

Mu2e-doc-5220-v8



Managed by Fermi Research Alliance, LLC for the U.S. Department of Energy Office of Science

Introduction

Rob Kutschke

Mu2e Computing Review

March 5, 2015

Mu2e Speakers

- Rob Kutschke (FNAL)
- Bertrand Echenard (Caltech)
- Dave Brown (Louisville)
- Bob Bernstein (FNAL)
- Dave Brown (LBL)
- Andrei Gaponenko (FNAL)
- Ralf Ehrlich (UVa)
- Zhengyun You (UC Irvine)
- Yuri Oksuzian (UVa)
- Ray Culbertson (FNAL)

Some Advice

- Some figures render beautifully on your Retina Display
 - Not so well on the 20th century vintage projector in this room
- You might wish to follow along on your laptop

Overview of Talks (1)

- Talks to provide context and define language
 - [Introduction](#)
 - [The Physics of Mu2e](#)
 - [The Mu2e Apparatus](#)
 - [Background Overview](#)
 - What we are doing now:
 - [Software, Tools and Environment](#) (1)
 - [Project 1: Simulation of Proton Microbunch Events](#) (1, 2)
 - [Project 2: Cosmic Ray Studies](#) (1, 2)
 - [Project 3: Beam Induced Hits in the CRV](#) (1, 2)
- (Charge Question(s) Addressed)

Overview of Talks (2)

- What do we plan going forward:
 - [Resource Needs](#) (2)
 - [Analysis Model](#) (1, 2, 3)
 - [Roadmap to Operations](#) (3)
- Summary
 - [Summary](#) (1, 2, 3)

Three Main Software Packages

- G4beamline
 - First out of the gate
 - Used for studies of the muon beamline and shielding
 - Future support uncertain (Muons Inc)
- Mu2e Offline
 - Based on art; our G4 model runs within Mu2e Offline.
 - Sim/Reco/Analysis/Trigger code developed in this environment
 - The primary tool for detector studies
 - Expect it eventually to replace G4beamline for many purposes
- MARS
 - Used primarily for energy deposition and shielding studies
 - Some critical calculations done in both Geant4 and MARS

