18 assistance to this effort. Milwaukee County OEM-RSD is available to assist user agencies with the
19 development or refinement of their radio-system failsoft plan.

20 Milwaukee County OEM would like to thank the City of Milwaukee and the City of Greenfield for the use of
21 their backup radio systems by user agencies during this failsoft event.

22 **5 Investigations into Cause**

23 As of the date of this Report, there has not been a confirmed cause of the failure of both "Controller A" and
24 "Controller B" MTC3600 PSCs. Two possible causes are being investigated.

25 First, the failure of the two analog-system MTC3600 PSCs occurred during a thunderstorm that had confirmed
26 lightning strikes throughout Milwaukee County from approximately 0400 to 1200 on June 03, 2017. Visual
27 confirmation of lightning damage shows that one strike is highly likely to be responsible for the damage to
28 radio system equipment at the Engine 38 radio site, causing that analog radio system site to be removed from
29 service. No equipment at Muirdale, including the two MTC3600 PSCs, showed any visible damage, including
30 the type of scorch marks found at the Engine 38 radio site. However, despite the lack of such visible evidence,
31 lightning damage could still be the cause of the controllers' failures.

32 Second, the two MTC3600 PSCs had previously shown failures that have remained undiagnosed but that
33 could be the result of defects from manufacturing or configuration. As is noted above, the MTC3600 product
34 line had been cancelled by Motorola and the two MTC3600 PSCs at Muirdale were among the last
35 manufactured by Motorola.

36 Motorola is assisting Milwaukee County in identifying the cause of the MTC3600 PSCs failures by conducting
37 the following actions:

- 38 1) The two failed MTC3600 PSCs will be sent to Motorola's Elgin Service Center for evaluation. Initially,
39 the Controller A will be sent for evaluation and, if possible, repair at which point it will be returned

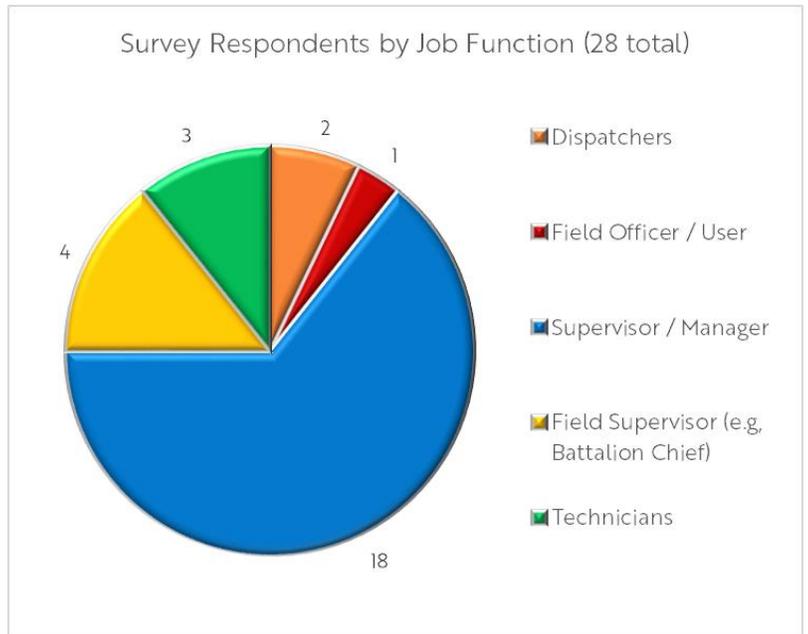
1 to Muirdale and replaced into service so that Controller B can then be sent for evaluation. The
2 examination of each MTC3600 PSC will include investigations into possible lightning/electrical
3 damage and other possible sources of failure (manufacturing, configuration, etc.). Milwaukee County
4 has asked Motorola to prepare a written report for each MTC3600 PSC's evaluation and those reports
5 will be provided as supplements to this Report upon their completion.

- 6 2) All radios sites in both the analog radio system and OASIS, including Muirdale, will be examined to
7 determine if they provide proper levels of electrical grounding and lightning protection. These
8 investigations will be conducted by an independent firm that specializes in radio site conditions and
9 will use Motorola's document "R56, Standards and Guidelines for Communications Sites" as their
10 baseline. The examination at Muirdale will include an inspection to identify any lightning damage
11 that has remained unseen to-date. Written reports will be prepared for each site listing their overall
12 condition and specifically noting any issues requiring remedy, which will then be addressed by
13 Milwaukee County and Motorola. Any findings from the inspection at Muirdale that could identify a
14 possible cause of the MTC36000 PSCs' failures will be provided as supplements to this Report.

15 6 Survey Feedback from User Agencies

16 To further gauge the impact of the failsoft event on user agencies and to identify opportunities for
17 improvements should similar events occur in the future, Milwaukee County OEM-RSD developed and issued
18 a survey to user agencies during the period of
19 June 12, 2017 to June 19, 2017. The survey
20 covered 6 topics and asked respondents to
21 rate each on a scale of 0 to 10 with the option
22 to provide short-text comments on each topic
23 and one additional open-ended comment
24 area for any topic not covered in the survey. A
25 total of 28 responses to the survey were
26 collected² with the distribution of the
27 functional role of all respondents shown in the
28 figure to the right.

29 The results of this survey are shown in the
30 following table which lists the average for each
31 numerical-rating question (along with the
32 standard deviation of responses).



² Responses received were from following user agencies (listed by the name provided by the respondent) : City of St. Francis Fire Department (2 responses received), Cudahy Police Department, Cudahy Fire Department, North Shore Fire/Rescue, North Central HIDTA, Greendale Police Department, Oak Creek Fire Department, Greendale Fire Department, Franklin Police Department, Milwaukee County Sheriff's Office, Milwaukee County OEM-EMS Division, City of Wauwatosa Police and Fire, Wauwatosa Police Department, South Milwaukee Police Department, Wauwatosa Fire Department, Wauwatosa Police and Fire Departments, Milwaukee County House of Corrections Maintenance Department, Milwaukee County Behavioral Health Division, General Mitchell International Airport (2 responses received), West Milwaukee Police Department, West Allis Police Department, Milwaukee County House of Corrections, Franklin Fire Department, and Oak Creek Police and Fire Dispatch, and Milwaukee County Transit System .

After-Action Report for June, 2017 Failsoft Event of Milwaukee County Countywide Analog Radio System

1 The optional comments provided by respondents to the survey's topics and questions can be made available
 2 upon request to Mr. Viel of OEM-RSD.

Topic, Question. & Scale	Average Rating (& Std Dev)
NOTIFICATION: Please rate OEM's performance on providing initial notification of the failsoft event (1 = poor, 10 = excellent).	Ave = 7.6 (Std Dev = 2.8)
BACKUP TRANSITION: Please rate the process of activating your backup systems and transitioning to their use (0 = very difficult, 10 = very easy).	Ave = 7.5 (Std Dev = 2.2)
BACKUP USE: Please rate the effectiveness of your backup system (0 = did not meet our needs, 10 = met our needs).	Ave = 7.1 (Std Dev = 2.8)
RESTORATION: Please rate OEM's performance to restore radio system service (0 = poor, 10 = excellent).	Ave = 7.8 (Std Dev = 2.1)
COMMUNICATIONS: Please rate OEM's performance to keep you informed on the efforts to restore service; including current status and expectations for next-steps and resolution (0 = poor communications, 10 = excellent communications).	Ave = 8.8 (Std Dev = 1.7)
FUTURE FAILURE PREPAREDNESS: Please rate your preparedness for any possible future radio system failure events (i.e., knowledge of backup systems and how to use them; awareness of who to contact, etc.) (0 = not prepared, 10 = very prepared).	Ave = 7.7 (Std Dev = 2.0)

3

4 **7 Open Issues and Assignments**

5 OEM-RSD has identified the following Open Issues that will be addressed to better protect the systems (both
 6 the existing analog radio system and OASIS) from failsoft and to improve response should a similar event
 7 occur in the future. Each issue is shown with an expected deliverable, identified responsible individual, and
 8 deadline.

#	Issue	Expected Deliverable	Responsible Individual	Deadline
1.	Analysis of cause of failures of Controller A and Controller B	Report describing the results of analysis of all failed components of both MTC3600 PSCs and identifying a cause of their failure.	Jayson Hardersen, Motorola	By July 15, 2017
2.	Analysis of Lightning Protection at All Milwaukee County Radio Sites	Report describing the status of electrical grounding and other lightning-protection methods at all Milwaukee County radio sites (to be based on Motorola's document R56, "Standards and Guidelines for Communications Sites").	Ron Mirka, Motorola	By July 31, 2017
3.	Review of Spare Parts Inventory for Controllers for Analog Radio System and OASIS	Recommendation to Milwaukee County of any changes to pool of spare parts for Analog Radio System and OASIS.	Rick Richford, Motorola	By July 15, 2017
4.	Review of Automated Alarm & Notification Configurations with OASIS Controllers	Agreement by Milwaukee County that OASIS Controllers are properly configured to provide alarms and	Rick Richford, Motorola	By July 31, 2017