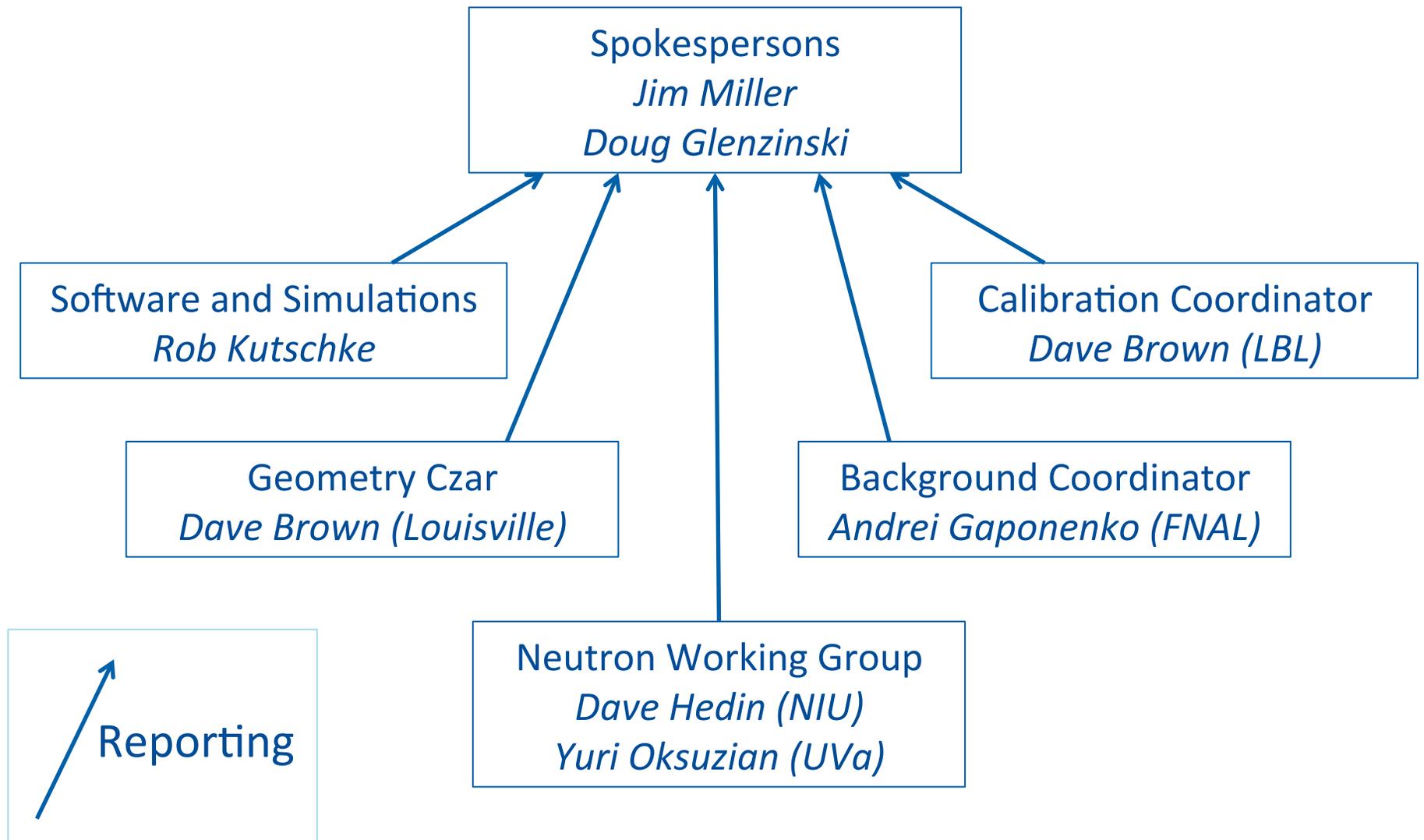
Three Main Software Packages

- Computing and workflow issues are similar for all three
 - All run on the grid using Mu2e written scripts that live on top of jobsub and use SCD supplied tools (eg ifdhc)
- Code development:
 - Mu2e Offline: our main code development effort is here.
 - G4beamline: we are not developers
 - MARS: development of end-user code only

What we will not cover in this review

- Jobs done by Accelerator Division using their own tools
 - Simulation of beam to the Delivery Ring
 - Simulation of the slow extraction
 - Simulation of the transport lines
 - Simulation of the Extinction RF dipole
- Internals of Mu2e Offline
 - Algorithms, data product design ...
- Details of our use of G4beamline or MARS

Management Structure (1)



Management Structure (2)

- Software and Simulations Group
 - Develop and maintain Mu2e Offline
 - Infrastructure, algorithms, data products, analysis tools
 - Perform physics studies using these tools.
 - Organize large simulation runs to produce events for general use
 - Assist Mu2e members with dedicated simulations
 - Train Mu2e members to use Mu2e Offline
 - Work with the collaboration to engage non-expert users.

Management Structure (3)

- Geometry Czar
 - Ensure that all Offline/G4beamline/MARS have consistent geometries.
 - The three tools have very different geometry description languages.
 - We do not have a single tool to generate all 3 geometries.
 - When we started G4beamline and MARS supported fewer shapes than Mu2e Offline, which talks directly to G4 without an intermediary.
 - Ensure that these geometries are up to date with drawings and other planning.
 - When multiple options exist, ensure that all options are implemented correctly.