After-Action Report for June, 2017 Failsoft Event of Milwaukee County Countywide Analog Radio System

#	Issue	Expected Deliverable	Responsible Individual	Deadline
		notifications to required OEM-RSD and Motorola personnel.		
5.	Completion of Draft OASIS Standard 006 for Backup Radio Systems	Approval by OASIS Governance Board of Standard 006 for Backup Radio Systems.	Erik Viel, Milwaukee County OEM-RSD	By August 30, 2017
6.	OASIS Outage Notification Standard 008	Approval by OASIS Governance Board of Standard 008 to describe the process to be used to notify users of system outages.	Erik Viel, Milwaukee County OEM-RSD	By August 30, 2017
7.	Completion of Performance Testing of Digital Microwave Backhaul Network	Delivery by Motorola to OEM-RSD of results of microwave network testing including, if necessary, any identified problems with an accompanying correction plan.	Ron Mirka, Motorola	By July 15, 2017
8.	Completion of All OASIS Failure Mode Functional Acceptance Test Plans	Signature by OEM-RSD to all OASIS Failure Mode Functional Acceptance Test Plans.	Steve Surwillo, Milwaukee County OASIS Project Manager	By August 30, 2017
9.	Confirmation of Points of Contact (Distribution List) and Distribution Methods for All Milwaukee County Radio System User Agencies	Updated OEM-RSD communications plan, including points of contact and methods.	Erik Viel, Milwaukee County OEM-RSD	By July 15, 2017
10.	Identification of Backup System and Backup System Transition Plan by All Milwaukee County Radio System User Agencies	Updated Radio System Backup Plans (1 per user agency).	Each User Agency	By August 30, 2017
11.	Agreement to Testing Plan for Transition Plan to Backup Systems Transition Plan and Conduct of First Instance of Testing Plan	Backup Radio System Testing Plan reviewed and approved by OASIS Technical and Operational Committees as well as executed an initial instance.	Erik Viel, Milwaukee County OEM-RSD	By August 30, 2017
12.	Training of User Agencies on Use of OASIS User Radios, Including How to Identify Failsoft and other Failure Modes	Completion of train-the-trainer session on APX radios with specific course materials on identifying and reacting to failure modes.	Steve Surwillo, Milwaukee County OASIS Project Manager	By August 30, 2017
13.	Development of a User Agency Transition Plan and Schedule	Completion of a User Agency Transition Plan and Schedule that describes when each user agency's user radios will be programmed for operation on OASIS.	Steve Surwillo, Milwaukee County OASIS Project Manager	By July 15, 2017

After-Action Report for June, 2017 Failsoft Event of Milwaukee County Countywide Analog Radio System

7 **Appendix A – Email and Teletype (TTY) Communications Log**

Update #	Topic	Time/Date Emailed	Time/Date TTY'ed
Original Email	Initial notification of failsoft	0854, June 03, 2017	n/a
Email Update #1	Radio technicians are on site and working to identify cause	1010, June 03, 2017	n/a
Original TTY	Spare parts for radio system failure are being sought	n/a	1347, June 03, 2017
Email Update #2	Steps take so far are unsuccessful, parts are being dispatched from Schaumburg	1344, June 03, 2017	1408, June 03, 2017
Email Update #3	Schaumburg replacement parts are being installed	1638, June 03, 2017	n/a
Email Update #4	System is out of failsoft but with limited capacity & no backup, work continues	1803, June 03, 2017	1804, June 03, 2017
Email Update #5	Recap of situation, request for radio discipline	2035, June 03, 2017	2044 & 2047, June 03, 2017 (sent in 2 parts)
Email Update #6	Start of day with limited capacity & no backup, parts from Elgin and other locations are in-bound	1211, June 04, 2017	1527, June 04, 2017
Email Update #7	Controller work with Elgin parts will occur later, be ready for failsoft	1519, June 04, 2017	1553, June 04, 2017
Email Update #8	Work has begun using Elgin parts, be ready for failsoft	1642, June 04, 2017	1645, June 04, 2017
Email Update #9	Work continues using Elgin parts, be ready for failsoft	1753, June 04, 2017	n/a
Email Update #10	Work continues using Elgin parts, be ready for failsoft	1920, June 04, 2017	n/a
Email Update #11	Work with Elgin parts unsuccessful, Colorado controller expected soon	2052, June 04, 2017	2054, June 04, 2017
Email Update #12	Work on Colorado controller has started	0044, June 05, 2017	0046, June 05, 2017
Email Update #13 (Sent as #12)	Work with Colorado controller was unsuccessful, system continues with limited capacity & no backup	0106, June 05, 2017	0109, June 05, 2017
Email Update #14	Recap of situation, plan to work with all available parts during the day, be ready for failsoft, continued request for radio discipline	1255, June 05, 2017	1257, June 05, 2017
Email Update #15	Work with available parts successful, System back to full capacity but no backup	1608, June 05, 2017	1620, June 05, 2017
Email Update #16	Start of day, plan to work with available parts to restore backup controller, be ready for failsoft	1007, June 06, 2017	n/a
Email Update #17	Backup controller restored, monitoring will continue	1228, June 06, 2017	n/a
Email Update #18 Final (Sent as #17)	Engine 38 radio site back on line, system remains operational	1603, June 06, 2017	n/a
Conference Call	Review of events and status with open Q&A held at 1600, June 07, 2017		

APPENDIX B

JULY FAILSOFT AFTER-ACTION REPORT

July, 2017 Failsoft Event of Milwaukee County Countywide Analog Radio System

1 **SCOPE:** This analysis summarizes the failsoft event that occurred on the Milwaukee County analog public
 2 safety radio system between July 26, 2017 and July 29, 2017. During this time, the new OASIS digital radio
 3 system remained in operation. A separate After-Action Report (AAR, dated June 28, 2017) was prepared for
 4 the failsoft event of June 03, 2017 to June 05, 2017 and this report includes references to that AAR.

5 **CHRONOLOGY:**

Timeframe	Event(s)
07/26/17 1700	During a heavy storm that disables the radio site at Engine 38 through a lightning strike, the analog radio system enters failsoft. Milwaukee County Office of Emergency Management (MC OEM) and Motorola Solutions, Inc. Field Service Organization (MSI-FSO) personnel begin investigations into the failure at the system's prime site at Muirdale. The City of Milwaukee's 8TAC/8CAL repeaters are enabled and user agencies are instructed to either continue to operate on the analog system in failsoft or switch to a backup system.
Balance of 07/26/17	MC OEM and MSI-FSO personnel switch to the system's backup controller and begin diagnosing possible issues with the two (main and backup) controllers. Their efforts do not restore service.
07/27/17	MC OEM and MSI-FSO personnel continue to diagnose the controllers and other central-control components; namely the system's Universal Simulcast Controller Interfaces (USCIs, which 'mix' trunking control data into audio conversations to provide user features) and the Simulcast Distribution Amplifiers (SDAs, which split the simulcast audio-and-data signals for distribution to sites). MSI identifies available replacement parts for the system's controllers and for the USCIs and SDAs and arranges for their overnight delivery. The system remains in failsoft.
07/28/17	The spare equipment arrives. MSI-FSO personnel configure and test them in the system. Additional staff from MSI arrive at Muirdale. The new controllers are installed in the system (a period of approximately 20 minutes of system outage results) but the system is remains in failsoft. By afternoon, attention turns to the USCIs and SDAs which are replaced with the spares. Failsoft ends in the late evening but the analog system remains disconnected from all wireline dispatch centers which are using backup control stations. (This condition is called "site trunking".)
07/29/17	MSI-FSO and other MSI technicians reconfigure the spare USCIs and SDAs. By noon, they fully restore system operation (end of failsoft and end of site trunking). All MSI and MC-OEM staff remain on-site for the balance of the day to monitor the system and confirm its full operation.

6 **CAUSE & RESOLUTION:** It has been established that the USCIs and SDAs failed, causing failsoft. These
 7 components date to the installation of the analog radio system in the 1990s) and considered "end-of-life" by
 8 MSI. Their replacement resulted in restoration of system operation. MSI will investigate which specific
 9 components failed in this equipment.