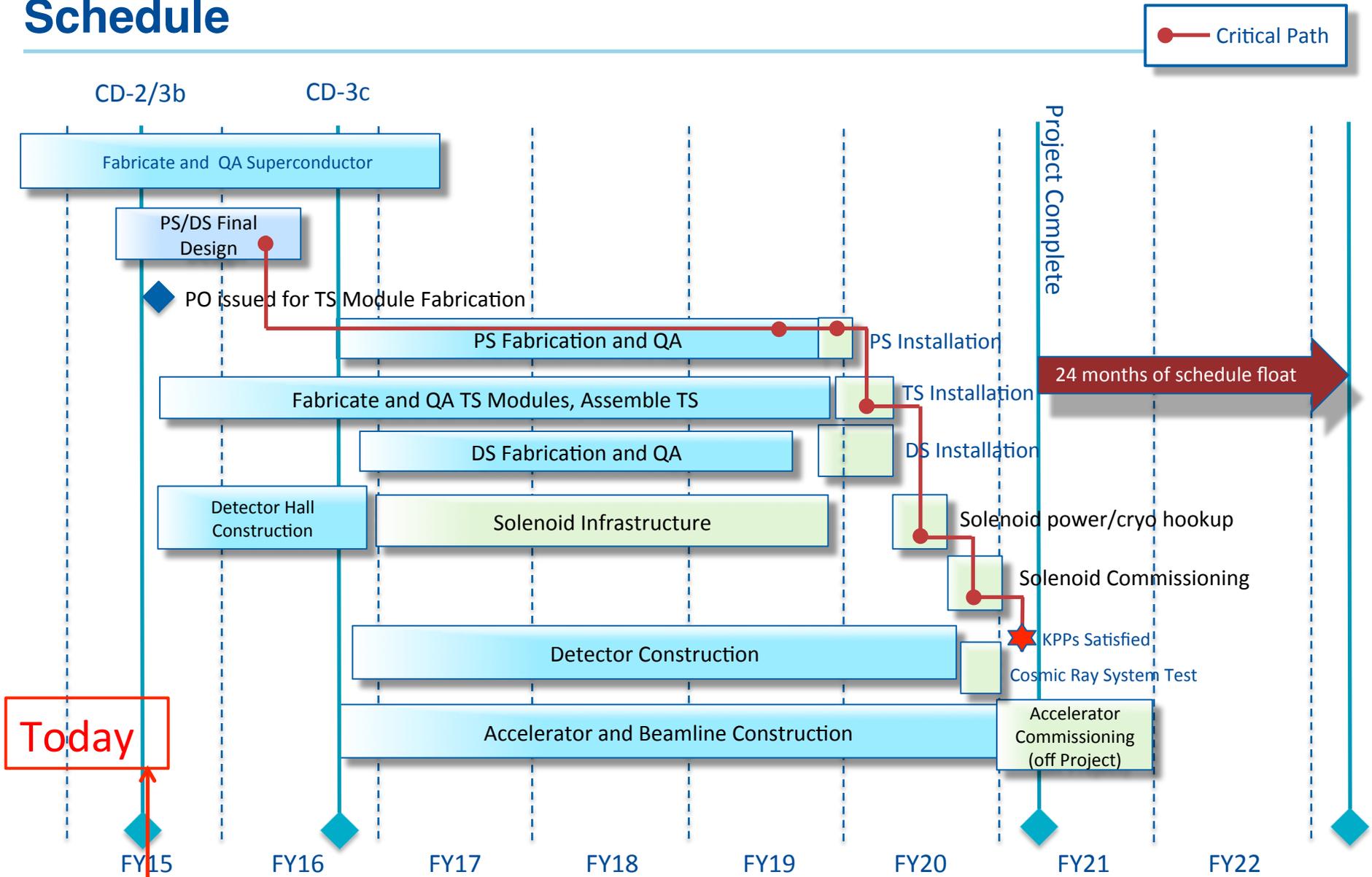
Management Structure (4)

- Background Coordinator
 - Ensure that calculations, simulations etc are done for all processes that can produce a fake signal
 - Ensure that these are done with up-to-date geometry, code, cuts, input event samples ...
 - Compute systematic errors on all of the above.
 - Primary tool is Mu2e Offline
- Calibration Coordinator
 - Develop strategies for measuring, with data, the absolute momentum scale of Mu2e
 - Primary tool is Mu2e Offline