10 **ACTION PLAN:** The AAR noted above describes a number of actions that were initiated following the June 2017
 11 failsoft event. Those same actions apply to this July 2017 failsoft event and their completion will help diagnose
 12 root cause, prevent future reoccurrence, and enhance response to future failures. Those actions include:

- 13 • Confirming the communications lists and processes regarding system failures (AAR Actions #6 & #9)
- 14 • Identifying backup systems to be used by user agencies during system failures (AAR Action #10)
- 15 • Reviewing on-hand inventory of spares and confirming all central-control equipment has pre-
 16 configured spare equipment in Milwaukee County (AAR Action #3)

17 Additionally, MC OEM, MSI, and Baycom (MSI's local radio service shop) have begun the rapid reprogramming
 18 of user agency radios to migrate them from the analog system to OASIS (AAR Action #13). This reprogramming
 19 will continue with all possible priority.

20 Finally, because the failsoft events of June and July both occurred immediately after lightning strikes disabled
 21 the remote radio site at Engine 38, the analog radio equipment at that site will remain disabled until any
 22 correlation between it and failsoft can be investigated. This will slightly reduce talk-in coverage (user-radio-
 23 to-system) in the northeast corner of the County and only for the analog radio system.

APPENDIX C

RADIO FEE ANALYSIS - MUNICIPALITIES & AGENCIES

Comparing fee share by number of radios per municipality/agency (per-radio, per-month or PRPM) fee structure against fee share by usage (push-to-talks per year or PTT)

Municipality or Agency	User Radios	PTT/yr	2017			2018			2019			2020			2021		
			PRPM Plan	PTT Plan	Delta												
			<i>\$ 9.00 user fee, prpm \$ 0.00 capital fund, prpm</i>			<i>\$12.00 user fee, prpm \$ 2.00 capital fund, prpm</i>			<i>\$14.00 user fee, prpm \$ 3.00 capital fund, prpm</i>			<i>\$14.00 user fee, prpm \$ 4.00 capital fund, prpm</i>			<i>\$14.00 user fee, prpm \$ 5.00 capital fund, prpm</i>		
Village of Bayside	35	15	\$ 3,780.00	\$ 0.44	\$ (3,779.56)	\$ 5,880.00	\$ 0.69	\$ (5,879.31)	\$ 7,140.00	\$ 0.83	\$ (7,139.17)	\$ 7,560.00	\$ 0.88	\$ (7,559.12)	\$ 7,980.00	\$ 0.93	\$ (7,979.07)
Village of Brown Deer	57	4,285	\$ 6,156.00	\$ 126.80	\$ (6,029.20)	\$ 9,576.00	\$ 197.24	\$ (9,378.76)	\$ 11,628.00	\$ 239.51	\$ (11,388.49)	\$ 12,312.00	\$ 253.60	\$ (12,058.40)	\$ 12,996.00	\$ 267.69	\$ (12,728.31)
City of Cudahy	103	508,692	\$ 11,124.00	\$ 15,053.93	\$ 3,929.93	\$ 17,304.00	\$ 23,417.22	\$ 6,113.22	\$ 21,012.00	\$ 28,435.20	\$ 7,423.20	\$ 22,248.00	\$ 30,107.86	\$ 7,859.86	\$ 23,484.00	\$ 31,780.52	\$ 8,296.52
Village of Fox Point	21	-	\$ 2,268.00	\$ -	\$ (2,268.00)	\$ 3,528.00	\$ -	\$ (3,528.00)	\$ 4,284.00	\$ -	\$ (4,284.00)	\$ 4,536.00	\$ -	\$ (4,536.00)	\$ 4,788.00	\$ -	\$ (4,788.00)
City of Franklin	165	837,314	\$ 17,820.00	\$ 24,778.97	\$ 6,958.97	\$ 27,720.00	\$ 38,545.06	\$ 10,825.06	\$ 33,660.00	\$ 46,804.72	\$ 13,144.72	\$ 35,640.00	\$ 49,557.94	\$ 13,917.94	\$ 37,620.00	\$ 52,311.16	\$ 14,691.16
City of Glendale	46	4,835	\$ 4,968.00	\$ 143.09	\$ (4,824.91)	\$ 7,728.00	\$ 222.58	\$ (7,505.42)	\$ 9,384.00	\$ 270.27	\$ (9,113.73)	\$ 9,936.00	\$ 286.17	\$ (9,649.83)	\$ 10,488.00	\$ 302.07	\$ (10,185.93)
Village of Greendale	114	464,370	\$ 12,312.00	\$ 13,742.28	\$ 1,430.28	\$ 19,152.00	\$ 21,376.89	\$ 2,224.89	\$ 23,256.00	\$ 25,957.65	\$ 2,701.65	\$ 24,624.00	\$ 27,484.57	\$ 2,860.57	\$ 25,992.00	\$ 29,011.49	\$ 3,019.49
City of Greenfield	224	-	\$ 24,192.00	\$ -	\$ (24,192.00)	\$ 37,632.00	\$ -	\$ (37,632.00)	\$ 45,696.00	\$ -	\$ (45,696.00)	\$ 48,384.00	\$ -	\$ (48,384.00)	\$ 51,072.00	\$ -	\$ (51,072.00)
Village of Hales Corners	86	180,240	\$ 9,288.00	\$ 5,333.91	\$ (3,954.09)	\$ 14,448.00	\$ 8,297.20	\$ (6,150.80)	\$ 17,544.00	\$ 10,075.17	\$ (7,468.83)	\$ 18,576.00	\$ 10,667.83	\$ (7,908.17)	\$ 19,608.00	\$ 11,260.48	\$ (8,347.52)
City of Oak Creek	145	973,667	\$ 15,660.00	\$ 28,814.11	\$ 13,154.11	\$ 24,360.00	\$ 44,821.95	\$ 20,461.95	\$ 29,580.00	\$ 54,426.66	\$ 24,846.66	\$ 31,320.00	\$ 57,628.23	\$ 26,308.23	\$ 33,060.00	\$ 60,829.79	\$ 27,769.79
Village of River Hills	18	-	\$ 1,944.00	\$ -	\$ (1,944.00)	\$ 3,024.00	\$ -	\$ (3,024.00)	\$ 3,672.00	\$ -	\$ (3,672.00)	\$ 3,888.00	\$ -	\$ (3,888.00)	\$ 4,104.00	\$ -	\$ (4,104.00)
City of St. Francis	69	338,337	\$ 7,452.00	\$ 10,012.54	\$ 2,560.54	\$ 11,592.00	\$ 15,575.06	\$ 3,983.06	\$ 14,076.00	\$ 18,912.57	\$ 4,836.57	\$ 14,904.00	\$ 20,025.07	\$ 5,121.07	\$ 15,732.00	\$ 21,137.58	\$ 5,405.58