Management Structure (5)

- Neutron Working Group
 - Understand the neutron and photon flux through all of the subsystems that care about it.
 - Understand how this flux affects deadtimes, efficiencies ...
 - Earlier work done with a factorized calculation: part by MARS, part by G4beamline, part by hand
 - Redo this in an integrated fashion using Mu2e Offline
 - Understand systematics

Schedule



Important Dates

- March 2016:
 - DOE CD3b Review
 - Complete calculations and figures by Dec 1, 2015
- Q4 FY20:
 - Commissioning with cosmic rays; detector outside the magnet.
- Mid to late FY21
 - Commissioning with beam and with the detector in the magnet.
- The last talk, the Roadmap to Operations, will fill in the details.

Big Questions For CD3

- 1) Significant beam related backgrounds reach the Cosmic Ray Veto (CRV) system and cause deadtime.
 - Is the deadtime within spec?
- 2) There are corners in the CRV system that have reduced coverage to accommodate penetrations and obstructions.
 - What is the rate of cosmic rays that can enter, unvetoes, via these regions and produce a fake signal? Is it acceptably low?
- 3) Recompute the resolutions, sensitivities and backgrounds (all with systematic errors) using the most recent design and the most recent simulation and reconstruction codes. At least the same size as the sample generated for the TDR.

What does Mu2e Need from SCD?

- 1) Support for running Offsite
 - Progress has been steady but slow; reliability issues.
 - Request SCD make it a priority to get us in production by April 1
 - Request SCD let remote sites know that we are a lab priority
 - Can a liaison help?
- 2) Request support from a graphics expert who can help us improve and integrate our event displays
 - Understanding, validating, debugging, explaining algorithms
 - Explaining Mu2e to reviewers
 - Onboarding new users
- 3) Production operators have been valuable. We would like them to assist during the simulation campaign that will occur ~April 1 to ~Sep 1.
- 4) The future of Muons Inc is uncertain. If G4beamline becomes orphaned, we request that SCD commit to building G4beamline against future versions of G4.

Backup Slides

G4beamline

- A wrapper on top of G4
 - No C++ or G4 knowledge needed
 - You only need to know its geometry language; easy to learn.
- Started at FNAL taken over by Muons Inc
 - Future support uncertain.
- First work on Mu2e was to simulate the muon beamline
 - Compute stopped muons per POT
 - Study non-muons entering the DS
 - G4beamline was the fast out of the gate option
- Does not have the hooks for detailed detector modelling
- Until recently it did not support all G4Solids
 - Booleans, Extruded solids

Human Resources

- 35 people have worked with one of Offline/G4Beamline/MARS in the past year or plan to work on it in the coming year.
 - Many have very low duty cycle or are no longer with Mu2e
- For the next year, only 15 plan to work >40% of their time on Mu2e computing/software/simulations.
 - Most are focused on science
 - We are understaffed for keeping the Mu2e specific infrastructure up to date.
 - If SCD could supply a good utility programmer it would be enormously beneficial.

People (1)

	to CD2/3a	To now	To CD3c	Institute		Main Project
Bob Bernstein	0.2	0.2	0.4	FNAL	Senior	STM
Steve Boi	0.2	0.3	0.3	NUI	Student	NWG
Dave Brown	0.5	0.5	0.5	LBL	Senior	Tracking
Dave Brown	0.04	0.14	0.28	Louisville	Senior	Geometry
Rick Coleman	0.4	0.4	0.4	FNAL	Senior	NWG
Ray Culbertson	0.1	0.8	0.8	FNAL	Senior	Infrastructure
Bertrand Echenard	0.3	0.3	0.3	Caltech	Postdoc	Calorimeter
Ralf Ehrlich	0.5	0.9	0.7	Uva	Postdoc	CRV
Dave Hendin	0.3	0.3	0.3	NIU	Senior	NTF
Andrei Gaponenko	0.9	0.05	0.8	FNAL	Wilson Fellow	Many
Krzysztof Genser	0.75	0.75	0.4	FNAL	Staff	G4
Vladimir Khalatian	0.6	0	0	NIU		NWG
Kyle Knoepfel	0.8	0.05	0	FNAL	Postdoc	Many
Rob Kutschke	0.5	0.1	0.6	FNAL	Senior	Many
Tony Leveling				FNAL	Senior	MARS
Vanya Logashenko	0.08	0	0	Novosibirsk	Senior	Trapped particles
Anna Mazzacane	0.5	0.25	0	FNAL	Staff	MARS, G4 standalone
Nikolia Mokhov	0.15	0.1	0.1	FNAL	Senior	MARS
James Mott	0.2	0.2	0.05	BU	Postdoc	pi+ calib