Village of Shorewood	41	-	\$ 4,428.00	\$ -	\$ (4,428.00)	\$ 6,888.00	\$ -	\$ (6,888.00)	\$ 8,364.00	\$ -	\$ (8,364.00)	\$ 8,856.00	\$ -	\$ (8,856.00)	\$ 9,348.00	\$ -	\$ (9,348.00)
City of South Milwaukee	90	394,244	\$ 9,720.00	\$ 11,667.01	\$ 1,947.01	\$ 15,120.00	\$ 18,148.68	\$ 3,028.68	\$ 18,360.00	\$ 22,037.69	\$ 3,677.69	\$ 19,440.00	\$ 23,334.02	\$ 3,894.02	\$ 20,520.00	\$ 24,630.36	\$ 4,110.36
City of Wauwatosa	224	901,237	\$ 24,192.00	\$ 26,670.67	\$ 2,478.67	\$ 37,632.00	\$ 41,487.70	\$ 3,855.70	\$ 45,696.00	\$ 50,377.93	\$ 4,681.93	\$ 48,384.00	\$ 53,341.33	\$ 4,957.33	\$ 51,072.00	\$ 56,304.74	\$ 5,232.74
City of West Allis	425	1,786,003	\$ 45,900.00	\$ 52,853.93	\$ 6,953.93	\$ 71,400.00	\$ 82,217.22	\$ 10,817.22	\$ 86,700.00	\$ 99,835.19	\$ 13,135.19	\$ 91,800.00	\$ 105,707.85	\$ 13,907.85	\$ 96,900.00	\$ 111,580.51	\$ 14,680.51
City of West Milwaukee	47	284,025	\$ 5,076.00	\$ 8,405.26	\$ 3,329.26	\$ 7,896.00	\$ 13,074.84	\$ 5,178.84	\$ 9,588.00	\$ 15,876.60	\$ 6,288.60	\$ 10,152.00	\$ 16,810.51	\$ 6,658.51	\$ 10,716.00	\$ 17,744.43	\$ 7,028.43
Village of Whitefish Bay	35	-	\$ 3,780.00	\$ -	\$ (3,780.00)	\$ 5,880.00	\$ -	\$ (5,880.00)	\$ 7,140.00	\$ -	\$ (7,140.00)	\$ 7,560.00	\$ -	\$ (7,560.00)	\$ 7,980.00	\$ -	\$ (7,980.00)
North Shore Fire/Rescue	120	174,115	\$ 12,960.00	\$ 5,152.67	\$ (7,807.33)	\$ 20,160.00	\$ 8,015.26	\$ (12,144.74)	\$ 24,480.00	\$ 9,732.81	\$ (14,747.19)	\$ 25,920.00	\$ 10,305.33	\$ (15,614.67)	\$ 27,360.00	\$ 10,877.85	\$ (16,482.15)
North Shore Police Departments	253	1,182,178	\$ 27,324.00	\$ 34,984.68	\$ 7,660.68	\$ 42,504.00	\$ 54,420.61	\$ 11,916.61	\$ 51,612.00	\$ 66,082.17	\$ 14,470.17	\$ 54,648.00	\$ 69,969.36	\$ 15,321.36	\$ 57,684.00	\$ 73,856.54	\$ 16,172.54
Mayfair Mall Security	68	916,263	\$ 7,344.00	\$ 27,115.34	\$ 19,771.34	\$ 11,424.00	\$ 42,179.42	\$ 30,755.42	\$ 13,872.00	\$ 51,217.87	\$ 37,345.87	\$ 14,688.00	\$ 54,230.69	\$ 39,542.69	\$ 15,504.00	\$ 57,243.50	\$ 41,739.50
MADACC	19	63,194	\$ 2,052.00	\$ 1,870.14	\$ (181.86)	\$ 3,192.00	\$ 2,909.10	\$ (282.90)	\$ 3,876.00	\$ 3,532.48	\$ (343.52)	\$ 4,104.00	\$ 3,740.27	\$ (363.73)	\$ 4,332.00	\$ 3,948.07	\$ (383.93)
North Central HIDTA	70	112,923	\$ 7,560.00	\$ 3,341.76	\$ (4,218.24)	\$ 11,760.00	\$ 5,198.30	\$ (6,561.70)	\$ 14,280.00	\$ 6,312.22	\$ (7,967.78)	\$ 15,120.00	\$ 6,683.53	\$ (8,436.47)	\$ 15,960.00	\$ 7,054.84	\$ (8,905.16)
US Department of Veterans Affairs	26	1,368	\$ 2,808.00	\$ 40.48	\$ (2,767.52)	\$ 4,368.00	\$ 62.96	\$ (4,305.04)	\$ 5,304.00	\$ 76.45	\$ (5,227.55)	\$ 5,616.00	\$ 80.95	\$ (5,535.05)	\$ 5,928.00	\$ 85.45	\$ (5,842.55)
System Total	2501	9,127,302	\$ 270,108.00	\$ 270,108.00	\$ 0.00	\$ 420,168.00	\$ 420,168.00	\$ 0.00	\$ 510,204.00	\$ 510,204.00	\$ 0.00	\$ 540,216.00	\$ 540,216.00	\$ 0.00	\$ 570,228.00	\$ 570,228.00	\$ 0.00

Milwaukee County Agencies	User Radios	PTT/yr	2017			2018			2019			2020			2021		
			PRPM Plan	PTT Plan	Delta												
			<i>\$ 55.83 user fee, prpm \$ 0.00 capital fund, prpm</i>			<i>\$ 55.67 user fee, prpm \$ 0.00 capital fund, prpm</i>			<i>\$ 55.20 user fee, prpm \$ 0.00 capital fund, prpm</i>			<i>\$ 55.20 user fee, prpm \$ 0.00 capital fund, prpm</i>			<i>\$ 55.20 user fee, prpm \$ 0.00 capital fund, prpm</i>		
Total	2413	7,843,323	\$ 1,617,771.72			\$ 1,617,980.52			\$ 1,598,371.20			\$ 1,598,371.20			\$ 1,598,371.20		

APPENDIX D

RADIO FEE ANALYSIS - NORTH SHORE MUNICIPALITIES & AGENCIES

Comparing fee share by number of radios per municipality/agency (per-radio, per-month or PRPM) fee structure against fee share by usage (push-to-talks per year or PTT)

Municipality or Agency	User Radios	PTT/yr	2017			2018			2019			2020			2021		
			PRPM Plan	PTT Plan	Delta												
			<i>\$ 9.00 user fee, prpm \$ 0.00 capital fund, prpm</i>			<i>\$12.00 user fee, prpm \$ 2.00 capital fund, prpm</i>			<i>\$14.00 user fee, prpm \$ 3.00 capital fund, prpm</i>			<i>\$14.00 user fee, prpm \$ 4.00 capital fund, prpm</i>			<i>\$14.00 user fee, prpm \$ 5.00 capital fund, prpm</i>		
Village of Bayside	35	15	\$ 3,780.00	\$ 0.44	(3,779.56)	\$ 5,880.00	\$ 0.69	(5,879.31)	\$ 7,140.00	\$ 0.83	(7,139.17)	\$ 7,560.00	\$ 0.88	(7,559.12)	\$ 7,980.00	\$ 0.93	(7,979.07)
Village of Brown Deer	57	4,285	\$ 6,156.00	\$ 126.80	(6,029.20)	\$ 9,576.00	\$ 197.24	(9,378.76)	\$ 11,628.00	\$ 239.51	(11,388.49)	\$ 12,312.00	\$ 253.60	(12,058.40)	\$ 12,996.00	\$ 267.69	(12,728.31)
Village of Fox Point	21	-	\$ 2,268.00	\$ -	(2,268.00)	\$ 3,528.00	\$ -	(3,528.00)	\$ 4,284.00	\$ -	(4,284.00)	\$ 4,536.00	\$ -	(4,536.00)	\$ 4,788.00	\$ -	(4,788.00)
City of Glendale	46	4,835	\$ 4,968.00	\$ 143.09	(4,824.91)	\$ 7,728.00	\$ 222.58	(7,505.42)	\$ 9,384.00	\$ 270.27	(9,113.73)	\$ 9,936.00	\$ 286.17	(9,649.83)	\$ 10,488.00	\$ 302.07	(10,185.93)
Village of River Hills	18	-	\$ 1,944.00	\$ -	(1,944.00)	\$ 3,024.00	\$ -	(3,024.00)	\$ 3,672.00	\$ -	(3,672.00)	\$ 3,888.00	\$ -	(3,888.00)	\$ 4,104.00	\$ -	(4,104.00)
Village of Shorewood	41	-	\$ 4,428.00	\$ -	(4,428.00)	\$ 6,888.00	\$ -	(6,888.00)	\$ 8,364.00	\$ -	(8,364.00)	\$ 8,856.00	\$ -	(8,856.00)	\$ 9,348.00	\$ -	(9,348.00)
Village of Whitefish Bay	35	-	\$ 3,780.00	\$ -	(3,780.00)	\$ 5,880.00	\$ -	(5,880.00)	\$ 7,140.00	\$ -	(7,140.00)	\$ 7,560.00	\$ -	(7,560.00)	\$ 7,980.00	\$ -	(7,980.00)
North Shore Fire/Rescue	120	174,115	\$ 12,960.00	\$ 5,152.67	(7,807.33)	\$ 20,160.00	\$ 8,015.26	(12,144.74)	\$ 24,480.00	\$ 9,732.81	(14,747.19)	\$ 25,920.00	\$ 10,305.33	(15,614.67)	\$ 27,360.00	\$ 10,877.85	(16,482.15)
North Shore Police Departments	253	1,182,178	\$ 27,324.00	\$ 34,984.68	7,660.68	\$ 42,504.00	\$ 54,420.61	11,916.61	\$ 51,612.00	\$ 66,082.17	14,470.17	\$ 54,648.00	\$ 69,969.36	15,321.36	\$ 57,684.00	\$ 73,856.54	16,172.54
System Total	626	1,365,428	\$ 67,608.00	\$ 40,407.67	(27,200)	\$ 105,168.00	\$ 62,856.38	(42,312)	\$ 127,704.00	\$ 76,325.60	(51,378)	\$ 135,216.00	\$ 80,815.34	(54,401)	\$ 142,728.00	\$ 85,305.08	(57,423)

Milwaukee County Agencies	User Radios	PTT/yr	2017			2018			2019			2020			2021		
			PRPM Plan	PTT Plan	Delta												
			<i>\$ 55.87 user fee, prpm \$ 0.00 capital fund, prpm</i>			<i>\$ 55.87 user fee, prpm \$ 0.00 capital fund, prpm</i>			<i>\$ 55.87 user fee, prpm \$ 0.00 capital fund, prpm</i>			<i>\$ 55.87 user fee, prpm \$ 0.00 capital fund, prpm</i>			<i>\$ 55.87 user fee, prpm \$ 0.00 capital fund, prpm</i>		
Total	2413	7,843,323	\$ 1,617,771.72			\$ 1,611,980.52			\$ 1,598,371.20			\$ 1,598,371.20			\$ 1,598,371.20		