Fraction of FTE

NWG: Neutron Working Group

STM: Stopping Target Monitor

People (2)

	to CD2/3a	To now	To CD3c	Institute		Main Project
Pasha Murat		0.8		FNAL	Senior	Calorimeter
Yuri Oksuzian	0.3	0.3		0.4 Uva	Postdoc	NWG
Anthony Palladino	0.05	0.7		0.4 BU	Postdoc	STM
Giani Pezzullo	0.9	0.9		0.6 Pisa	Student	Calorimeter
Vitaly Pronskihk	0.85	0.85		0.75 FNAL	Senior	MARS
Igor Rakhno				FNAL	Senior	MARS
Markus Roehrken	0.5	0.5		0.5 Caltech	Postdoc	Stop Tgt Opt
Zafar Usbov				0.7 Dubna	Senior	Cal standalone
Costas Vellidis	0.1	0.2		0.8 Athens/FNAL	Senior	Beta source study
Chiho Wang	0	0		0.4 Duke	Senior	Wire Stabilitiy
Mike Wang	0.4	0		0.1 FNAL	Staff	Trk Trigger
Zhengyun You	0.9	0.9		0.6 UCI	Postdoc	p-bar Background
Totals:	11.02	10.49	10.48			

Total 31 people: but many at very low duty cycle or have left Mu2e

Stop Tgt Opt: Optimization of Stopping Target

New People

	Fraction FTE	Institute		Main Project
Sarah Demers	0.25	Yale	Senior	Cal Trigger
Merril Jenkins		Alabama		
Lotte Thomsen	0.1	Yale	Postdoc	Cal Trigger
Shilo Xia	0.5	Yale	Student	Cal Trigger

People Working With Mu2e Offline, ≥ 0.4 to CD3c

	Fraction FTE	Institute	Level	Main Project
Bob Bernstein	0.4	FNAL	Senior	STM
Dave Brown	0.5	LBL	Senior	Tracking
Ray Culbertson	0.8	FNAL	Senior	Infrastructure
Ralf Ehrlich	0.7	Uva	Postdoc	CRV
Andrei Gaponenko	0.8	FNAL	WF	Many
Krzysztof Genser	0.4	FNAL	Staff	G4
Rob Kutschke	0.6	FNAL	Senior	Many
Pasha Murat	0.8	FNAL	Senior	Calorimeter
Yuri Oksuzian	0.4	Uva	Postdoc	NWG
Anthony Palladino	0.4	BU	Postdoc	STM
Giani Pezzullo	0.6	Pisa	Student	Calorimeter
Markus Roehrken	0.5	Caltech	Postdoc	Stop Tgt Opt
Costas Vellidis	0.8	Athens	Senior	Beta study
Chiho Wang	0.4	Duke	Senior	Wire Stabilitiy
Zhengyun You	0.6	UCI	Postdoc	p-bar Background

15 people; most tasked to do science, not infrastructure.
Understaffed for infrastructure development.

Meeting Structure

- Weekly Meetings of Software and Simulation Group
- Bi-Weekly meetings of the Neutron Working Group
- As needed meetings of the calibration and background groups.